

BIBLIOGRAPHICAL ABSTRACTS

1842-1951

1842

(OA) Ludwig Moser, "Ueber den Process des Sehens und die Wirkung des Lichts und alle Körper," *Annalen der Physik und Chemie*, Vol. 56, No. 6, pp. 177-234 (1842).

Concerns the effect of oily, contaminated surfaces and the breaking of a stream of water flowing over them (water break). "Breath figures" formed by breathing suddenly on cool surface of glass, the moisture condensing in small droplets, on any slightly greasy surface, but forming continuous film over clean surfaces.

(OB) Ludwig Moser, "I. Ueber das Latent Werden des Lichts," *Annalen der Physik und Chemie*, Vol. 57, No. 9, pp. 1-34 (1842)

Observed that when droplets would not adhere to a metal surface, cleaning with filter paper, alcohol, or ether would permit droplet spreading. One of the first indications concerning water break.

1893

(1) Genie Civil, Vol. 23, p. 375 (1893).

Taken from a reference in *Engineering and Mining Journal*. This article outlines several methods of aluminum cleaning, including grease removal with organic solvents, acid, and hand finishing. A varnish of turpentine and stearic acid, and a polish of bloodstone is used for polishing.

1902

(1A) A. Pockels, "Ueber das spontane Sinken der Oberflächen spannung von Wasser, Wässerigen Lösungen und Emulsionen," *Annalen Physik*, Vol. 8, pp. 854-871 (1902).

Suggested a cleanliness test based upon some kinds of detachable contamination on a solid surface. Depends upon dipping of contaminated solid into a clean water surface covered by clean ignited talc, the contamination spreading along the water, pushing back the talc. This effect was called "solution currents," but absence does not necessarily indicate a clean surface, since some contamination either adheres too strongly or is non-spreading in character.

1916

(1B) American Chemical Paint Co., "Cleaning Metals for Painting," British Patent No. 107,921, December 7, 1916; *Chemical Abstracts*, Vol. 11, p. 2966 (1917).

Steel to be painted is cleaned by applying strong solution of ortho-, pyro-, or metaphosphoric acid in water, alcohol, or other solvent, and removing the products of the action by applying relatively weak solution of orthophosphoric acid.

(1C) A. Ctockli, "Cleaning Metal, etc.," British Patent No. 101,313, March 24, 1916; *Chemical Abstracts*, Vol. 11, p. 90 (1917).

Use of two-solvent layer, lower of water and the upper of benzine, petrol, etc.

1917

(1D) A. A. Leraas, "Mixture for Cleaning and Polishing Metals, etc.," U. S. Patent No. 1,211,188, January 2, 1917; *Chemical Abstracts*, Vol. 11, p. 693 (1917).

Comprised of:

	Parts
Buttermilk	36
Salt	4
Paraffin oil	36
Turpentine	18
Denatured alcohol	18
Water	18
Oil of cedar leaves	1
Dye (garnet)	0.03 dissolved in alcohol one part

(1E) F. E. Whitham, "Cleaning Metal Turnings, etc.," British Patent No. 109,749, April 17, 1917; *Chemical Abstracts*, Vol. 12, p. 134 (1918).

Turnings of aluminum, steel, iron, or other metal, which is subjected to the action of an alkali or acid in working or otherwise, is treated at the earliest opportunity with an acid or alkali for neutralization and consequent prevention of corrosion or waste.

1918

(1F) E. P. Later, "Preparation of Metal Parts for Electroplating. II," *Foundry*, Vol. 46, pp. 353-355 (1918); *Chemical Abstracts*, Vol. 12, p. 1949 (1918).

Indicates the essential features of buffing and cleaning, the materials used, and precautions necessary.

(1G) C. B. Morey and C. J. Huber, "Cleaning Gold, Silver, or Other Metals," U. S. Patent No. 1,274,186, July 30, 1918; *Chemical Abstracts*, Vol. 12, p. 2046 (1918).

Articles are immersed in a solution formed of sodium chloride 1/2 cup, vinegar 1/3 cup, and water 1 gal, and while immersed brought into contact with zinc or other metal of greater electropositive character than the articles undergoing treatment.

(1H) S. Ohashi, "Solution for Cleaning Metal," Japanese Patent No. 32,462, March 29, 1918; Chemical Abstracts, Vol. 12, p. 2185 (1918).

Aqueous solution of:

	Parts
Ferrous sulfate	96
Oxalic acid	12
Tartaric acid	18
Alum	6
Water	1000

(1I) C. G. Reid, "Detergent," U. S. Patent No. 1,266,713, May 21, 1918; Chemical Abstracts, Vol. 12, p. 1819 (1918).

Composition for cleaning and polishing metals formed of hydrofluoric acid 10, barium sulfate 15 to 25, ammonium sulfate 6, ammonium fluoride 15, molasses 21, emery flour or other abrasive 6, and water 22 parts.

1919

(1J) C. Ellis and A. A. Wells, "Composition for Cleaning Cylinders of Internal-Combustion Engines," U. S. Patent No. 1,310,985, July 22, 1919; Chemical Abstracts, Vol. 13, p. 2430 (1919).

Composition formed of ammonium nitrate 3 to 5 per cent, mixed with liquids such as alcohol, acetone, carbon disulfide, and gasoline.

(1K) H. E. Finlay and F. L. Fangborn, "Cleaning Metal and Protecting It from Rust," U. S. Patent No. 1,290,952, January 14, 1919; Chemical Abstracts, Vol. 13, p. 836 (1919).

Article of metal to be cleaned and protected from rust is pickled in hot solution of hydrochloric and nitric acids, then immersed in cold potassium cyanide solution of 30 Be, washed in soda ash solution, and immersed in oil heated to above 100 C.

(1L) J. Guise, "Cleaning Hooks, Needles, etc.," British Patent No. 151,688, June 9, 1919; Chemical Abstracts, Vol. 15, p. 497 (1921).

Fish or other hooks, needles, pins, and like metal articles requiring high finish are dipped in a solution of alphaboric acid, then immersed in pickling bath of diluted hydrochloric acid, swilled with water, and scoured in a rotating barrel containing solution made up for one gal. of 1/4 oz cream of tartar, 8 oz potassium hydroxide or other neutralizing material, and 1 oz of tin salts, and with or without very small quantity of ammonia,

(1M) A. G. Hopkins, "Cleaning and Polishing Mixtures," U. S. Patent No. 1,319,475, October 21, 1919; Chemical Abstracts, Vol. 14, p. 105 (1920).

Mixture suitable for metal cleaning is formed of finely pulverized Spanish whiting 2.5 lb, gasoline 2 gal, water 2 gal, paraf-

fin 1 lb, oil of turpentine 1 qt, and oil of citronella 1 oz.

(1N) G. Magnuson, "Composition for Cleaning and Polishing Wood or Metals," U. S. Patent No. 1,317,171, September 30, 1919; Chemical Abstracts, Vol. 13, p. 3290 (1919).

Mixture formed of oil of citronella 20, butter of antimony 10, peanut oil 10, paraffin oil 40, and white vinegar 10 parts.

1920

(1O) G. S. Gilmore, G. Alexander, and T. G. Alexander, "Cleaning Metals," British Patent No. 174,489, November 22, 1920; Chemical Abstracts, Vol. 16, p. 1842 (1922).

Pickling fluid, particularly for preparing aluminum or aluminum alloys for soldering or for cleansing aluminum cooking utensils, consists of water solution of phosphoric, nitric, and acetic acids. Formic acid may be used in place of acetic in the same proportions. Bath may have the following composition:

Orthophosphoric acid	60-90
Nitric acid	20
Acetic acid	5-10
Water	250

(1P) S. C. Langdon and M. A. Grossman, "The Embrittling Effects of Cleaning and Pickling upon Carbon Steels," Transactions, Am. Electrochemical Soc., Vol. 37, pp. 543-578 (1920).

Typical rather than recommended practice in cleaning methods. Process used was solvent cleaning followed by immersion cleaning in a solution of sodium carbonate 80 g per l, sodium hydroxide 120 g per l, and rosin 1 g. per l.

The strength of rods was practically unaffected by removal of grease either by solvent or alkaline immersion. Removal of grease from plates caused reduction of about 10 per cent in the penetration value, and the change probably is due to change in surface condition and not to physical properties. Pumice brushing caused reduction in strength of both rods and plates apparently due to surface scratching. Electrolytic cleaning (as cathode) of rods or plates in alkaline cleaner does not produce any greater change than that caused by alkaline immersion. Sand blasting caused considerable reduction in ability to withstand alternating stress test. Also discusses effects produced by acid pickling and pickling after treatment.

(1Q) W. C. Lindemann, "The Electrolytic Cleaning of Metals for Enameling Purposes," Journal, Am. Ceramic Soc., Vol. 3, pp. 252-255 (1920); Chemical Abstracts, Vol. 14, p. 2063 (1920).

Details the use of proprietary compounds which in process used are said to be economical, to eliminate iron sludge, to

eliminate sponging or scrubbing to remove deposits of carbon formed during sealing.

(1R) S. R. Mason, "Electrolyte for Cleansing Metals," U. S. Patent No. 1,337,718, April 20, 1920; Chemical Abstracts, Vol. 14, p. 1788 (1920).

Electrolyte suitable for cleaning iron, steel, or other metals formed of water 1000, potassium or sodium cyanide 32, potassium or sodium hydroxide (or potassium or sodium carbonate), and grape sugar 8 parts.

(1S) J. H. Richards, "Cleaning for Electroplating," Metal Industry, Vol. 18, p. 518 (1920); Chemical Abstracts, Vol. 15, p. 634 (1921).

General discussion of cleaning problems; chief requirements of cleaning agents listed. Hot water dip and frequent preparation of new cleaning solutions recommended.

1921

(1T) T. A. Edison, "Electrolytic Metal-Cleaning Solution," U. S. Patent No. 1,369,271, February 22, 1921; Chemical Abstracts, Vol. 15, p. 1259 (1921).

Electrolyte for cleaning preliminary to electroplating is formed of sodium sulfate or potassium sulfate solution nearly saturated and rendered alkaline with caustic alkali.

(1U) J. H. Gravell, "Cleaning Metals," U. S. Patent No. 1,387,645, August 16, 1921; Chemical Abstracts, Vol. 15, p. 3973 (1921).

Iron, steel, or similar metals cleaned by subjection to the action of an etching acid such as orthophosphoric acid in the presence of benzene to remove oil from the material. Alcohol or acetone also may be used.

(1V) J. H. Gravell, "Cleaning Metals with Acid," U. S. Patent No. 1,398,507, November 29, 1921; Chemical Abstracts, Vol. 16, p. 709 (1922).

Steel cleaned by solution of 85 per cent phosphoric acid 1, alcohol 1, fusel oil 0.17, and water 1.5 parts to remove oil and rust.

(1W) S. R. Maison and Nippon Denki Kaishiki Kaisha (Japan Electric Co.), "Electrolytic Cleaning of Metals," Japanese Patent No. 37,965, February 2, 1921; Chemical Abstracts, Vol. 16, p. 1189 (1922).

Solution of 32 g of sodium or potassium cyanide, 4 g sodium or potassium hydroxide, sodium or potassium carbonate, and 8 g grape sugar in 1 l of water used.

1922

(1X) W. H. C. D. Charity, "Cleansing Compositions," British Patent No. 203,950,

November 7, 1922; Chemical Abstracts, Vol. 18, p. 735 (1924).

Mixture of dried waste lime with portland cement to which brownstone or other color may be added, using the mixture for cleaning metals.

(1Y) E. L. Couch, "Cleaning Articles Electrolytically," Canadian Patent No. 218,335, May 9, 1922; Chemical Abstracts, Vol. 16, p. 2454 (1922).

Metal article is placed upon an electrode, both electrodes are kept in motion, and an electrolyte is directed against the electrodes.

(1Z) L. J. G. de Burlet and V. L. J. Beque, "Cleaning Metals," British Patent No. 186,338, September 19, 1922; Chemical Abstracts, Vol. 17, p. 258 (1923).

Metal articles prior to tinning, galvanizing, etc., cleaned in a concentrated solution of the double chloride of zinc and ammonia at a density of not less than 35 Be which is kept boiling during immersion of the article. The article may be left to dry up to 24 hr before galvanizing or 6 hr before lead coating or tinning. Cleaning process may be accelerated by preliminary immersion of the articles in dilute hydrochloric acid.

(2) Maurice de Keghel, "Products for the Maintenance and Cleaning of Metals and Their Manufacture," Produits Chimie, Vol. 25, pp. 327-332 (1922); Journal, Inst. Metals, Vol. 30, p. 660 (1923).

Processes for polishing and cleaning are divided into the following classes: (1) direct dry hard abrasion, (2) wet soft abrasion, and (3) dry soft abrasion.

(2A) M. de Keghel, "The Cleaning and Polishing of Metals," Revue des produits chimiques, Vol. 25, pp. 327-333 (1922); Chemical Abstracts, Vol. 16, p. 2838 (1922).

Very brief discussion of corrosion and tarnishing of metals and large number of formulas for cleaning and polishing liquids, pastes, powders, and papers for various metals such as copper, nickel, German silver, brass, gold, silver, etc. Galvanic cleaning of gold and silver objects also briefly discussed.

(2B) J. H. Gravell, "Cleaning Composition for Use on Metals," U. S. Patent No. 1,428,064, September 5, 1922; Chemical Abstracts, Vol. 16, p. 3627 (1922).

For cleaning steel before painting, a mixture comprising clay, water, orthophosphoric acid, dextrinized starch, ethyl alcohol, and butyl alcohol was used.

(2C) E. E. Hallinger, "Mixture for Cleaning Metals or Glazed Ware," U. S. Patent No. 1,418,800, June 6, 1922; Chemical Abstracts, Vol. 16, p. 2761 (1922).

Steel wool saturated with paraffin and paraffin oil and coated with pumice stone.

(2D) H. W. Hutton, "Cleaning Compositions," British Patent No. 207,561, December 7, 1922; Chemical Abstracts, Vol. 18, p. 1556 (1924).

Composition for metal and other cleaning consists of abrasive, hydrocarbon oil, alkali, sulfonated castor oil, and sulfonated fatty oil other than castor.

(2E) I. R. Jascowitz, "Cleaning Metals by Electrolysis," Canadian Patent No. 219,629, June 13, 1922; Chemical Abstracts, Vol. 16, p. 2454 (1922).

Metal article immersed as cathode in an electrolyte of spent caustic-melt solution containing sodium hydroxide 50, sodium sulfite 28, sodium sulfate 8, sodium carbonate 8, and phenol 1 to 2 per cent.

(3) F. MacDonald, "Industrial Methods of Metal Cleaning," Forging and Heat Treating, Vol. 8, pp. 66-70 (1922). Listed in Journal, Inst. Metals, Vol. 22, p. 527 (1922), but no abstract.

(4) R. Seligman and P. Williams, "Cleaning of Aluminum Utensils," Journal, Inst. Metals, Vol. 28, pp. 297-298 (1922).

Danger of pitting aluminum while cleaning with soda solutions can be eliminated by adding enough sodium silicate to the soda solution to (a) combine with the calcium in the water used and (b) to leave a slight excess of silicate to form a protective coating of colloidal aluminum silicate on the metal. 10 to 12 per cent silicate is required.

(4A) S. E. Smyth, "Detergent," U. S. Patent No. 1,429,978, September 26, 1922; Chemical Abstracts, Vol. 16, p. 4023 (1922).

Composition formed of reaction products of oleic acid 37.7 oz, potassium hydroxide 8.12 oz, water 11.6 oz mixed with kerosene 50.2 oz, and denatured alcohol 26.1 oz.

1923

(5) "Cleaning and Polishing Aluminum," Aluminum-, Messing-, und Kupfer-Waren, Vol. 5, No. 12, p. 9 (1923); Journal, Inst. Metals, Vol. 30, p. 660 (1923).

To obtain a bright white surface the article is dipped for 15 sec in a hot 10 per cent solution of NaOH saturated with NaCl, washed, dried, and polished. Again immersed in the same solution for about 30 sec or until gas is evolved, washed, dried. If copper is present, a brown stain is found which is removed by immersion in concentrated nitric acid.

(5A) W. Blum and H. S. Rawdon, "The Influence of the Base Metal on the Structure of Electrodeposit," Transactions, Am. Elec-

trochemical Soc., Vol. 43, Preprint 1923; Chemical Abstracts, Vol. 17, p. 1925 (1923).

Cathodes of cast or annealed copper were cleaned with benzene and alcohol followed by cathode suspension in alkaline cyanide bath. Structure of the electrodeposit is direct continuation of the structure of the cathode when prepickled with 1 : 1 nitric acid.

(5B) J. J. Varn Buhler, "Composition for Removing Rust from Metals," U. S. Patent No. 1,473,529, November 6, 1923; Chemical Abstracts, Vol. 18, p. 450 (1924).

Composition for cleaning metals before painting or enameling formed of glycerol 32, hydrochloric acid 32, and methyl alcohol 64 oz.

(6) B. Haas, "Preparation of Polishing Pastes for Aluminum," Aluminum, Vol. 5, No. 8, pp. 7-10 (1923); Journal, Inst. Metals, Vol. 30, p. 660 (1923).

Methods and preparations for polishing.

(7) Rohrig, "Diminishing Attack of Alkali Solutions on Aluminum by the Addition of Water Glass," Chemiker-Zeitung, Vol. 47, pp. 528-529 (1923).

Describes in detail tests involving the use of water glass as a corrosion inhibitor in 0.05 per cent quantities at room temperature and at the boil in combination with caustic soda and soda ash. This amount seems to protect adequately with soda ash and with caustic soda at the same concentration.

1924

(7A) W. E. Wandel, "Cleaning Metals," British Patent No. 208,103, January 22, 1923; Chemical Abstracts, Vol. 18, p. 1556 (1924).

Rusting iron cleaned by covering with a layer comprising one or more drying oils and a basic substance such as ferric oxide, allowing layer to harden, then stripping off with included rust, etc.

(8) "Cleaning Aluminum," Automotive Industry, Vol. 50, February 14, 1924, p. 353.

It was found by Rohrig that the addition of 1/2 per cent of water glass to a soda solution reduced or eliminated the solvent action on aluminum.

Suggested by W. Ostwald that aluminum parts of the cooling systems of auto be rendered immune from the solvent action by filling the system for the first time with weak soda solution containing water glass.

(9) E. M. Baker and R. Schneidewind, "Metal Cleaning with Alkaline Cleaning Solutions," Transactions, Am. Electrochemical Soc., Vol. 45, pp. 327-352 (1924); Chemical Abstracts, Vol. 18, p. 1439 (1924).

Efficiency of alkaline cleaning solutions determined by measuring the relative interfacial tensions of these solutions and water,

and these solutions with a standard mineral oil. Measured industrial soaps, NaOH, trisodium phosphate, sodium carbonate, and sodium silicate. According to these results sodium silicate is the most effective.

(9A) O. P. Barbour, "Composition for Cleaning Aluminum," U. S. Patent No. 1,491,456, April 22, 1924; Chemical Abstracts, Vol. 18, p. 2062 (1924).

Mixture for stain removal from aluminum formed of alumina 2, aluminum sulfate 1, and tartaric acid 2 parts, mixed with water.

(10) T. S. Blair, "Prepared Metal Cleaners," The Metal Industry (New York), Vol. 22, pp. 488-489 (1924); Journal, Inst. Metals, Vol. 34, p. 665 (1925).

Emphasis upon proper cleaner and proper application to conserve time and money.

(11) William Blum and G. A. Hogaboom, "Principles of Electroplating and Electroforming," McGraw-Hill Book Co., New York, N. Y., pp. 125-132 (1924).

General information and some specific formulas for metal cleaning.

(11A) A. Edmondson, "Cleaning and Polishing Composition," U. S. Patent No. 1,519,907, December 16, 1924; Chemical Abstracts, Vol. 19, p. 565 (1925).

Liquid mixture for cleaning and polishing metals and other surfaces formed of glauher salts 2 drams, glycerol 1 oz, and water 1 gal.

(12) H. A. Gardner, "Recent Observations Regarding the Corrosion, Cleansing, and Protection of Aluminum," Mechanical Engineering, Vol. 46, pp. 206-207 (1924).

Much is given on the causes of corrosion and protective measures. Aluminum fittings, castings, and motor parts oftentimes must be cleaned. Dipping in benzol gives effective results in many cases but danger is involved in handling such solvents. Combinations of caustic soda, borax, and soda ash in hot water in 5 per cent solutions are more effective but may etch the aluminum. Addition of 2 to 3 per cent neutral soap paste to this liquid is proposed and this apparently aids in decreasing corrosive effect of the alkalies. The metal is placed in boiling baths for 5 to 30 min and then rinsed by flushing. No data on embrittlement were obtained. Sodium silicate is useful in inhibiting attack. Suggests the use of 5 per cent NaOH or soda ash with the addition of not less than 0.5 per cent sodium silicate for cleansing aluminum parts. Addition of a small amount of soap paste might aid.

(12A) J. H. Gravell, "Cleaning Metal Surfaces Preparatory to Coating," U. S. Patent No. 1,503,443, July 29, 1924; Chemical Abstracts, Vol. 18, p. 2867 (1924).

In preparation for painting on metal surfaces, a composition is used formed of trisodium phosphate or similar alkali metal compound and an alcohol of higher boiling point than ethyl, such as butyl alcohol, together with water.

(12B) B. O. Henning, "Deoxidizing and Cleansing Metals and Alloys," U. S. Patent No. 1,513,989, November 4, 1924; Chemical Abstracts, Vol. 19, p. 32 (1925).

Mixture of steam and volatilized boric acid introduced into a molten metal or alloy.

(12C) I. Jascowitz and J. Rosenbaum, "Electrolytic Cleaning of Metals," U. S. Patent No. 1,493,205, May 6, 1924; Chemical Abstracts, Vol. 18, p. 1953 (1924).

Articles of iron, steel, or other metals cleaned by electrolytic action in electrolyte comprised of the residue of phenol manufacture comprising caustic soda 50, sodium sulfite 28, sodium sulfate 8, and sodium carbonate 8.

(12D) Madsenell Corp., "Cleaning Steel Sheets, etc.," British Patent No. 236,241, June 27, 1924; Chemical Abstracts, Vol. 20, p. 897 (1926).

To remove surface carbon or occluded hydrogen or other gases from steel sheets, they first are treated with hot caustic soda to remove grease, rinsed, pickled in dilute hydrochloric acid or sulfuric acid, and treated as anode, in a bath of over 84.5 per cent sulfuric acid with a cathode of lead, iron, or steel.

(12E) Madsenell Corp., "Cleaning Steel Sheets, etc.," British Patent No. 236,242, June 27, 1924; Chemical Abstracts, Vol. 20, p. 897 (1926).

Follows treatment of British Patent No. 236,241 with sodium carbonate or alkaline solution which is allowed to dry and then removed with acidulated water. Alkaline treatment claimed to cause black or dark blue substances to ooze from metal which are removed by subsequent rinsing.

(12F) E. M. Smith, "Cleaning and Polishing Composition," U. S. Patent No. 1,514,235, November 4, 1924; Chemical Abstracts, Vol. 19, p. 157 (1925).

Mixture composed of oxalic acid 4 oz, rottenstone 4 oz, ammonia 2 oz, and water 1 gal.

(12G) M. H. Troyer, "Cleaning and Polishing Composition," U. S. Patent No. 1,491,572, April 22, 1924; Chemical Abstracts, Vol. 18, p. 2062 (1924).

Mixture of finely powdered feldspar 80 and finely powdered soda ash 20 per cent used in cleaning and polishing of metals and other surfaces.

(12H) P. H. Walker and J. H. Bower, "Composition for Cleaning Gun Barrels and Other Metal Surfaces," U. S. Patent No. 1,484,690, February 26, 1924; Chemical Abstracts, Vol. 18, p. 1371 (1924).

Dry mixture containing sulfate and per-sulfate of ammonia, to give metal-cleaning solution on treatment with water and an alkaline reagent such as caustic soda. Adapted for removal of copper or other metal deposits from gun barrels.

(12I) J. J. Varn Buhler, "Removing Rust," U. S. Patent No. 1,533,622, April 14, 1925; Chemical Abstracts, Vol. 19, p. 1760 (1925).

Cleaning rust-removing composition of an acid, oil, solvent, etc., such as hydrochloric acid, linseed oil dissolved in alcohol, and methyl alcohol.

(12J) J. H. Gravell, "Removing Rust from Metals," U. S. Patent No. 1,549,410, August 11, 1925; Chemical Abstracts, Vol. 19, p. 2926 (1925).

Composition of orthophosphoric acid, water, alcohol, and monosodium phosphate used for rust removal.

(12K) J. H. Gravell, "Cleaning Metals for Painting," U. S. Patent No. 1,549,411, August 11, 1925; Chemical Abstracts, Vol. 19, p. 2926 (1925).

Metals treated with a solution comprising orthophosphoric acid, gelatine, and alcohol.

(12L) M. Vigeant, "Metal-Cleaning Composition," U. S. Patent No. 1,545,219, July 7, 1925; Chemical Abstracts, Vol. 19, p. 2731 (1925).

Composition for cleaning silver or other metals comprising sodium cyanide 14, ammonium carbonate 2, and water 128 parts.

1926

(13) W. L. Carver, "New Process is Developed for Cleaning Metal Body Surfaces," Automotive Industry, Vol. 54, pp. 148-149 (1926); Journal, Inst. Metals, Vol. 39, p. 656 (1928).

Description of the application of a proprietary compound by spray gun method. The compound consists of slenna, powdered charcoal, methylethyl ketone, and phosphoric acid. This mixture is sprayed upon the body surface and, when it drops off, the body is subjected to an alcohol bath. Leaves the surface clean and neutral with a slight etch.

(14) Jacob Hay, "Cleaning and Preparing of Metals for Enamel," Monthly Review, Am. Electroplaters' Soc., Vol. 13, No. 8, pp. 10-14 (1926); Journal, Inst. Metals, Vol. 41, p. 630 (1929).

Aluminum die castings should be cleaned with strong sodium hydroxide solution, rinsed in cold water, then dipped in a mix-

ture of three parts of nitric acid and one part sulfuric acid, washed, dried, and heated to 400 F. Zinc or galvanized metals should be cleaned first in a weakly alkaline solution, rinsed, and dipped in a solution of 1 lb copper chloride, 1 lb copper sulfate, 1 lb ammonium chloride, and 1 lb hydrochloric acid in 6.4 gal of water.

(14A) F. C. Schmutz, "Cleaning Articles of Non-Ferrous Metals," U. S. Patent No. 1,601,511, September 28, 1926; Chemical Abstracts, Vol. 20, p. 3651 (1926).

Non-ferrous metals or alloys such as brass, nickel, or copper subjected to electrolytic action in solution containing a fish-oil soap and a reagent of non-plating character, such as sodium chloride, which lowers the specific electrical resistivity of water and reduces foaming.

1927

(15) "Testing of a Universal Cleaning Reagent," Jahresberichte, Chemisch-Technische Reichsanstalt, Vol. 6, pp. 211-212 (1927); Journal, Inst. Metals, Vol. 41, p. 631 (1929).

A cleaning reagent comprising 33 per cent water, 56 per cent sodium bicarbonate, 10 per cent soft soap, and small amounts of sodium carbonate, glycerine, and traces of iron and aluminum oxides has no harmful effect on aluminum.

(16) P. H. Groggins and Walter Scholl, "Ortho-dichlorobenzene—An Excellent Cleaner for Metals," Industrial and Engineering Chemistry, Vol. 19, pp. 1029-1030 (1927); Chemical Abstracts, Vol. 21, p. 3426 (1927).

Ortho-dichlorobenzene can be used unmodified or as a paste in five parts to one part of precipitated chalk. It acts as a solvent for oxides of nickel, silver, copper, and aluminum, and has negligible action on the metals.

(17) Edgar T. Painton, "The Working of Aluminum," Chapman & Hall, Ltd., London, p. 210 (1927); Bulletin No. 3, Mellon Inst. of Industrial Research. A Select, Annotated Bibliography of the Hygienic Aspects of Aluminum and Aluminum Utensils.

The dark film occasionally obtained upon boiling certain kinds of water in aluminum utensils is thought to be due to the small percentage of iron impurities in the metal acting in conjunction with the impurities in the water. This film may be removed by boiling with a dilute acetic acid solution or fruit juices.

1928

(18) D. J. Benoliel, "Growth of Industrial Cleaning. The History, Chemistry and Mechanism of Metal Cleaners," The Metal

Industry (New York), Vol. 26, pp. 79-80, 121-123 (1928); Journal, Inst. Metals, Vol. 41, p. 630 (1929).

Lists the variety of cleaning jobs based upon the metals involved.

(19) "Practical Industrial Metal Cleaning," Black and White, Vol. 1, No. 3, pp. 36-38; No. 4, pp. 28-30 (1928); Journal, Inst. Metals, Vol. 40, p. 702 (1928).

Discussion of the general technique in immersion cleaning of metal parts.

(19A) F. M. Dorsey, "The Madsenell Process—Its Products and Their Uses," Industrial and Engineering Chemistry, Vol. 20, No. 10, pp. 1094-1099 (1928).

Emulsifiable oil or grease cannot be efficiently removed by a saponifying agent or vice versa and are to be avoided because of the difficulty in removal. Used electrolytic cleaning in 6 oz per gal of either sodium or potassium hydroxide and 1/2 oz per gal whale-oil soap. Mentions necessity for thorough rinsing.

(20) Drews, "Harmless Method of Cleaning Aluminum Fermenting or Storage Casks," Brennerie-Zeitung, Vol. 45, p. 223 (1928); Chemical Abstracts, Vol. 24, p. 2540 (1930).

A hot 10 per cent sodium carbonate solution (containing no free alkali), to which has been added 1/5 to 1/2 per cent of Na_2SiO_3 , makes a very satisfactory cleaning solution for aluminum utensils. A formula for manufacture is: 1/2 kg of crystalline Na_2CO_3 is dissolved in 10 l of H_2O and to this is added 250 ml of 38 deg Bé technical Na_2SiO_3 , and the solution warmed before using.

(21) G. E. Heron, "Cleaning Sheet Metal to Be Finished," Industrial Finishing, Vol. 4, pp. 107-108, 110 (1928); Journal, Inst. Metals, Vol. 40, p. 702 (1928).

Discussion of the troubles caused by improper cleaning and explains how to keep cleaning solutions and rinses in first class condition.

1929

(22) "Tests on Aluminum Cleaning Methods," Jahresberichte, Chemisch-Technische Reichsanstalt, Vol. 8, pp. 182-183 (1929); Journal, Inst. Metals, Vol. 47, p. 235 (1931).

The addition of chromate or silicate to strongly alkaline cleansers of aluminum prevents corrosion.

(22A) C. Fischer, Jr. and L. A. Stegemeyer (to Twitchell Process Co.), "Process of Treating Metal to Remove Scale," U. S. Patent No. 1,736,282, November 19, 1929; "Detergents," Patent Publications, Inc., 1950.

Use of a mineral oil, sulfonic reagent of the class recovered from the operation of refining mineral oil to produce white oil, to inhibit the action of a mineral acid used in the removal of scale from a metal.

(23) F. J. Gavin, "Cleaning Aluminum for Decorating Purposes," Metal Cleaning and Finishing, Vol. 1, No. 7, November, 1929, pp. 585-586.

Aluminum sheet is coated with oil for shipping purposes, hence, cannot be successfully decorated until cleaned. The average decorator can easily remove the oil by placing any good hydrocarbon thinner or turpentine substitute in the fountain of his coating machine. Apply a heavy coat of this to the composition roller, leave off the bottom scraper bar to permit the thinners to coat on the bottom of the plates and then pass the sheets through the automatic oven for 15 min at 500 to 550 F, after which the metal will be found to be lithographically clean.

(24) O. F. Hunziker, W. A. Cordes, and B. H. Nissen, "Metals in Dairy Equipment—Corrosion Caused by Washing Powders, Chemical Sterilizers, and Refrigerating Brines," Journal of Dairy Science, Vol. 12, pp. 252-284 (1929).

Nineteen different metals, plated metals, and metal alloys were tested. Aluminum and a manganese alloy of aluminum containing 1.25 per cent manganese were among those tested. The alkalies tested were a special alkali (35 per cent NaOH , 62 per cent Na_2CO_3), sodium carbonate, Wyandotte (49 per cent Na_2CO_3 , 36 per cent NaHCO_3), trisodium phosphate, tin cleaner, Diversol, and NaOH . Chemical sterilizers were sodium hypochlorite, Diversol, and Chloramine-T. The test comprised partial immersion of the metal strips in solutions in closed Mason jars for 5 hr at 150 F for alkalies and 5 days at 70 F for chemical sterilizers. Used 0.5 per cent solutions of alkalies. Found that the addition of 0.025 per cent sodium chromate to 0.5 per cent solution of trisodium phosphate in water very greatly reduced corrosion. With 0.5 per cent solutions of alkalies the addition of sodium silicate in 0.05 per cent quantities did not reduce the attack of NaOH and trisodium phosphate but completely eliminated corrosion by soda ash. For tin-coated equipment the use of trisodium phosphate solution (0.16 to 0.5 per cent) combined with 0.025 per cent sodium chromate is best.

(24A) S. T. Sherrick (to E. S. Kassler, Jr. and T. P. Campbell), "Cleaning Composition," U. S. Patent No. 1,736,375, November 19, 1929; Chemical Abstracts, Vol. 24, p. 699 (1930).

Composition comprising acid-treated bentonite, flour, and salt.

1930

(25) "Preparation of Sheet Metal for Painting," Bulletin No. 16, August, 1930, 15 pp., Am. Chemical Paint Co., Ambler, Pa.

The whole paper is given over to the preparation of sheet metal preparatory to painting, and discusses the Deoxidine Process. Deoxidine is a cleaning liquid made up of phosphoric acid, wetting agents, and other additions.

(26) "Sodium Metasilicate for Metal Cleaning," Brass World, Vol. 26, p. 248 (1930); Journal, Inst. Metals, Vol. 47, p. 50 (1931).

The superiority of sodium metasilicate for nearly all metal cleaning purposes is described.

(26A) K. Briel, "Commutator Cleanser," U. S. Patent No. 1,750,990, March 18, 1930; "Detergents," Patent Publications, Inc., 1950.

Composition comprising approximately equal parts of oleic acid and paraffin oil with approximately 10 per cent of amyl acetate.

(27) W. F. Cahill, "Preparation of Metals for Finishing," Monthly Review, Am. Electroplaters' Soc., Vol. 17, No. 1, pp. 24-26 (1930); Journal, Inst. Metals, Vol. 43, p. 672 (1930).

Hints on the removal of grease and stains by means of the tumbling barrel and electrolytic cleaning baths.

(28) "Removing Metal Scale," Ceramic Industry, Vol. 14, p. 552 (1930); Journal, Inst. Metals, Vol. 50, p. 578 (1932).

A method is described for electrochemical means for descaling while at the same time protecting the metal from hydrogen embrittlement, in which a metal is co-deposited upon the work when the scale is removed.

(29) "Electrolytic Metal Cleaning Without Corrosion," Chemical and Metallurgical Engineering, Vol. 37, pp. 634-635 (1930); Journal, Inst. Metals, Vol. 47, p. 118 (1931).

The Bullard-Dunn electrolytic process in which a metal film is deposited on the metal to be cleaned the instant each particle of scale is removed. The film is a metal, resistant to the acid bath, such as lead, tin, or zinc.

(29A) C. G. Chevalier, "Compound for Cleaning," U. S. Patent No. 1,749,317, March 4, 1930; "Detergents," Patent Publications, Inc., 1950.

Consists of an oil-removing and surface-polishing composition of finely divided oil-adsorbent material to which has been added diatomaceous earth.

(29B) H. P. Corson (to Grasselli Chemi-

cal Co.), "Metal Cleaning and Pickling Bath," U. S. Patent No. 1,742,986, January 7, 1930; "Detergents," Patent Publications, Inc., 1950.

Cleaning and pickling bath for metals, comprising dilute mineral acid containing a small amount of cinchona bark alkaloid.

(29C) H. P. Corson and R. E. Lawrence (to Grasselli Chemical Co.), "Process of Cleaning Metal Articles," U. S. Patent No. 1,773,953, August 26, 1930; "Detergents," Patent Publications, Inc., 1950.

Process of pickling and cleaning metal articles by subjecting them to an acid bath containing as the active pickling and cleaning ingredient a non-oxidizing acid and incorporating into the acid an inhibitor comprising a sulfonation product of a mineral oil which contains in the neighborhood of 10 per cent or more total sulfur and which contains part of the sulfur in the form of sulfones and which in its general properties is identical with or similar to icthyol.

(29D) T. E. Dunn (to Bullard Co.), "Cleaning Metal Articles Electrolytically," U. S. Patent No. 1,775,671, September 16, 1930; Chemical Abstracts, Vol. 24, p. 5240 (1930).

In removing scale from castings the article is made the cathode and an excess of hydrogen generated on the surface of the articles for removal of foreign matter with concurrent deposition of a continuous coating of lead.

(30) Julius Fischer, "Cleaning of Metal Parts—I. Dry Cleaning," Werkssleit., Vol. 4, pp. 53-55, 127-131 (1930); Journal, Inst. Metals, Vol. 47, iii, p. 50 (1931).

Mechanical methods of cleaning are discussed.

(31) M. Freyman, "Cleanser for Aluminum Vessels," Petit Journal du Brasseur, p. 774 (1930); Brewing Trade Review, Vol. 44, p. 452 (1930); Journal, Inst. Brewing, Vol. 36, p. 512 (1930); Journal, Inst. Metals, Vol. 47, March, 1931, p. 166.

Discusses the removal of beer scale from aluminum surfaces. Used washing soda and water glass. This treatment is not always successful. Prior to the use of the above treatment control corrosion tests were made in the laboratory.

(32) A. K. Graham, "Industrial Cleaning of Metal," Monthly Review, Am. Electroplaters' Soc., Vol. 17, No. 1, pp. 4-10 (1930); Journal, Inst. Metals, Vol. 43, p. 672 (1930).

General discussion of metal cleaning.

(32A) J. H. Gravell (to American Chemical Paint Co.), "Foam-Producing Process and Material for Acid Metal-Cleaning Baths," U. S. Patent No. 1,757,959, May

13, 1930; "Detergents," Patent Publications, Inc., 1950.

Pickling bath for metals consisting of a metal etching acid and water and further comprising a reaction-controlling agent capable of generating formaldehyde in insufficient amount to stop the generation of hydrogen and cellulose waste liquor.

(32B) J. D. Klinger and Clete L. Boyle, "Composition for and Process of Cleaning Metal," U. S. Patent No. 1,752,746, April 1, 1930; "Detergents," Patent Publications, Inc., 1950.

Comprised of a rust-removing acid and the monobutyl ether of ethylene glycol.

(32C) R. E. Lawrence (to Grasselli Chemical Co.), "Acid Treatment of Metal Articles," U. S. Patent No. 1,780,594, November 4, 1930; "Detergents," Patent Publications, Inc., 1950.

Process of pickling and cleaning metal articles which comprises use of an acid bath containing as the active pickling and cleaning ingredient a non-oxidizing acid and the use of an inhibitor of the class of substances comprising thioglycolic acid and its derivatives containing the radical $\text{COOH}-\text{CH}_2-\text{S}$.

(33) "Cleaning Method for Aluminum Castings," Metallbörse, Vol. 20, February, 1930, p. 428.

The following method is recommended for the removal of oil, dirt, and finger marks from aluminum castings. The casting is placed in the usual hot (90 C) alkaline cleaning solution until the surface begins to tarnish. It is then removed, washed in cold water, and dried. The casting is then placed for a few seconds in a cold solution of a mixture of two parts concentrated nitric acid and one part concentrated sulfuric acid. It is then rinsed in cold water and then in boiling water. A small amount of borax soap (about 8 g per liter) is generally added to the hot water bath in order to remove the last traces of acid and to prevent spotting and finger prints.

(34) R. W. Mitchell, "The Cleaning of Metal," Metal Cleaning and Finishing, Vol. 2, pp. 13-18, 111-114, 207-210, 299-304, 389-395, 485-493, 585-594, 598, 673-680, 684, 759-762, 839-847, 935-945, 1025-1031 (1930).

Theoretical and practical discussion of the action of cleaning compounds; general explanation of alkalinity ranges and the colloidal and buffer actions of cleaners. Colloidal action as applied to detergent processes. Properties of soap and other washing colloids. Surface tensions of various liquid solutions and colloidal solutions and their relation to detergent action. Interfacial tension. Adsorption and emulsification. Alkalinity and acidity. Buffer action.

Measurement of cleaning action. Comparison of various detergents.

(35) R. W. Mitchell, "Cleaning Aluminum," The Metal Industry, Vol. 28, pp. 171-172 (1930).

The amphoteric nature of aluminum is pointed out. Many aluminum alloys contain some metal electronegative to aluminum such as copper, iron, or nickel. Segregation of these produces an opportunity for galvanic action which show themselves by pitting and hydrogen evolution. Alloys containing silicon also are subject to attack, as silicon and silicides dissolve readily in hot alkaline solutions.

Soluble silicates and chromates are useful for preventing corrosion. This effect is attributable to a thin layer of insoluble aluminum silicate in one case and the deposition of a similar thin layer of insoluble chromate in the other. Also, it is possible in the latter case that an insoluble chromite or chromic aluminate is formed.

In strongly alkaline solutions chromates are ineffective and it is said that their effect is retardant rather than inhibitive. On zinc and tin the chromates are more effective.

The amount and kind of silicate is important. The more alkaline ones do not protect well, and those too high in silica form a heavy, difficultly rinsable film. Such a deposit is unsightly and may result in alteration in the dimensions of machined parts.

A test is described which is useful in the evaluation of aluminum cleaners. Aluminum strips 1/4 in. wide by 1 to 2 in. long are inserted in 6-in. calibrated test tubes which have been filled with the cleaner solution and inverted in the beaker containing the solution. For exact quantitative determination the metal strip is cleaned with benzene or ether, wiped, and weighed. The strips are inserted in the test tubes and the beakers placed in a water or steam bath at 200 F for a given period (15 min). At the end of this period, the gas evolved is measured, the pieces removed, and rinsed in a standard manner and weighed.

A specification for a suitable material would read: Solution concentration of 2 to 6 per cent by weight should not evolve more than 2 cc of gas nor dissolve more than one milligram of metal per square inch of surface at 200 to 210 F. The material should rinse freely and leave no visible deposit.

In aluminum cleaning, solutions should be maintained at not over 210 F and preferably at 200 F.

This method may be applied to zinc and its alloys, such as die-casting metal, or magnesium alloys.

(35A) P. I. Murrill (to R. T. Vanderbilt Co.), "Pickling and Cleaning of Metals," U. S. Patent No. 1,748,494, February 25, 1930;

"Detergents," Patent Publications, Inc., 1950.

Use of a suitable acid solution to which a small amount of a derivative containing nitrogenous heterocyclic bases or their derivatives is added.

(35B) F. J. Pilgrim, "Cleaning and Polishing Compound," U. S. Patent No. 1,743,865, January 14, 1930; "Detergents," Patent Publications, Inc., 1950.

Cleaning and polishing compound consisting of 80 parts of quicklime high in magnesia, 40 parts of kerosene, 20 parts of stearic acid, and 20 parts of tallow, all in parts by weight.

(36) E. G. Porst, "Metal Cleaning," American Enameler, Vol. 3, No. 6, p. 9, No. 7, p. 5 (1930); Journal, Inst. Metals, Vol. 50, p. 578 (1930).

The type of cleaner is determined by the kind of soil to be removed. Soil removal is divided into two steps: (1) wetting, (2) suspending. The actual dislodging is accomplished in one or more ways: (1) saponification, (2) dissolution, (3) chemical dissolution, (4) agitation, (5) colloidal action, and (6) heating.

(37) H. S. Rawdon, "Corrosion-Prevention Methods as Applied in Aircraft Construction," Proceedings, Am. Soc. Testing Mats., Vol. 30, Part II, p. 61 (1930); Chemical Abstracts, Vol. 25, p. 1786 (1931).

Bare aluminum surfaces are cleaned by the use of a mild etching solution such as a dilute solution of phosphoric acid. Another solution is a caustic "dip" followed by neutralization with weak acid. Mild abrasives may be used, even sand blasting for the heavier parts, each followed by a chemical cleaning. Special precautions are to be taken against "crevice" corrosion involving the use of protective tape, etc.

(37A) R. Seligman, "Removing Incrustation Formed on Metallic Surfaces," U. S. Patent No. 1,759,762, May 20, 1930; "Detergents," Patent Publications, Inc., 1950.

Process for removal of hot milk incrustation on metallic surfaces by treating the surface with pure orthophosphoric acid containing a colloid soluble in the acid to prevent or minimize the action of the acid upon the metallic surface itself.

(37B) W. L. Semon (to B. F. Goodrich Co.), "Method of Cleaning Metals," U. S. Patent No. 1,756,311, April 29, 1930; "Detergents," Patent Publications, Inc., 1950.

Treatment of metals with a solution comprising a strong non-oxidizing acid and a small proportion of an arylamine derivative of a benzothiazole.

(38) Frank P. Spruance, "Initial Cleaning and Preparation of Sheet Metal Surfaces of Bodies Are of Major Importance in Production," Automotive Industry, Vol. 62, pp. 374-376 (1930); Journal, Inst. Metals, Vol. 47, p. 680 (1931).

Metal cleaners should: (1) remove oil, grease, and antisqueak compounds so that the entire surface can be acted upon, (2) remove rust and destroy rust removers, (3) remove alkalies and destroy their paint-shedding action, and (4) produce a surface to which the prime coat will adhere tightly.

(39) Hermann Stadlinger, "Newer Methods for Cleaning Oily Metal Parts in Industrial and Technical Processes," Chemiker-Zeitung, Vol. 54, pp. 354-355 (1930); Journal, Inst. Metals, Vol. 47, p. 457 (1931); Chemical Abstracts, Vol. 24, p. 3578 (1930).

Various methods are described. A new cleaner "P 3" sold in powder form by Henkel and Co. consists of a mixture of low-alkali water glass and trisodium phosphate. Experiments show no corrosion of aluminum, zinc, etc. Also a special grade which does not attack tin plate, brass, or duralumin is produced. In special metal washing machines 1 to 4 per cent solutions at 80 to 90 C will serve, depending upon the kind of oil and dirt.

(40) James G. Vail, "Sodium Metasilicate: Its Place Among Industrial Alkalies," Chemical and Metallurgical Engineering, Vol. 37, pp. 736-740 (1930); Transactions, Am. Inst. Chemical Engrs., Vol. 25, p. 123-142 (1930); Chemical Abstracts, Vol. 25, p. 777 (1931).

Greasy aluminum jar caps were cleaned with 1 per cent boiling solutions of commercial alkalies for 5 min. The metasilicate produces a bright surface while corrosion was apparent with the others. Similar results were obtained even when solutions had the same Na_2O content. Corrosive action upon aluminum is said to be due at least in part to the anion involved.

(40A) J. C. Vignos (to Rubber Service Laboratories Co.), "Inorganic Acid Solutions for Pickling Metals such as Iron and Steel," U. S. Patent No. 1,750,651, March 18, 1930; "Detergents," Patent Publications, Inc., 1950.

Compound consists of a highly ionized mineral pickle acid solution containing less than 1 per cent by weight of a sulfonated mercaptan.

(40B) J. C. Vignos (to Rubber Service Laboratories Co.), "Metal Pickling," U. S. Patent No. 1,756,317, April 29, 1930; "Detergents," Patent Publications, Inc., 1950.

Process of cleaning metal surface which comprises immersing metal in a sulfuric

acid solution containing a small proportion of the reaction product of an aldehyde and a salt of an aryl-substituted dithiocarbamic acid.

(40C) J. C. Vignos (to Rubber Service Laboratories Co.), "Cleaning and Preservation of Metallic Surfaces," U. S. Patent No. 1,779,787, October 28, 1930; "Detergents," Patent Publications, Inc., 1950.

Process of pickling ferrous products by subjecting the metal to be pickled to the action of a sulfuric acid solution containing a small proportion of sulfonated creosote oil.

(41) Tom L. Wheeler, Jr., "Industrial Cleaning," *Brass World*, Vol. 26, pp. 11-14 (1930); *Journal, Inst. Metals*, Vol. 43, p. 672 (1930).

General discussion.

1931

(42) "Metso"—a New Cleaner for Aluminum," *Aluminum Broadcast*, Vol. 3, No. 6, p. 20 (1931); *Journal, Inst. Metals*, Vol. 50, p. 706 (1932).

This is a proprietary form of sodium metasilicate. A 1 per cent solution in certain cases is said to clean aluminum without corrosion.

(42A) J. Baddiley and E. Chapman (to British Dyestuffs Corp., Ltd.), "Detergent, Cleansing, and Polishing Compositions," U. S. Patent No. 1,836,430, December 15, 1931; "Detergents," Patent Publications, Inc., 1950.

Cleansing agent comprising a sulfonated, alkylated mineral oil fraction and mineral abrasive material.

(42B) T. W. Bartram and D. H. Tompkins (to Rubber Service Laboratories Co.), "Cleaning and Preserving of Metallic Surfaces," U. S. Patent No. 1,808,200, June 2, 1931; "Detergents," Patent Publications, Inc. (1950).

Pickling of ferrous metals in a sulfuric acid solution containing a small proportion of a sulfonated aldehyde-amine reaction product.

(43) A. Burg, "Degreasing and Cleaning Metal Parts," *Emailltechnik Monats Blätter*, Vol. 7, pp. 51-54 (1931); *Journal, Inst. Metals*, Vol. 50, p. 192 (1932).

In the preparation of metal pieces for enameling it is necessary to thoroughly degrease and clean the surface. The annealing process is used to burn off oil and grease, or the surface is cleaned chemically by treating in baths of organic or inorganic solvents. The latter are divided into three classes: (1) solvents, (2) emulsifying agents, and (3) saponifying chemicals.

(44) E. J. Dobbs, "Theory of Metal Cleaning," *Journal, Electrodepositors' Tech. Soc.*, Vol. 7, pp. 161-162 (1931-1932); *Journal, Inst. Metals*, Vol. 53, p. 216 (1933).

Wetting power, emulsifying, and peptizing action are shown to be necessary functions of complex aqueous metal cleaning solutions. The constituents of the metal cleaner contributing each are discussed. The use of organic solvents especially in the vapor phase is reviewed. An etching process is described for cleaning steel and brass prior to electrodeposition.

(44A) G. Jones and D. W. Marshall (to Jones), "Silver Cleaning Composition," U. S. Patent No. 1,823,402, September 15, 1931; "Detergents," Patent Publications, Inc., 1950.

Abrasive type cleaner containing infusorial earth substantially 20 per cent, sodium oleate substantially 20 per cent, an alkali metal halide 5 to 15 per cent, the balance water.

(44B) R. Justh, "The Removal of Grease in Chromium-Plating Practice," *Metallwaren-Industrie und Galvano-Technik*, Vol. 29, pp. 549-550 (1931); *Chemical Abstracts*, Vol. 26, p. 1196 (1932).

Various methods are discussed for removing grease from articles to be chromium-plated.

(45) C. L. Mantell, "Composition and Uses of Heavy-Duty Metal Cleaners," *Metal Cleaning and Finishing*, Vol. 3, pp. 305-306 (1931); *Journal, Inst. Metals*, Vol. 50, p. 707 (1932).

An explanation is given for buffer action in cleaning operations.

(46) C. L. Mantell, "Alkali Solutions as Metal Cleaners," *Metal Cleaning and Finishing*, Vol. 3, pp. 641-645 (1931); *Journal, Inst. Metals*, Vol. 50, p. 505 (1932); *Chemical Abstracts*, Vol. 25, p. 5653 (1931).

Relation between pH, ionization, concentration and temperature of alkaline solutions containing NaOH, sodium carbonate, ammonia, and their combinations is outlined. It is shown that such solutions have definite limitations for cleaning purposes, their saponifying action being less important than supposed.

(47) C. L. Mantell, "Testing of Electrocleaners," *Metal Cleaning and Finishing*, Vol. 3, pp. 945-949 (1931).

An outline of methods for the determination of conductivity of cleaning solutions of various compositions.

(48) "Bullard-Dunn Electrochemical Cleaning Process," *Maschinenkonstrukteur*, Vol. 64, p. 111 (1931); *Journal, Inst. Metals*, Vol. 50, p. 768 (1932).

Descaling with hydrogen and the deposition of lead which affords protection for the metal against etching, pitting, or hydrogen embrittlement. The process can be modified to remove oil or grease. It is claimed that no alteration of measurement takes place, at the same time facilitating the determination of flaws. The lead coating may be used as an undercoat for subsequent plating.

(49) "New Process of Metal Cleaning (Emulso Primer)," *Metal Cleaning and Finishing*, Vol. 3, p. 921 (1931); *Journal, Inst. Metals*, Vol. 50, p. 707 (1932).

The Emulso primers are triethanolamine salts, useful for emulsion cleaning of aluminum.

(50) R. W. Mitchell, "Maintenance and Life of Cleaning Solutions," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 18, No. 6, pp. 30-34 (1931); *Journal, Inst. Metals*, Vol. 50, p. 121 (1932).

A method is given for replenishing cleaning solutions.

(51) R. W. Mitchell, "Equipment for Cleaning Metal," *Metal Cleaning and Finishing*, Vol. 3, pp. 13-26, 107-115, 195-203, 287-294, 377-382, 463-466, 549-552, 631-634, 711-714, 793-796, 869-874, 953-957 (1931); Vol. 4, pp. 15-19, 71-78, 139-146, 207-214, 273-276, 333-338, 389-394, 445-450, 491-495, 541-545, 589-592, 637-642 (1931); Vol. 5, pp. 31-35 (1933).

Mainly a discussion of equipment. Other factors discussed are temperature in relation to cleaning operations, agitation as an aid to cleansing, importance of rinsing, theory and methods employed in electrolytic cleaning.

(52) "Clean Metal Surfaces." *Oberflächentechnik*, Vol. 8, pp. 2-5 (1931); *Journal, Inst. Metals*, Vol. 50, p. 263 (1932).

Methods are described for cleaning and polishing of ferrous and non-ferrous metal castings.

(52A) W. L. Semon (to B. F. Goodrich Co.), "Method of Cleaning and Pickling Metals," U. S. Patent No. 1,830,566, November 3, 1931; "Detergents," Patent Publications, Inc., 1950.

Deals with treating metals with a solution comprising a strong acid and a small proportion of an alkyl-substituted pseudo-thiourea.

(52B) T. J. Stinson, "Cleaning Composition," U. S. Patent No. 1,817,276, August 4, 1931; "Detergents," Patent Publications, Inc., 1950.

Composition formed by mixing chloride of lime, Prosperity soda, and vinegar in substantially the proportion of 2 1/2 lb chloride of lime, 1/2 lb Prosperity soda, and 1/2 part vinegar.

(53) Floyd T. Taylor, "Bullard-Dunn Process of Cleaning," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 18, No. 8, pp. 17-22 (1931); *Journal, Inst. Metals*, Vol. 50, p. 121 (1932).

The process comprises electrolytic cleaning in sulfate-chloride electrolyte using lead anodes, whereby scale is removed and replaced with a lead film to prevent subsequent oxidation. The article so cleaned may be plated without removal of the lead film, or the film may be removed by a short anodic treatment in an alkaline bath.

(53A) D. H. Tompkins (to Rubber Service Laboratories Co.), "Cleaning and Preserving of Metallic Surfaces," U. S. Patent No. 1,808,184, June 2, 1931; "Detergents," Patent Publications, Inc., 1950.

Pickling of ferrous articles by subjecting them to the action of a sulfuric acid solution containing a small proportion of a sulfuric acid derivative of a reaction product of sulfur dioxide and an aldehyde-amine product.

(53B) D. H. Tompkins (to Rubber Service Laboratories Co.), "Cleaning and Preserving of Metallic Surfaces," U. S. Patent No. 1,808,185, June 2, 1931; "Detergents," Patent Publications, Inc., 1950.

Pickling process comprising subjecting metal to be pickled to the action of a non-oxidizing mineral acid solution containing a small proportion of a hydrochloric acid derivative of a reaction product of sulfur dioxide and an aldehyde-amine product.

(53C) D. H. Tompkins (to Rubber Service Laboratories Co.), "Cleaning and Preserving of Metallic Surfaces," U. S. Patent No. 1,808,186, June 2, 1931; "Detergents," Patent Publications, Inc., 1950.

Metal pickling with a non-oxidizing acid solution containing a small proportion of a phosphoric acid derivative of a reaction product of sulfur dioxide and an aldehyde-amine product.

(53D) D. H. Tompkins (to Rubber Service Laboratories Co.), "Cleaning and Preserving of Metallic Surfaces," U. S. Patent No. 1,808,187, June 2, 1931; "Detergents," Patent Publications, Inc., 1950.

Pickling process with sulfuric acid solution containing a small proportion of a chromic acid derivative of a reaction product of sulfur dioxide and an aldehyde-amine product.

(53E) L. L. Tuorto, "Compound for Cleaning and Polishing Surfaces," U. S. Patent No. 1,815,599, July 21, 1931; "Detergents," Patent Publications, Inc., 1950.

Compound consists of approximately 10 parts of lard, 4 parts of wax, 1 part of naphtha, and 1 part of glycerine.

(54) A. D. Weill, "Modern Practice in Metal Cleaning," *Journal, Electrodepositors' Tech. Soc.*, Vol. 7, pp. 157-160 (1931-1932); *Journal, Inst. Metals*, Vol. 53, p. 216 (1933).

Aluminum cleaning is accomplished with aqueous solutions composed of mild alkalis such as phosphates and/or cyanides. Electrolytic cathodic cleaners may contain copper salts, incomplete deposition of the copper film indicating greasy patches. Suitable methods are given for cleaning stampings of brass, and similar metals, die castings of zinc, aluminum, and tin alloys, lead and pewter prior to electroplating.

(55) S. Wernick, "The Cleaning of Iron and Steel," *Journal, Electrodepositors' Tech. Soc.*, Vol. 7, pp. 163-165 (1931-1932); *Journal, Inst. Metals*, Vol. 53, p. 216 (1933).

Methods for descaling, degreasing, and electrocleaning steel prior to electroplating or other finishing is described. Discussion of the function of soap deliberately added or formed by saponification, together with rinsing properties, method providing visual evidence of completeness of grease removal, and the use of inhibitors in acid solutions to prevent overpickling.

(56) Leslie Wright and F. Taylor, "Modern Metal Cleaning," *Journal, Electroplaters' and Depositors' Tech. Soc.*, Vol. 6, pp. 71-90 (1931); *Journal, Inst. Metals*, Vol. 47, p. 406 (1931).

Includes a historical introduction from the time of Berzelius to the present. The constitution of soap solutions and their physical properties are enumerated, and the mechanism of cleaning with special references to the action of alkalis is discussed. Measurable values in the evaluation of alkalis are: (1) actual alkalinity (pH), (2) potential alkalinity denoting reserve, and (3) buffer value. Detergent actions described. Methods for measuring detergent action are outlined and the materials involved are discussed. Alkalis, together with soap, constitute the best detergent, and factors determining the type of soap used in metal cleaning are cost, foaming, free rinsing, and solubility. Rosin soap (as against tallow) is highly satisfactory because of free rinsing. High pH causes tarnishing but this is minimized by the addition of inhibitors such as sodium silicate.

1932

(57) "Cleaning Aluminum," *American Machinist*, European Edition, Vol. 76, p. 973 (1932); *Journal, Inst. Metals*, Vol. 53, p. 52 (1933).

Types of solutions most suitable for aluminum cleaning are: (1) volatile solvents, (2) aqueous solutions of soap and mild alkalis, and (3) "water-soluble controlled alkali" solutions. The make-up and method of using these solutions is described. A matte finish

is produced by dipping the work in a solution containing 5 gal nitric acid, 1 gal hydrofluoric acid, 1 qt sulfuric acid, or 8 parts nitric acid and 1 part hydrofluoric acid.

(57a) H. V. Churchill (to Aluminum Co. of America), "Cleansing Composition," U. S. Patent No. 1,890,214, December 6, 1932; "Detergents," Patent Publications, Inc., 1950.

Water-soluble powder for cleaning aluminum consisting of about 99 per cent of tartaric acid and about 1 per cent of an alkali metal fluoride.

(57b) J. H. Essick, "Carbon Remover," Canadian Patent No. 323,384, June 21, 1932; *Chemical Abstracts*, Vol. 26, p. 4428 (1932). See U. S. Patent No. 1,869,310, Reference 57c.

(57c) J. H. Essick, "Carbon Remover," U. S. Patent No. 1,869,310, July 26, 1932; "Detergents," Patent Publications, Inc., 1950.

A carbon remover for internal combustion engines, consisting of the following ingredients taken in the appended approximate proportions for the production of a 50-gal batch:

Benzol (90 proof)	18.5
Alcohol (denatured, 188 proof)	12
Oil of cedar wood (U S P grade)	1
Camphorated oil (U S P grade)	1
Turpentine	1
Acetone	16.5

(57d) C. L. Mantell, "Tests for Cleanliness (of Metals)," *Metal Cleaning and Finishing*, Vol. 4, pp. 25-26, 33-34 (1932); *Chemical Abstracts*, Vol. 26, p. 2679 (1932).

Water break shown to be unreliable and the need for a better test stressed.

(57e) C. R. Matthis, "Carbon Remover," U. S. Patent No. 1,878,245, September 20, 1932; "Detergents," Patent Publications, Inc., 1950.

Consisting of the following proportions by per cent:

Oil of cedar wood	10
Acetone	50
Benzol	16
Alcohol	24
Naphthalene	1 lb to each 6 gal of the liquid

(57A) W. C. Gangloff (to Drackett Chemical Co.), "Cleanser for Aluminum," U. S. Patent No. 1,870,311, August 9, 1932; "Dishwashing Detergents and Dishwashing Machines," *Bibliographic Series No. 5*, Quartermaster Research and Development Laboratories, p. 1 (1949).

An aluminum cleaner of the following composition:

	Per Cent
Powdered pumice	25
Powdered silica, calcined	25
Sesquicarbonate of soda	25
Trisodium phosphate	10
Powdered soap	10
Ammonium chloride	5

(58) "Cleaning Aluminum Tanks," *The Metal Industry* (New York), April, 1932, p. 146, August, 1932, p. 330; *Aluminum Broadcast*, Vol. 3, December 1, 1932, p. 17.

Difficulty in the proper pickling of aluminum tanks is outlined. Shows the need for control of the pickling bath and the subsequent rinse.

(59) "Aluminum Cleaner," *The Metal Industry* (New York), Vol. 30, June, 1932, p. 249.

The proprietary product "Houghto-Clean" for aluminum cleaning is described. Said to be designed for each special type of application.

(59A) H. Schneider, "Health Hazards in the Degreasing of Metals, and Their Prevention," *Arbeitschutz*, pp. 143-148 (1932); *Chimie & Industrie*, Vol. 28, p. 1332; *Chemical Abstracts*, Vol. 27, p. 1300 (1933).

Precautions in degreasing with alkaline solutions, electrolytically or by volatile solvents.

(59B) W. A. Scott (to the De Laval Separator Co.), "Cleansing Composition," U. S. Patent No. 1,879,953, September 27, 1932; "Detergents," Patent Publications, Inc., 1950.

Cleansing of dairy equipment by composition comprising trisodium phosphate, sodium metasilicate, soda ash, and soap in about the following relative proportions: trisodium phosphate 3 to 50 per cent, sodium metasilicate 40 to 60 per cent, soap 2 to 10 per cent, and not over about 10 per cent of soda ash.

(59C) W. L. Semon (to B. F. Goodrich Co.), "Method of Cleaning and Pickling Metals," U. S. Patent No. 1,852,194, April 5, 1932; "Detergents," Patent Publications, Inc., 1950.

Treating iron or steel with a solution comprising a strong non-oxidizing acid and a small proportion of a saturated heterocyclic compound containing at least three different atoms in the ring, two of such atoms being carbon and nitrogen, a third being selected from the oxygen group of elements (or sulfur in the ring).

1933

(60) "Cleaning Products for Brewing Vats," *Aluminum Limited Abstract Bulletin* 4, March 15, 1933, p. 15.

A study of the action, on aluminum, of special products intended to retard corrosion, which are added to the cleaning products used to dissolve the tartar of brewery vats and vessels. A number of proprietary German products are listed. Very satisfactory results were obtained with sulfonated acids.

(60A) E. Blough and H. V. Churchill (to Aluminum Company of America), "Alkaline Detergent Compositions and Method of Rendering the Same Non-Corrosive to Aluminum," U. S. Patent No. 1,912,175, May 30, 1933; "Detergents," Patent Publications, Inc., 1950.

Mildly alkaline detergent composition containing about 0.07 to 0.4 per cent of sodium silicate serving to inhibit corrosion of an aluminum container when the composition is packaged therein.

(60B) T. K. Cleveland, "Metasilicate, Its Detergent Applications," *Soap*, Vol. 9, pp. 19-21 (1933); *Chemical Abstracts*, Vol. 34, p. 862 (1934).

Use in the metal industry.

(60C) Firsau, "Modern Degreasing and Cleaning," *Oberflächentechnik*, Vol. 10, pp. 3-5 (1933); *Chemical Abstracts*, Vol. 27, p. 1300 (1933).

Precautions for health and the exposure hazards of volatile solvents such as benzine, benzene, and trichloroethylene. Inorganic agents such as caustic soda, phosphates, and silicates mentioned. Latter materials said to be preferable because of lessened attack on metal.

(61) L. E. Frost, "Paint Metal Products," *Industrial Finishing*, Vol. 10, No. 1, November, 1933, p. 19.

Methods are given for the removal of grease and dirt with petroleum products such as benzene or gasoline; with lacquer thinner or toluol; or with a cleaning compound dissolved in water, all preparatory to painting.

(62) J. Geschelin, "Metal Cleaning, Methods and Materials," *Automotive Industry*, Vol. 68, pp. 466-470, 522-526, 702-703 (1933); *Journal, Inst. Metals*, Vol. 53, p. 584 (1933).

Aluminum is best cleaned by the use of a mild alkaline cleaner or solvent, then rinsed in clear, cold water. The surface is then made uniformly active by dipping for from 5 to 30 sec in a solution of one part 50 per cent HF with nine parts water. In the case where an acid dip is to follow, the preliminary dip is eliminated. The surface is then roughened by etching, rinsed in clear cold water, and then transferred to the plating bath. Care must be taken in the selection of the alkaline cleaner, and it is recommended that equal quantities of sodium carbonate and trisodium phosphate be added in 1 to 3 oz quantities to 1 gal of water at 180 to 200 F. Such a mixture attacks the metal mildly in the same manner as an electrolytic cleaning.

Quotes the New Jersey Zinc Co. recommendations for zinc cleaning.

(62A) A. W. Hotherhall, "The Adhesion of Electrodeposited Coatings to Steel," *Transactions, Electrochemical Soc.*, Vol. 64, 15 pp. (1933); *Chemical Abstracts*, Vol. 27, p. 4486 (1933).

Principal causes of poor adhesion are:

(1) surface layer initially weak or embrittled by co-deposition of hydrogen, (2) presence when deposition commences of a film of oxide, greasy or adsorbed colloidal matter, or insoluble matter such as carbon or carbides liberated during etching, (3) layer of defective deposit formed in early stages of deposition.

(63) "Cleaning Metal Parts," *Industrial Finishing*, Vol. 10, No. 1, November, 1933, p. 9.

A description of wet cleaning of metals with naphtha or chemical solutions applied by hand dipping or by automatic dipping or spraying as the material is mechanically conveyed to and from the cleaning, rinsing, and drying stations.

(63A) Carl Johnson (to Oakite Products, Inc.), "Cleaning Metal Surfaces such as in Removing 'Carbon Smut' from Cold-Rolled Steel," U. S. Patent No. 2,032,174, February 25, 1933; *Chemical Abstracts*, Vol. 30, p. 2547 (1936).

Removal of grease and associated solid particles from metal surface with a mixture readily emulsified in water which contains kerosene 85 to 95 per cent together with oleic acid soap, cresylic acid, and water. Permits removal of solid particles and leaves a thin film of grease which is subsequently removed.

Lists as essential requirements for emulsion cleaners the ready emulsification in water, a solvent as prime ingredient which is soluble or miscible with oils or greases present in the surface to be cleaned, a soap or blending agent to make soap soluble in solvent, and water in sufficient amounts to produce blending of other ingredients.

Solvents may be aliphatic or aromatic hydrocarbons, chlorinated aliphatic or aromatic materials; soap may be soda, potash, or ammonia or amine products of fats and oils; blending agent of phenolic, cresylic, or alcohol type; and water to cause blending of other ingredients.

(63B) R. Justh, "Triphosphate Electrolytic Cleaners for Platers," *Oberflächentechnik*, Vol. 10, p. 57 (1933); *Chemical Abstracts*, Vol. 27, p. 2386 (1933).

Trisodium phosphate commonly used as a degreasing agent and consists basically of trisodium phosphate and sodium hydroxide. Mechanism of degreasing is described as colloidal chemistry and mechanical process, and these explained.

(63C) R. Justh, "Hidden Sources of Defects in Degreasing of Materials," *Ober-*

flächentechnik, Vol. 10, pp. 271-272 (1933); *Chemical Abstracts*, Vol. 28, p. 1279 (1934).

Unsatisfactory plating often due to degreasing process applied immediately before plating. Passivation of the surface produced in degreasing must be removed by acid treatment and rinsing. Brittle deposits attributed to excessive electrolytic cleaning. Advisable to process pieces while still wet and without drying between cleaning, rinsing, and plating. Acid treatment of cold-formed parts before plating recommended.

(64) "A Select, Annotated Bibliography on the Hygienic Aspects of Aluminum and Aluminum Utensils," *Bulletin No. 3*, Mellon Inst. of Industrial Research, 69 pp., 150 references (1933).

(64A) H. C. Mougey (to General Motors Research Corp.), "Metal Cleaning Composition," U. S. Patent No. 1,897,813, February 14, 1933; "Detergents," *Patent Publications*, Inc., 1950.

Composition for cleaning surfaces of ferrous metal comprising an acid adapted to remove rust, such as phosphoric acid, and a water-soluble oil solvent selected from the group of substances consisting of di-, tri-, and tetra-ethylene glycol and their ethers, the methyl, ethyl, and propyl ethers of propylene glycol, the acetates of glycol and di-ethylene glycol and of the ethyl ethers of ethylene glycol.

(65) E. B. Sanigar, "Specifications for Chemicals and in Cleaning Metals," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 20, No. 3, pp. 26-29 (1933); *Journal, Inst. Metals*, Vol. 1, p. 207 (1934).

Chemical specifications are given for sodium hydroxide, sodium carbonate, sodium silicate, trisodium phosphate, potassium hydroxide, potassium carbonate, trichlorethylene, and carbon tetrachloride.

(66) E. K. Strachen, "Composition and Action of Metal Cleaners," *Metal Cleaning and Finishing*, Vol. 6, pp. 426-429 (1933); *Journal, Inst. Metals*, Vol. 1, p. 207 (1934).

A practical discussion. General formulas are given.

(66A) C. A. Thomas and C. A. Hochwalt (to Thomas and Hochwalt Laboratories, Inc.), "Composition for Removing Carbon Deposits," U. S. Patent No. 1,896,759, February 7, 1933; "Detergents," *Patent Publications*, Inc., 1950.

Composition comprised as an essential ingredient a chlorinated naphthalene.

(67) C. J. S. Warrington, "Modern Methods of Cleaning Metals," *Canadian Chemistry and Metallurgy*, Vol. 17, pp. 77-78 (1933); *Journal, Inst. Metals*, Vol. 53, p. 668 (1933).

A description of pickling methods is given.

(67A) S. Wernick, "Cleaning of Metals. III. Theory of the Alkaline Cleaner," *Industrial Chemistry*, Vol. 9, pp. 275-277 (1933); *Chemical Abstracts*, Vol. 28, p. 4348 (1934).

Relative detergent value given for caustic soda, soda ash, trisodium phosphate, and $\text{Na}_2\text{O} \cdot 4\text{SiO}_2$. Discussion of detergent and surface and interfacial tension and their effect upon emulsification.

(67B) S. Wernick, "Cleaning of Metals. IV. Some Practical Aspects of Alkaline Cleaning," *Industrial Chemistry*, Vol. 9, pp. 308-311 (1933); *Chemical Abstracts*, Vol. 28, p. 4348 (1934).

Discusses trichloroethylene and carbon tetrachloride for degreasing. Use of alkaline materials with or without china clay discussed. Aluminum tri-hydroxide also indicated. Zinc cleaned with sodium zincate and sodium silicate and aluminum by aluminum zincate and sodium silicate. Copper, brass, and nickel-silver cleaned by aqueous 1 to 2 per cent solution of potassium cyanide.

1934

(67C) K. Altmanberger, "The Mechanics of Adherence in Metal Plating," *Oberflächentechnik*, Vol. 11, pp. 15-16 (1934); *Chemical Abstracts*, Vol. 28, p. 2653 (1934).

Stresses the importance of cleaning for satisfactory adherence.

(68) "Cleaning of Aluminum Appliances," *Aluminum*, Vol. 17, pp. 34-36 (1934); *Aluminum Limited Abstract Bulletin* 6, December 15, 1934, p. 6.

A list of the cleaning products which are available in Germany and which are suitable for the general cleaning of aluminum, as well as for the cleaning of brushed and highly polished aluminum surfaces.

(68A) H. C. Bernard, "Metal Cleaning and Metal-Cleaning Compounds," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 20, No. 11, pp. 28-30 (1934); *Chemical Abstracts*, Vol. 30, p. 8130 (1936).

A review.

(68B) K. B. Blodgett, "Interference Colors in Oil Films on Water," *Journal, Optical Soc. of America*, Vol. 24, pp. 313-315 (1934); *Chemical Abstracts*, Vol. 29, p. 4649 (1935).

Directions given for making oil films of any desired uniform thickness. Oxidized motor oil was used, and film thickness was controlled with a non-spreading oil or by a confining barrier.

(69) M. Chaussain and H. Fournier, "Chemical Methods of Cleaning Corroded Light Metals," *Comptes rendus*, Vol. 198, pp. 936-939 (1934); *Journal, Inst. Metals*, Vol. 1, p. 240 (1934); *Chemical Abstracts*, Vol. 28, p. 3368 (1934).

Use of dilute nitric acid for cleaning aluminum and its alloys examined by determining the loss in weight of corroded and uncorroded metal in acids at varying temperatures and concentrations and acting for varying times. Temperature should be 60 to 70 C. Loss of metal due to solution increases with dilution to a maximum for about 40 per cent acid, the loss caused by concentrated and 10 per cent acid being approximately the same, but metal cleaned in concentrated acid is bright and well cleaned; that in 10 per cent is dull.

(70) M. Chaussain and H. Fournier, "Chemical Methods of Cleaning Light and Ultra-Light Metals After Corrosion," *Revue de Métallurgie*, Vol. 31, pp. 201-211 (1934); *Journal, Inst. Metals*, Vol. 1, November, 1934, p. 498.

A discussion of acid cleaning.

(70A) C. E. Clindinin, "Practical Methods of Cleaning Before Electroplating," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 20, No. 7, pp. 5-11 (1934); *Chemical Abstracts*, Vol. 28, p. 3987 (1934).

Review of composition and the use of cleaners employed with and without electric current.

(70B) H. E. Fritz, "Acid Cleaning and Electroplating with Rubber-Lined Equipment," *Metal Cleaning and Finishing*, Vol. 6, pp. 159-164 (1934); *Chemical Abstracts*, Vol. 28, p. 3987 (1934).

Use of "anode" rubber coating process and equipment.

(70C) W. A. Koehler, "Cleaning Articles to be Plated," *Metal Cleaning and Finishing*, Vol. 6, pp. 283-286 (1934); *Chemical Abstracts*, Vol. 28, p. 5764 (1934).

A review.

(71) H. Krause, "Chemical Cleaning of Non-Ferrous Metals," *Maschinenbau*, Vol. 13, pp. 187-189 (1934); *Journal, Inst. Metals*, Vol. 1, p. 631 (1934).

A discussion of cleaning solutions.

(71A) M. Marean, "Solvent Degreasing," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 21, No. 2, pp. 31-40 (1934); *Chemical Abstracts*, Vol. 30, p. 8043 (1936).

A review.

(72) Erling Mathiesen and Erling Mikkelsen, "Tests on Washing Compounds for Use in the Canning Industry," *Tidsskrift for Hermetikindustri (Norwegian Cannery Export Journal)*, Vol. 20, pp. 185-192 (1934); *Journal, Inst. Metals*, Vol. 2, p. 633 (1935).

For general use a mixture comprising essentially sodium carbonate and water glass with a little soap is most effective for tin plate and sheet aluminum.

(72A) R. J. Piersol, "Cleaning Prior to Plating," *Metal Cleaning and Finishing*, Vol. 6, pp. 229-234 (1934); *Chemical Abstracts*, Vol. 28, p. 5764 (1934).
A review.

(73) H. Schnegg, "Beer Scale on Aluminum Vessels," *Zeitschrift für das gesamte Brauwesen*, Vol. 57, pp. 1-2, 5-10, 13-18, 21-27 (1934); *Journal, Inst. Metals*, Vol. 1, May, 1934, p. 270, August, 1934, p. 399.

A comparison was made between several proprietary compounds and nitric acid for the removal of scale from aluminum vessels.

(74) C. Schwartz and H. Gilmore, "Sodium Metaphosphate in Mechanical Dishwashing," *Industrial and Engineering Chemistry*, Vol. 26, pp. 998-1001 (1934).

A study of the effect of the admixture of sodium metaphosphate with detergent compounds and comparison with the behavior of several commercial dishwashing preparations showed that the mixtures containing sodium metaphosphate were in every case superior to the products now available. By reason of its excellent detergent properties, noncorrosive action on aluminum, and complete prevention of film, the following composition (or the dehydrated equivalent) was the best of those studied: 40 per cent NaPO_3 , 15 per cent $\text{Na}_3\text{PO}_4 \cdot \text{H}_2\text{O}$, 40 per cent $\text{Na}_2\text{SiO}_3 \cdot 5\text{H}_2\text{O}$, and 5 per cent NaOH .

(75) Alfred B. Searle, "Metal Cleaning Preparations," *Chemist and Druggist*, Vol. 121, pp. 462-463 (1934); *Journal, Inst. Metals*, Vol. 2, p. 118 (1935).

Aluminum is best cleaned in soap solution in hot water using a scrubber made of fine metal turnings or a hard brush. Care should be taken not to leave washing soda or substances containing it in contact with aluminum.

(76) Vereinigte Aluminium-Werke, A.-G., Research Dept., "Treatment of Aluminium Ware in the Household," *Aluminium*, Vol. 17, pp. 34-36 (1934); *Journal, Inst. Metals*, Vol. 2, January, 1935, p. 32.

Methods are given for cleaning domestic aluminum ware. Various proprietary compositions are recommended.

(76A) S. Wernick, "Cleaning of Metals. VI. Degreasing by Means of Organic Solvents," *Industrial Chemistry*, Vol. 10, pp. 479-481 (1934); *Chemical Abstracts*, Vol. 29, p. 5403 (1935).

Removal of grease and polishing powder accomplished by trichloroethylene and suitable equipment illustrated.

1935

(76B) "Cleaning of Aircraft Metal Surfaces Prior to Application of Initial Pro-

TECTIVE COATING," *Army Specification 98-20007*, June 21, 1935.

Detailed requirements cover mechanical cleaning, soak or electro-cleaning methods for steel parts, solvent cleaning, proprietary cleaning compounds, pickling. Also includes methods for corrosion-resistant steel, brass or bronze parts, aluminum or aluminum alloy parts, and magnesium alloys.

(77) Chester L. Baker, "Effect of Alkaline Detergents upon Metals," *Industrial and Engineering Chemistry*, Vol. 27, p. 1358 (1935).

Work was restricted to the effect of alkalies upon aluminum, tin plate, copper, and zinc at $60 \pm 2^\circ\text{C}$. Effects of variables of concentration and immersion time were studied.

Technique.—Series of solutions of each alkali were prepared. One hundred millimeters of each in tightly stoppered glass bottles was brought to $60 \pm 2^\circ\text{C}$ in a constant-temperature oven. Numbered 0.75-by 2.5-in. strips of virgin aluminum, block tin plate, commercial sheet zinc, and electrolytic copper were carefully cleaned, dried, and weighed and then immersed for 8 to 24 hr. They were then removed, thoroughly washed with distilled water, then alcohol, dried, and weighed. Since attack occurred immediately with aluminum, the study did not establish time-concentration areas within which no attack occurred. In some cases strips carried incrustation so that weight losses do not in every case represent total loss of metal. NaOH , sodium carbonate, attacked immediately and vigorously at all concentrations (0.005 to 10.0 per cent). Trisodium phosphate attacked immediately. Metal was dissolved quantitatively by alkali at all concentrations. Sodium stearate attacked at all concentrations above 0.04 per cent, causing surface blackening. In all cases greasy films of stearic acid were present with this soap and this probably inhibited attack somewhat. Metasilicate in solutions ranging from 0.60 to 5.00 per cent produced no visible attack in 24 hr. At concentrations below 0.60 per cent, surface was slightly dulled and at very low concentrations the metal blackened, but the metal lost was small. At concentrations above 5.00 per cent, attack increased with concentration and at 10 per cent loss of metal was considerable.

(78) H. J. Barnum, P. S. Lucas, and Bruce Hartsuch, "Use of Cleaners in the Dairy Plant," *Special Bulletin No. 262*, Michigan Agricultural Experiment Station, 24 pp. (1935); *Journal, Inst. Metals*, Vol. 3, p. 130 (1936); *Chemical Abstracts*, Vol. 30, p. 1149 (1936).

Cleaners are classified on the basis of comparison, into modified or neutral soda, soda ash, special alkalies, trisodium phos-

phate, and colloidal material. Some are highly buffered and others are highly caustic. The emulsifying power is determined with butter fat. Evaluated water-softening power. Aluminum, copper, and tinned steel were severely scratched by the volcanic ash content of the cleaners. Tinned steel and aluminum were most severely corroded.

(78A) K. B. Blodgett, "Films Built by Depositing Successive Monomolecular Layers on a Solid Surface," *Journal, Am. Chemical Soc.*, Vol. 57, pp. 1007-1022 (1935); *Chemical Abstracts*, Vol. 29, p. 5328 (1935).

Calcium soaps of palmitic, stearic, and arachidic acids deposited on metals such as chromium, nickel, brass, steel, cast iron, silver, and platinum. Good interference colors given and thickness of such films determined.

(79) H. J. M. Creighton and W. A. Koehler, "Principles and Application of Electrochemistry," John Wiley and Sons, Inc., New York, N. Y., Vol. 2, pp. 150-151, (1935).

Cleaning of aluminum in organic solvents may be used. Alkaline cleaners are satisfactory provided that the concentration of the alkali is not sufficient to mar the luster. It is advisable to follow the alkaline cleaning by acid cleaning with 5 per cent hydrofluoric acid solution. The hydrofluoric acid serves the dual purpose of neutralizing any remaining alkali and remedying to a small degree the imperfection in alkaline cleaning.

(79A) G. Genin, "Detergents Employed in the Dairy Industry," *Lait*, Vol. 15, pp. 838-870 (1935); *Chemical Abstracts*, Vol. 30, p. 1882 (1936).

Review of various alkalies used and their mechanism of action.

(80) R. W. Mitchell, "Recent Advances in Metal Cleaning Technology," *Metal Cleaning and Finishing*, Vol. 7, pp. 9-14, 65-68, 133-135 (1935).

Solvents, nascent soaps, and sulfonated cleaners are discussed. Use of phosphates of tin and aluminum formed in the trisodium phosphate cleaning solutions to prevent attack upon the corresponding metals. The use of chromates and silicates for inhibition of alkaline corrosion upon tin and aluminum, though not new, have again been patented.

(81) N. Promisel, "Detergent Properties of Some Alkalies Used in Plating Cleaners," *Monthly Review, Am. Electroplaters' Soc.*, pp. 4-19, June, 1935; *Metal Abstracts*, Vol. 7, p. 20; *Chemical Abstracts*, Vol. 30, p. 4234 (1936).

Rated on: wetting, oil displacement, stalagmometric measurement, chemical

activity, deflocculation, alkalinity, pH and buffer action, tarnish and corrosive effect on metals. For emulsification, soap and sulfonated alcohols were best. Caustic and sodium tetraborate were best in saponification. Sodium silicate was the most effective deflocculator.

(81A) U. C. Tainton, "Cleaning Metals," French Patent No. 776,083, January 16, 1935; *Chemical Abstracts*, Vol. 29, p. 3243 (1935).

Cleaning electrolytically in a fused bath of caustic soda or potash or, if lower temperature required, other alkaline salts such as sodium nitrite may be used. Metal to be cleaned forms the cathode.

1936

(82) "When Metals Must Be Cleaned," *American Machinist*, European Edition, Vol. 80, No. 42, pp. 871-872 (1936); *Journal, Inst. Metals*, Vol. 4, p. 17 (1937).

Describes various machines and reagents for cleaning metals in their preparation for painting.

(83) Clete L. Boyle, "Cleaning Agent for Metals that Are to be Painted," Canadian Patent No. 356,078, February 25, 1936; *Chemical Abstracts*, Vol. 30, 2659 (1936).

Mixture of an acid, such as phosphoric, in oil solvent, such as monobutyl ether of ethylene glycol. A compatible wetting agent such as the soluble salt of an alkylated naphthalene sulfonic acid may be used in acid solution.

(84) Charles B. Durgin (to Swann Research, Inc.), U. S. Patent No. 2,037,566 (1936).

A cleaner for tin, zinc, and aluminum comprising the following:

Material	Parts
Trisodium phosphate	63
Sodium perborate	10
Sodium silicate (ratio of Na ₂ O: SiO ₂ of 1:2 or 1:1.32)	25
Magnesium sulfate	2

(85) F. E. P. Griggs, "Metal Cleaning," *Canadian Chemistry and Metallurgy*, Vol. 20, p. 258, 260 (1936).

Removal of (1) rusts and tarnishes, (2) greases and oils, and (3) material adhering to the grease. Outlines requirements for alkaline cleaners: (1) wetting and penetration, (2) colloidal dispersion of soil, and (3) emulsification, saponification, and conductivity. Mentions organic synthetic detergents. Outlines methods for electrolytic cleaning and solvent degreasing.

(86) G. B. Hogaboom, Jr., "Practical Pointers on the Use of Solvents and Alkaline Solutions in Metal Cleaning," *Abrasive and Cleaning Methods*, Vol. 1, No. 6, pp. 20-22 (1936).

A short review, mainly of solvents used in degreasing prior to plating. A few suggestions are given as to the cleanser to be employed in the final cleaning.

(87) "Precautions in the Cleaning of Aluminum Tanks with Nitric Acid," *Illustrirt Zeitschrift für das Blechindustrie*, Vol. 66, pp. 942-943 (1936); *Journal, Inst. Metals*, Vol. 4, December, 1937, p. 682.

The use of dilute nitric acid for removing the deposit from the walls of aluminum brewing vats, while obviating attack on the metal, may result in the production of nitrous fumes due to oxidation of oxalic acid in the deposit.

(87A) C. Johnson, "New Metal-Cleaning Process," *Products Finishing*, Vol. 1, No. 3, pp. 15-22 (1936); *Chemical Abstracts*, Vol. 31, p. 2144 (1939).

Use of an aqueous solution of an emulsifying agent in hydrocarbon solvent. Metal surface retains oil film and displaces dirt particles which are rinsed away. Among the specifications given for solvent and emulsion is one that the solvent shall absorb 25 per cent by volume of heavy lubricating oil without losing rapid emulsifying characteristics and without appreciable increase in viscosity. Cleaning process consists of: (1) application of hydrocarbon solution of emulsifying agent, (2) water washing, and (3) removal of thin residual oil film. Polished and bright cold-rolled steel stock said to be cleaned and plated in hot cyanide plating bath after steps 1 and 2 above.

(88) A. L. Kaye, "Colloidal and Surface Aspects of Metal Cleaning and Finishing," *Metal Cleaning and Finishing*, Vol. 8, pp. 9-12, 40, 71-72, 93-94, 179-182, 311-312 (1936).

Theoretical aspects of metal cleaning.

(89) "Cleaning Aluminum Equipment in a Brewery," *Light Metals Review*, Vol. 2, February 15, 1936, p. 267.

An abrasive paste was used for cleaning aluminum equipment comprising brewery yeast and ashes taken from the boiler smoke box. The paste is applied to an ordinary wiping cloth and the equipment rubbed vigorously, followed by thorough rinsing with water.

(90) Maiborada and Korolev, "Chemical Cleaning of Parts Made of Aluminum and Duralumin in the Airplane Building Industry," *Aeronautical Industry*, Nos. 8 and 9, pp. 33-34 (1936); *Journal, Inst. Metals*, Vol. 4, December, 1937, p. 682.

The parts to be cleaned are immersed in warm (50 to 60 C) 5 per cent caustic soda solution containing 1 per cent sodium chloride, for 30 sec. thoroughly washed, immersed in concentrated nitric acid, and again washed in water.

(90A) M. Marean, "Principles of Solvent Degreasing," *Metal Cleaning and Finishing*, Vol. 8, pp. 553-558, 590 (1936); *Chemical Abstracts*, Vol. 31, p. 477 (1937).

General discussion.

(91) W. R. Meyer, C. S. Tompkins, and V. F. Stine, "Cleaning of Metals," *Metals Handbook*, Am. Soc. Metals, pp. 825-841 (1936); *Journal, Inst. Metals*, Vol. 4, p. 556 (1937).

A discussion of metal cleaning.

(92) W. Mohr and Wullhorst, "Experiments with Various Cleansers for Use in Can-Washing Machines," *Molkerei-Zeitung* (Hildesheim), Vol. 50, pp. 2490-2492, 2525-2528 (1936); *Journal, Inst. Metals*, Vol. 4, p. 148 (1937); *Chemical Abstracts*, Vol. 31, p. 1507 (1937).

The action of two commercial agents and of calcined soda (95 to 100 per cent sodium carbonate) and caustic soda on aluminum, tinned iron, and tinned copper, which materials are used in milk transport cans, was studied. As in actual practice the temperature was 85 C and time 12 sec. The concentration of reagents was 0.25 per cent. Soda ash and NaOH are recommended only when silicate is added as a corrosion preventive.

(92A) L. A. Rogers and F. C. Evans, "The Use of Tribasic Sodium Phosphate in Cleaning Dairy Equipment," *Journal, Bacteriology*, Vol. 31, pp. 87-88 (1936); *Chemical Abstracts*, Vol. 30, p. 1882 (1936).

Five per cent solution of trisodium phosphate said to be excellent detergent and has distinct bactericidal action. Corrosive effect eliminated by the addition of 3 per cent of sodium chromate to the phosphate crystals.

(92B) L. A. Rogers and F. R. Evans, "Cleaning Dairy Equipment with Trisodium Phosphate," *Journal, Dairy Science*, Vol. 19, pp. 733-738 (1936); *Chemical Abstracts*, Vol. 31, p. 3578 (1937).

Trisodium phosphate with sodium chromate, perborate, and metasilicate to lessen corrosive action tested for cleaning dairy equipment. Three to 5 per cent sodium chromate on the weight of trisodium phosphate prevented corrosion. Trisodium phosphate shown to be effective cleaner by bacterial count.

(92C) U. C. Tainton, "Cleaning Metal Surfaces," *German Patent* No. 636,489, October 10, 1936; *Chemical Abstracts*, Vol. 31, p. 652 (1937).

See French Patent No. 776,083, Reference 81A.

(93) James G. Vail, "Soluble Silicate Cleansers," *Industrial and Engineering Chemistry*, Vol. 28, p. 294 (1936).

Aluminum is sensitive to alkalis in varying degrees according to the acid radical. At 60 C. and 24-hr exposure sodium metasilicate is safe up to a concentration of 1 per cent sodium oxide content, whereas the same Na_2O content as caustic, carbonate, or phosphate is harmful. With increasing relative amounts of SiO_2 , still higher concentrations of Na_2O become safe. Curves are given to show loss in weight versus Na_2O concentration.

(94) L. Zakarias, "The Displacement of Fats and Oils (by Fatless Detergents)," *Chimie et Industrie*, Vol. 36, pp. 1095-1100 (1936); *Chemical Abstracts*, Vol. 31, p. 3171 (1937). See also *Chemical Abstracts*, Vol. 30, p. 7347 (1936).

Three methods for evaluation of degree of cleaning of metal and other surfaces: (1) repulsion or adhesion of water to surface; (2) acidification and determination of fat; and (3) formation of grease spot on tissue paper. This third method is said to be best. Describes use of fat-free, starch-base cleansing agents for commercial application for which they were tried and found effective, especially for aluminum and aluminum utensils.

1937

(94A) D. J. Benoliel, "Alkalies in Pickle Room Cleaning," *American Enameler*, Vol. 10, No. 6, pp. 10, 20 (1937); *Chemical Abstracts*, Vol. 31, p. 7811 (1937).

Sodium silicate has high emulsifying and dirt carrying power, but the ratio of sodium oxide to silica must be balanced. Soap should be used only on make-up of the tank.

(94B) D. J. Benoliel, "Wetting Agents Doing Better Job in Metal Cleaning (for Enameling)," *Ceramic Industry*, Vol. 28, pp. 520, 522, 534 (1937); *Chemical Abstracts*, Vol. 31, p. 5529 (1937).

Sulfonated cresol compounds almost as rapid as soap and possess other advantages. Titration method for alkali control not as satisfactory as "Strip" method.

(94C) E. J. Daniels and D. J. Macnaughton, "The Wetting of Metals by Metals with Particular Reference to Tinning and Soldering," *Wetting and Detergency*, Chemical Publishing Co. of New York, pp. 77-84 (1937).

Discussion of wetting of solid metal by liquid metals and degree and type of wetting which results. Use of flux assists materially in wetting by assisting in removal of oxide film and actual cleaning of the solid surface. The authors indicate that further information is desired on the action of fluxes concerning the effects on surface tension of the molten metal as by partially satisfying the affinities of surfaces and also on the degree of influence on wetting.

(95) W. W. Davidson, "Solvent Degreasing," *Transactions, Electrochemical Soc.*, Vol. 72, pp. 413-427 (1937).

The solvent degreasing process for the removal of oil and grease from articles prior to being electroplated or otherwise "finished" is described in some detail. Fundamental principles of equipment design and the characteristics of the stabilized, noninflammable solvents are discussed.

(95A) F. A. Maurer, "Cleaning (Metals) Before Plating," *Metal Industry* (London), Vol. 50, pp. 633-635 (1937); *Chemical Abstracts*, Vol. 32, p. 3737 (1938).

Practical methods reviewed and applications discussed.

(96) W. Ritter and T. Nussbaumer, "The Action of Cleansing Agents on Certain Metals," *Schweizerische Milchzeitung*, Vol. 63, pp. 301-302, 311, 323-324, 330, 337-338 (1937); *Chemical Abstracts*, Vol. 31, p. 8488 (1937).

The corrosive action of several cleansing agents on certain metals and alloys, both alone and in combination, was studied. The metals and alloys were: (1) copper, (2) tinned copper, (3) tinned iron, (4) aluminum, (5) Aluman, (6) Antikorodal, (7) anodically-oxidized aluminum, (8) peraluman, and (9) stainless steel. The cleansers commonly used in cleaning dairy equipment were: (a) a 1 per cent solution of Neomoscan, which contains 12 per cent silicic acid, 14 per cent alkali, and 3.4 per cent hypochlorite, (b) a 0.75 per cent solution of " P_3 ," which contains Na_3PO_4 and Na_2SiO_3 (water glass), (c) a 0.63 per cent solution of " P_3 -steril," which contains an increased amount of water glass, (d) a 1 per cent solution of " P_3 -Zinnfest alt," (e) a 1 per cent solution of " P_3 -Zinnfest neu," which contains an increased amount of water glass and an organic chlorine preparation, (f) a 1 per cent solution of "soda," (g) a 1 per cent solution of "soda" containing 0.83 per cent water glass of sp. gr. 1.42 and containing 27 per cent SiO_2 , (h) a 1 per cent solution of Na_3PO_4 , (i) a 1 per cent solution of Na_3PO_4 , containing 0.2 per cent Na_2SiO_3 , (j) a 1.5 per cent solution of "Try," which contains 24 per cent Na_3PO_4 , 20 per cent Na_2CO_3 , and 2.4 per cent Na_2SiO_3 , and (k) a 1 per cent solution of "Tartrex," which contains 93.4 per cent $\text{KHC}_4\text{H}_4\text{O}_6$ and 6.8 per cent H_2O . Cleansers a, c, and e had no appreciable corrosive action on any of the metals; j was strongly corrosive toward aluminum and its alloys; f and j were strongly corrosive when insufficient water glass was present; k was strongly corrosive, especially toward tinned metals, but less so toward aluminum and its alloys. Metals in combination in solutions containing water glass show only a very small electrical potential and very slight corrosion; but if the amount of water glass is insufficient, galvanic action and corrosion

in such cleansers as f and h are excessive. Metals in k undergo excessive galvanic action and corrosion. When a base metal is in contact with a noble metal, the corrosion of the former is increased, and that of the latter is decreased. Copper is a noble metal in cleanser k and is not corroded when in contact with another metal; alone, it is strongly corroded. Tinned metals are strongly corrosive toward k, and are corroded still more when in combination with a noble metal such as copper or stainless steel. The latter metal was not corroded in any reagent, either when alone or in combination. Aluminum and its alloys were not corroded in alkalis if sufficient water glass was present, but were corroded in its absence. In the latter case, anodic oxidation or the use of resistant alloys of aluminum does not prevent corrosion.

(96A) V. P. Sacchi, "Degreasing Preliminary to Electroplating," *Industria meccanica*, Vol. 19, pp. 322-324 (1937); *Chemical Abstracts*, Vol. 31, p. 5688 (1937).

General observations on the necessity, effects, and methods of degreasing for good adhesion.

(96B) V. P. Sacchi, "Electrolytic Degreasing," *Industria meccanica*, Vol. 19, pp. 741-747 (1937); *Chemical Abstracts*, Vol. 32, p. 1186 (1938).

Mechanism of electrolytic degreasing discussed as to bath, saponification, emulsification, peptization, mechanical removal, and removal by electrophoresis.

(96C) E. V. D. Wallace, "Vapor-Phase Degreasing," *Products Finishing*, Vol. 1, No. 6, pp. 16-22 (1937); *Chemical Abstracts*, Vol. 31, p. 2982 (1937).

Review from early methods to date. Process not limited to heavy parts. Advantages of degreasing enabling water solutions to completely remove dirt and rust more effectively.

(97) C. B. F. Young, "Cleaning of Metallic Surfaces," *The Iron Age*, Vol. 140, October, 1937, pp. 40-43, 185-200.

The absolute necessity for clean base surface is indicated when subsequent coatings are to be applied. Three types of materials to be removed are: (1) inorganic materials—oxides, sulfides, and basic carbonates; (2) organic compounds, oils and greases which will saponify, and oils and greases which will not saponify; (3) mixtures of (1) and (2). Removal of group 1 is accomplished by pickling, but as with brass and copper, a basic cyanide solution may be useful. Use of the electrochemical descaling bath is described. Pickling of tin, zinc, zinc-base die castings, and aluminum in 5 to 10 per cent solutions of hydrochloric acid is suggested. Electrolytic cleaning is described. Trisodium

phosphate can be used for cleaning zinc-base die castings in either immersion or electrochemical solution. Describes solvent degreasing.

1938

(97A) Cleaner, Engine; Spray Type, U. S. Army Air Forces Specification 50062-B, July 27, 1938; Amendment No. 2, April 10, 1942.

Intended for use in cleaning aircraft engines and accessories. Specifications cover pistol grip, spray type, engine cleaner appliance, including drawings.

(97B) D. J. Benoliel, "What Metal Cleaner Should I Use?," *Products Finishing*, Vol. 2, No. 5, pp. 23-24, 26-28 (1938); *Chemical Abstracts*, Vol. 32, p. 2067 (1938).

Recommendations given for methods of cleaning steel for electroplating, brass and steel to be lacquered, metals for Japanning and painting and vitreous enameling.

(98) E. Windsor Bowen, "Surface Preparation of Aluminum and Aluminum Alloys Before Anodic Treatment," *Aluminum and the Non-ferrous Review*, Vol. 3, p. 169 (1938).

Apparently a review of methods of preparing surfaces for anodic treatment issued to licensees of the Alumilite Process. The article is concerned mainly with finishing methods such as sand blasting and burnishing although cleaning methods are suggested.

(99) J. M. Cosgrove, "The Spot Test as an Aid in the Rapid Evaluation of Cleaners," *Metal Cleaning and Finishing*, Vol. 10, No. 3, p. 186 (1938).

Evaluation of metal cleaners by deposition of a spot of burnt transformer oil upon metal surface and measurement and comparison of elapsed time to remove the spot.

(99A) S. Field and A. D. Well, "Electroplating," Pitman and Sons, Ltd., 1938.

Chapter 9 on Mechanical Cleaning, pp. 142-154, and Chapter 10, pp. 155-175, on Chemical Cleaning. These are reviews of practice.

(99B) E. Greulich, "Degreasing of Steel with Different Degreasing Materials," *Korrosion u. Metallschutz*, Vol. 14, pp. 340-345 (1938); *Chemical Abstracts*, Vol. 33, pp. 2463 (1939).

Describes evaluation of benzine for degreasing of steel oiled with drawing oil and hydrogenated fish oil. Degreasing at temperature above room temperature necessary for good work.

(100) Carroll L. Griffith and Lloyd A. Hall to The Griffith Laboratories, Inc., "Inhibited Detergent Composition," U. S.

Patent No. 2,155,045 application, July 20, 1938.

A corrosion-inhibiting alkaline composition for cleaning zinc, iron, and tin ware in an aqueous solution thereof at from cold to boiling temperatures consisting by weight essentially of about 85 per cent of water-soluble inorganic alkaline detergent, about 5 to 7.2 per cent of a solid hypochlorite salt of a metal from the group consisting of alkali metals and alkali earth metals, and about 9 to 10 per cent of zinc compound from the group consisting of water-soluble zinc salts, zinc oxide, zinc hydroxide, and zinc carbonate.

(101) Carroll L. Griffith and Lloyd A. Hall (to The Griffith Laboratories, Inc.), "Inhibited Detergent Composition," U. S. Patent No. 2,155,046 application, February 28, 1938.

A corrosion-inhibiting alkaline composition for cleaning zinc, iron, and tin ware in a solution thereof at from cold to boiling temperatures consisting essentially of about 85 per cent of water-soluble inorganic alkaline detergent, about 5 to 6 per cent of a solid hypochlorite salt of a metal from the group consisting of alkali metals and alkali earth metals, and about 9 to 10 per cent of water-soluble zinc salt.

(101A) E. E. Halls, "Removal of Grease with Trichloroethylene," *Machinist*, Vol. 82, pp. 424-426E (1938); *Chemisches Zentralblatt*, 1939, I, p. 1277; *Chemical Abstracts*, Vol. 34, p. 6916 (1940).

Ordinary trichloroethylene compared with stabilized product for degreasing iron parts. Data given on characteristics of trichloroethylene and methods of procedure.

(102) Leo Ivanovszky, "Metal Cleaning Agents," *Ole, Fette, Wachse, Seife, Kosmetik*, No. 10, pp. 9-11. Listed in *Chemical Abstracts*, Vol. 32, p. 91, 1938, but no abstract.

(103) "Degreasing and Cleaning Solutions for Aluminum and Its Alloys," *Light Metals*, Vol. 1, December, 1938, pp. 386-387.

The chemical properties of aluminum are such that special attention must be devoted to the composition of solutions employed in processing it, and to the conditions under which such solutions are used. Several solutions other than the chlorinated hydrocarbons are suggested. These are reviewed, their advantages and disadvantages are pointed out, and inhibitors suggested.

(104) R. W. Mitchell, "Metal Cleaning by Emulsion Degreasing," *Proceedings, Am. Electrochemical Soc.*, p. 238 (1938); *Chemical Abstracts*, Vol. 33, p. 5750 (1939).

Emulsion degreasing in two fashions: (1) metal dipped in or sprayed with organic solvent containing an oil-soluble soap or emul-

sifying agent. Surface given pressure spray rinse which causes emulsification. (2) The solution of oil-soluble soap in organic solvent mixed with kerosene and water to form emulsion. One to 3 min contact with this and then spray rinse. Cost 2 cents per 100 sq ft. Metals which are to be plated require a treatment with alkaline cleaner after degreasing.

(105) Ether, Alkylated, Phenolic (For Cleaning Aircraft), Navy Aeronautical Specification RM-70, February 7, 1938.

Evaluation of interfacial tension, deflocculation of Norit carbon, stability, and panel tests with aluminum alloy sheet.

(106) F. K. Savage, "Alkaline Cleaners and Wetting Agents," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 35, pp. 445-450 (1938).

Alkalinity should be closely controlled. Has been found that zinc and aluminum are attacked rapidly above pH of 10, tin above 11, brass above pH of 12 to 12.5, depending upon composition, and that iron high in silicon may be pitted above pH 13. Mentions use of wetting agents in cleaners to increase the speed, efficiency, and free-rinsing characteristics of cleaners without undesirable properties of the soaps. The efficiency of wetting agents is determined by the drop method.

1939

(107) Valborg Aschehoug and Rolv Vesterhus, "Detergents for Aluminum," *Tidsskrift for Hermetikindustri (Norwegian Cannery Export Journal)*, Vol. 25, pp. 62-65 (1939); *Food*, Vol. 8, p. 292 (1939); *Journal, Inst. Metals*, Vol. 6, July, 1939, p. 271.

An investigation was made of four solutions regarding their suitability as bactericidal agents in the cleaning of aluminum. A mixture containing 23.6 per cent sodium carbonate, 22.8 per cent trisodium phosphate, 23.6 per cent sodium silicate, and 30.2 per cent water was found to have the strongest bactericidal action in 0.5 to 1.0 per cent solutions at 50 C in 5 to 10 min. Equally good results were obtained with a mixture containing 15.1 per cent sodium hydroxide, 6.3 per cent sodium carbonate, 26.1 per cent sodium silicate and 52.5 per cent water. Two other detergents tested were inferior.

(108) Bennett (Hyde) Ltd., "Degreasing Metals," *British Patent No. 516,218*, December 28, 1939.

The metal surface is first wetted with a solution of a soap-forming substance dissolved in a suitable grease solvent, and the thus wetted surface is treated with an aqueous solution of a suitable saponifying agent, preferably in hot condition, to form

as a reaction product in situ a soap. The surface is then rinsed with water to emulsify and wash away the grease film and the grease solvent.

(108A) D. J. Benoliel, "Preliminary Study of Wetting Agents in Ground-Coat Enamels," *Bulletin, Am. Ceramic Soc.*, Vol. 18, pp. 353-354 (1939); *Chemical Abstracts*, Vol. 33, p. 9570 (1939).

No indication of increased wetting power was noted from the addition of such agents. Because wetting agents affect the set, their use would require special set-up additions in ground-coat milling, but they do not appear to affect firing, bond, or boiling tendency of ground coat.

(109) Robert H. Brown and Robert B. Mears (to Aluminum Company of America), "Composition for Cleaning Aluminum," U. S. Patent No. 2,316,219 application, April 22, 1939.

A dry, water-soluble, aluminum-surface cleanser for use in aqueous solution, said cleanser being characterized by an acidic cleansing reaction in said solution and consisting substantially of an alkali metal fluoride and metaphosphoric acid, the latter being the major component and the principal active cleansing agent.

(110) Robert H. Brown and Robert B. Mears (to Aluminum Company of America), "Composition for Cleaning Aluminum," U. S. Patent No. 2,316,220 application, April 22, 1939.

This comprises a mixture of alkali metal fluoride and ammonium dihydrogen phosphate.

(110A) L. C. Camel, "Alkaline Cleaning as It Affects the Plating Industry," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 26, pp. 777-785 (1939); *Chemical Abstracts*, Vol. 34, p. 327 (1940).

A review.

(110B) F. W. Curtis, "Finishing Touches to Metal Office Equipment," *Products Finishing*, Vol. 3, No. 5, pp. 14-17 (1939); *Chemical Abstracts*, Vol. 33, p. 2463 (1939).

Description of degreasing with trichloroethylene and carbon tetrachloride.

(111) W. L. Davies, "Dairy Detergents," *Dairy Industry*, Vol. 4, No. 1, pp. 3-6 (1939).

The analyses of 11 dairy detergents are given. Four of these contain colloidal materials, all contain NaOH and Na_2CO_3 , and many contain Na_2SO_3 or Na_3PO_4 , or both. Soda ash is the constituent contained in greatest percentage in most of the detergents. Analytical procedures are given for determining these various alkaline materials in the presence of the others.

(111A) W. B. Harris, C. B. Ford, F. A. Patty, and T. Hatch, "Safe Operation of Degreasing Tanks Using Trichloroethylene," *American Journal of Public Health*, Vol. 29, pp. 603-614 (1939); *Chemical Abstracts*, Vol. 33, p. 5543 (1939).

(112) C. C. Hermann and R. W. Mitchell, "Cleaning of Metals," *The Iron Age*, Vol. 144, July 6, 1939, pp. 48-50.

Aluminum, zinc, and soft metal alloys must be cleaned in alkaline solutions of low pH to avoid corrosion, at a pH value lying between 9 to 10.5. Brass must not be cleaned at a pH over 12.5 to avoid heavy tarnish.

(112A) A. W. Hotherhall, "Notes on the Adhesion of Electrodeposited Metals to Steel," *Proceedings, Am. Electroplaters' Soc.*, Vol. 27, pp. 1-7 (1939); *Chemical Abstracts*, Vol. 34, p. 1918 (1940).

Adhesion of coatings to basis metal due to atomic forces as evidenced by continuation of crystal structure of basis metal by electrodeposited coating. Thin oxide film on cleaned steel does not necessarily prevent good adhesion, but lack of good cleaning may cause poor adhesion of nickel coating. A low degree of adhesion can result from weakened surface structure as by machining or polishing.

(113) F. Juraschek, "Metal Cleaning and Finishing Economics," *The Iron Age*, Vol. 143, January 26, 1939, pp. 21-28, 48.

There is no sharp line between cleaning and finishing. Gives a guide showing nine separate steps. Under the cleaning step he lists 12 methods: (1) wiping (by hand or machine), (2) brushing (by hand or machine), (3) sand blasting, (4) tumbling, (5) hydraulic spraying, (6) steam gun spraying, (7) dipping in still tank, (8) machine washing, (9) electrolytic cleaning (anodic and cathodic), (10) continuous acid or alkaline dip, (11) vapor degreasing (trichloroethylene), and (12) volatile degreasing (carbon tetrachloride).

(113A) I. Langmuir and V. J. Schaefer, "Properties and Structure of Protein Monolayers," *Chemical Reviews*, Vol. 24, pp. 181-202 (1939).

Discussion of preparation and measurement of thickness and other properties of protein monolayers. Also includes measurements of oxidized oil and piston oils showing the relationship of color to pressure of their films.

(114) "Cleaning Aluminum Alloy Components Prior to Painting and Enameling," *Light Metals*, Vol. 2, July, 1939, pp. 246-248.

The foreign matter to be removed may consist of one or more of the following: (1) mineral oil blanking lubricant, (2) pure

oil of a compounded type used in drilling and tapping, or on automatic screw machines, (3) soap emulsions used in milling, blanking, pressing, etc., (4) heavy soap-base drawing compounds, utilized in heavy press work, (5) swarf, and (6) general dust and dirt.

Generally speaking, hand cleaning is effective for the removal of all these forms of contamination; solvent vapor can efficaciously remove (1) and (2), while a combination of solvent liquor and vapor is suitable for (5) and (6). Solvent spray in conjunction with vapor will remove (3) and (4) in restricted circumstances. Alkali solutions are in all cases effective in immersion systems and, with some reservations, in spray machines. A combination of solvent and alkali processes applied in two stages often affords an economic solution to many problems. Practical notes are presented and laboratory test data are given relating to various types of cleaning agent.

(114a) W. Machu, "Electrolytic Cleaning, Especially Pickling of Metal Parts," *Korrosion u. Metallschutz*, Vol. 15, pp. 105-122 (1939); *Chemical Abstracts*, Vol. 33, p. 7203 (1939).

Extensive patent review with 39 references.

(114A) S. J. Miller, B. Sway, and E. P. Breckel (to du Bois Soap Co.), "Detergent Compositions Suitable for Use on Floors, Engine Blocks, etc.," U. S. Patent No. 2,162,023, June 13, 1939; *Chemical Abstracts*, Vol. 33, p. 7443 (1939).

A free-flowing granular detergent composition is formed comprising water-soluble fatty acid soap, cresylic acid, diethylene glycol, trisodium phosphate, sodium metasilicate, sodium carbonate or caustic soda, and an absorbent earth, the intercomponent ratio between the diethylene glycol and cresylic acid and absorbent earth of the composition being from 1:1.5 to 1:4.20 parts, respectively.

(115) W. Mohr, et al., "Efficiency of Various Detergents and Chemical Sterilizers in the Dairy and Action on Metals and Alloys," *Proceedings, Eleventh World's Dairy Congress, Berlin*, pp. 489-494 (1938); *Journal, Inst. Metals*, Vol. 6, January, 1939, p. 10.

Three types of detergents were studied: (1) sodium hydroxide-sodium carbonate, (2) those containing trisodium phosphate, and (3) those containing organic disinfectants. Solution concentrations of 0.5 to 2.0 per cent of these with small amounts (up to 10 per cent) trisodium phosphate and sodium silicate possessed effective sterilizing action. Proprietary preparations containing sulfonated soaps are effective as 0.1 per cent solutions. The sodium hydroxide-sodium carbonate solutions attacked copper alloys,

copper, zinc, and iron slightly even in the presence of the following ions: CrO_4^{--} , PO_4^{---} , and SiO_3^{--} . Aluminum was badly pitted by such solutions.

(116) R. M. Nepomnyashchaya, "Degreasing Articles Made of Light Alloys," *Novaya Tekhnol. v. Aviastroeniil Pervoe Glavnoe Upravlenie NKAP, Kabinet Obmena Opytom po Novoi Tekhnol. i Organizatsii Proizvodstva*, No. 4, pp. 20-23 (1939); *Khimicheskii Referativnyi Zhurnal*, No. 2, p. 88 (1940).

Conditions for degreasing light alloys before anodic polarization are selected. The use of organic solvents is not recommended; they are expensive, poisonous, and form a film on the metal not readily washed off. The etching of light alloys in 10 per cent NaOH solution at 60 C, followed by etching in strong HNO_3 , does not ensure degreasing. NaOH solution possesses a greater degreasing ability than do its mixtures with phosphates. Nepomnyashchaya recommends 5 per cent $\text{NaPO}_3 \cdot 12\text{H}_2\text{O}$ + 3 per cent Na_2SiO_3 + 1 to 2 per cent NaOH; 50-60 C for 5 min. The proposed method produced a minimum loss of weight of the sample. The effect of the degreasing bath was verified under plant conditions.

(116A) H. Prelinger, "Electrolytic Descaling," *Korrosion u. Metallschutz*, Vol. 15, pp. 374-380 (1939); *Chemical Abstracts*, Vol. 34, p. 3186 (1940).

Review of principles and technical features of cathodic descaling methods, especially the Bullard-Dunn and Tainton processes. Anodic descaling of alloy steel briefly discussed.

(116B) V. P. Sacchi, "Electrolytic Degreasing with Simultaneous Deposition of a Metallic Film," *Industria meccanica*, Vol. 21, pp. 117-123, 215-219 (1939); *Chemical Abstracts*, Vol. 33, p. 5294 (1939).

Degreasing of metals in alkali cyanide bath prior to electroplating, depositing simultaneously copper and/or cadmium. Advantages claimed are: (1) use of cold baths, (2) better throwing power, (3) better control of the degreasing process, (4) passivation of ferrous metals greatly retarded. Degreasing bath may be applied to many other metals and alloys.

(116C) V. P. Sacchi, "Cupro-Cleaning, Electrolytic Degreasing with Simultaneous Formation of Metal Coating," *Korrosion u. Metallschutz*, Vol. 15, pp. 321-339 (1939); *Chemical Abstracts*, Vol. 34, p. 3186 (1940). See Reference 116B.

(117) F. W. Smither, "Washing, Cleaning, and Polishing Materials," Circular No. C424, Nat. Bureau Standards, 63 pp. (1939).

An excellent description of the present-day cleansing agents. Discusses metal pol-

ishes and gives formulas, one of which includes orthodichlorobenzene as an ingredient. Numerous literature references and Federal specifications are listed.

(118) V. E. Tartakovskaya and N. B. Ivanova, "New Methods of Testing Degreasing of Metals," *Zavodskaya Lab.*, Vol. 8, pp. 874-875 (1939); *British Chemical Abstracts*, B1, p. 32 (1944); *Journal, Inst. Metals*, Vol. 12, p. 304 (1945).

Iron and aluminum objects are dipped in 3 per cent copper sulfate, and zinc in 0.1 per cent copper sulfate solution, as a result of which a coating of copper forms on the surface except where protected by grease. Copper and brass similarly treated with 3 per cent mercuric chloride. Smallest traces of grease such as fingerprints are revealed in this way.

1940

(119) Compound, Cleaning: Aircraft, Air Corps Specification 20015-B, October 12, 1940.

Tests compound with 24S-T aluminum alloy for corrosion resistance, cleaning power against a composition comprising asphalt, aircraft engine oil, kerosene, xylene, and powdered rottenstone which is baked at 143 to 150 C for 3 hr. Also includes a rinsing test.

(119a) D. J. Benoliel, "Laboratory Control of Drawing Compounds on Porcelain Enamel Metals," *Bulletin, Am. Ceramic Soc.*, Vol. 19, pp. 259-261 (1940); *Chemical Abstracts*, Vol. 34, p. 5611 (1940).

No abstract, presumably a review.

(119A) Clete L. Boyle, "Treating Iron or Steel Surfaces," *British Patent No. 517,916*, February 13, 1940; *Chemical Abstracts*, Vol. 35, p. 7219 (1941).

Method for subjecting oxide coating to mechanical treatment to remove loose material, leaving a coating which adheres tightly, then treating with aqueous phosphoric acid and wetting agent and allowing to remain until dry. Phosphoric acid used in amount sufficient to convert oxide coating to phosphate coating.

(120) A. P. Chachin and N. T. Kuptsova, "Electrolytic Cleaning of Gasoline-Engine Valves," *Aviapromyshlennost*, No. 11-12, pp. 77-78 (1940); *Khimicheskii Referativnyi Zhurnal*, Vol. 4, No. 6, p. 93 (1941); *Chemical Abstracts*, Vol. 37, p. 6564 (1943).

The scale formed on valves of motors with antiknock fuel contains lead compounds. These can be electrolytically removed in a bath containing 1 kg of caustic soda and 116.6 g of soda ash per liter at 135 to 145 F. The valve is first degreased in gasoline, then cathodically cleaned for 5 to 10 min,

and finally anodically cleaned for 10 sec at 6 amp and 6 v.

(121) T. K. Cleveland, "Solutions for Metal Cleaning," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 27, pp. 432-442 (1940); *Chemical Abstracts*, Vol. 34, p. 6731 (1940).

Sodium silicate is recommended for cleaning zinc and aluminum because it attacks these metals to a lesser extent than other alkaline cleaners.

(122) Cowles Metal Cleaning Tips, June, September, November, 1940.

Factors determining the efficiency of metal cleaning products are as follows: (1) alkali action—pH or alkaline activity which determines chemical classification, total alkalinity for neutralization and saponification, detergent pressure which is the combined effect of total alkalinity and pH, (2) colloidal action—colloidal dispersion and peptization action, adsorption of dirt, (3) anion action, (4) conductivity, (5) solvent action, (6) wetting action, (7) emulsifying action, (8) rinsing ability, (9) stability under conditions of use, and (10) safety. Cleaners are classified as follows:

Strongly alkaline—pH 11.6 and above.

Moderately strongly alkaline—alkali of pH 11.0 to 11.5 which are suitable for brass, copper, and some of the white metal alloys. Also effective on certain types of dirt on steel and iron.

Moderately alkaline—pH 10.9 to 10.4. These detergents are particularly suitable for cleaning aluminum and washing painted surfaces.

Mildly alkaline—pH 10.3 and below. Detergents have very little use in metal field. pH measured for classification of alkaline metal cleaners by determination of pH of 0.01N solutions on the basis of Na_2O (0.031 per cent Na_2O) at 25 C, that is, determination of per cent total Na_2O and then divide into the factor 3.1 to determine the number of grams per 100 ml water.

An effective aluminum cleaner should possess the following characteristics: (1) alkaline action should be optimum for the metal, (2) colloidal action is highly desirable, (3) solvent and wetting action on soil should be high, (4) emulsifying action is of prime importance, (5) rinsing ability should be good particularly where metal is subsequently to be anodized, (6) should be safe to the metal and safe to the hands, (7) should possess good solubility, and (8) should be economical.

Conductivity in electrocleaning is important because more rapid gas release takes place at both anode and cathode causing corresponding increase in the scrubbing action. This current-carrying capacity is of greater importance in cleaning steel than with brass and softer metals where demand for vigorous action is less.

(123) H. G. H. Crowther, "Degreasing of Metal Parts—Use of Aqueous Solutions," *The Metal Industry* (London), Vol. 56, pp. 23-25 (1940).

The principles of the alkaline degreasing of metals are discussed. A successful degreasing solution must be capable of wetting the surface, reducing the interfacial tension between the greasy deposit and H_2O , and emulsifying and deflocculating the deposit. It must also be susceptible of easy removal from the work by rinsing after degreasing is completed.

(124) H. L. Cupples, "A List of Commercially Available Detergents, Wetting, Dispersing, and Emulsifying Agents," *Bulletin E-504*, U. S. Dept. of Agriculture, 56 pp., June, 1940.

Over 300 commercial agents are listed with, wherever available, a description of the agent, its chemical composition, and surface properties.

(125) The Griffith Laboratories, Ltd., "Metal-Cleaning Detergent," *Canadian Patent No. 388,542*; *Soap*, Vol. 16, p. 65 (1940).

An alkaline composition for inhibiting corrosion and cleaning zinc, iron, and tin ware at temperatures varying from cold to boiling consists of about 85 per cent of water-soluble inorganic alkaline detergent such as soda ash and trisodium phosphate, 5 to 6 per cent of a solid hypochlorite, and 9 to 10 per cent of a water-soluble zinc salt.

(126) E. E. Halls, "Efficient Trichloroethylene Degreasing," *Metal Treatment*, Vol. 6, pp. 131-133 (1940); *Chemical Abstracts*, Vol. 35, p. 6903 (1941).

Attention is given to the following points for efficient operation: low running costs, good cleaning, and high production rates, solvent degreasing can be the cleanest, most rapid, efficient, and safest of cleaning operations. Choose the best stabilized solvent. In design of plant consider mode of heating, recovery of solvent, escape of vapor, and adequacy of cooling. Select vapor or liquor according to the class of work. Operate fully loaded so that inevitable solvent losses occur with maximum work. Study the mode of packing the work. Have men work in fresh rather than solvent-laden air.

(127) Jay C. Harris, "Chemical Evaluation and Control in Metal Cleaning," *Proceedings, Am. Electroplaters' Soc.*, 5 pp. (Preprint) (1940); *Chemical Abstracts*, Vol. 34, p. 7237 (1940).

The necessity for performance tests is emphasized. Titration and pH values are useful for control of acid and alkaline baths. Determination of the amounts of mineral oil or lanolin emulsified by a given concentration of agent in water. Sedimentation tests used as aid in determination of the point

where baths are overloaded. Visual tests such as "waterbreak" and swabbing the dried metal surface with tissue paper are useful. Electrolytic cleaning methods suggest the determination of current consumption to obtain unit cleanliness.

(128) Huntley and Palmers, Ltd., "Cleaning and Degreasing Tins," *British Patent No. 528,347*, October 28, 1940; *Chemical Abstracts*, Vol. 35, p. 7590 (1941).

Electrolytic bath for immersion, containing an electrolyte consisting of a mildly alkaline solution with a pH not exceeding 8 and conveniently prepared from disodium phosphate with the addition of casein.

(129) Jan Korecky, "Chemical Methods of Finishing the Surfaces of Metals," *Chemicky Obzor*, Vol. 15, pp. 178-180 (1940); *Chemisches Zentralblatt*, Vol. 112, II, 1200 (1941); *Chemical Abstracts*, Vol. 38, p. 1999 (1944).

Objects to be treated chemically to provide surface finish must first be thoroughly cleaned and these methods of cleaning are described.

(129A) B. F. Lewis, "The Relation of Cleaning Technics and Adhesion of Electrodeposits," *Proceedings, Am. Electroplaters' Soc.*, Preprint, 7 p., 1940; *Chemical Abstracts*, Vol. 34, p. 6172 (1940).

Anodic cleaning frequently produces better adhesion of electrodeposits than does cathodic. This is attributed to diffusion layers that have been subjected to hydrogen in casting or copper coating. Adhesion is improved by preparatory treatments that caused copper to follow crystal orientation of the basis metal.

(129B) J. G. Magrath, "Flame Cleaning, Dehydrating and Descaling," *Heat Treating Forging*, Vol. 26, pp. 217-221, 235-236 (1940); *Chemical Abstracts*, Vol. 34, p. 6916 (1940).

Discussion of oxyacetylene process for flame cleaning. Loosens scale and dehydrates the surface, which is primed before recondensation of moisture can take place.

(130) "New Aluminum Cleaner," *Metal Finishing*, Vol. 38, August, 1940, p. 446; *Light Metals Bulletin*, Vol. 2, September 5, 1940, p. 204.

A new proprietary aluminum cleaner, "Cowles AE," is described. Is a mildly alkaline cleaner designed to prevent corrosion of non-ferrous metals. Use 3 to 6 oz per gal of water. For mirror-finished aluminum surfaces for 1-hr exposure at the boil, this shows no visible corrosive effect.

(131) E. W. Myers, "Trichloroethylene Degreasing," *American Mutual Magazine*, Vol. 19, pp. 2-8 (1940); *Review of Current Literature Relating to Paint, Colour, Var-*

nish & Allied Industries, Vol. 14, p. 166 (1941); Chemical Abstracts, Vol. 35, p. 6349 (1941).

A discussion of principles involved in the proper design of equipment of using and controlling the toxic trichloroethylene vapors.

(131A) "Compound, Cleaning and Detinning," Naval Aircraft Factory, Specification C-97, June 7, 1940.

Compound to be used electrolytically and to be free from starch, rosin, soap, abrasive, and insoluble or inert filler. Intended for electrolytic cleaning after vapor degreasing and as electrolytic detinner in lieu of trisodium phosphate or caustic soda solution. Specification includes total alkalinity, silica, surface tension, separation in solution, jelling character, pH, and electrical conductivity and rinsing properties.

(132) "Metal Surface Cleaners," Product Engineering, Vol. 11, p. 359 (1940).

Brief methods of cleaning and trade-named preparations for aluminum and aluminum alloys, bronze, copper, zinc, cadmium, and zinc-base die castings.

(133) H. Schuller, "Cleaning and Degreasing of Metals with Detergents," Metallwirtschaft, Vol. 19, November 29, 1940, pp. 1101-1102.

Comparisons are made between inorganic and organic compounds for the cleaning of metals. A new inorganic cleanser known as Henkel P₃ is described. It is claimed that one of its advantages is the cutting down of surface tension.

(134) Verein für Chemische und Metallurgische Production, "Removal of Beer-Scale, Milk-Scale, and Similar Calcareous Deposits from Pasteurizing and Cooling Machines and Piping," German Patent No. 694,237, June 27, 1940.

A dilute solution of tartaric acid, tartrates, or a mixture of both, having a pH of 2 to 4 is very effective in removing the scales. To it may be added phosphoric, lactic, or citric acid, or their salts. This cleaning solution does not attack metals.

(134A) W. N. Witheridge and H. T. Walworth, "Ventilation of a Trichloroethylene Degreaser," Journal, Ind. Hyg. Toxicology, Vol. 22, pp. 175-187 (1940); Chemical Abstracts, Vol. 34, p. 4179 (1940).

Trichloroethylene does not "roll over" the edge of the degreaser, and horizontal slot-type ventilation is necessary.

1941

(135) J. R. Akers and R. B. Mears, "Cleaning Aluminum," Soap, Vol. 17, pp. 25-27, 71-74 (1941).

Knowledge of the behavior of aluminum is based upon the characteristics of the thin protective oxide film present upon all aluminum exposed to the atmosphere. It is usually the case that substances having no effect upon the oxide likewise have little or no effect upon the metal. Presence of oxygen actually protects aluminum in contrast to other metals. Halogen salts of the alkali metals, particularly in the presence of minute amounts of Cu, Sn, or Ni compounds cause localized attack. Inhibitors for corrosive salt solutions are sulfonated oils or sodium chromate. Sodium hexametaphosphate is a useful inhibitor in waters containing dissolved heavy metal salts. Inhibitors in alkaline solutions are sodium disilicate and sodium silicofluoride. Corrosion by tap water often produces a brown to black, closely adherent film. This optical effect is due to etching of the metal. Dark coatings are also formed when uninhibited alkaline cleaners are used, these comprising precipitated iron, copper, and possibly silicon, which were present in the aluminum alloy being cleaned. When cleaning aluminum, for certain purposes, compounds or chemicals which will uniformly remove small amounts of metal are often useful, but also important to have available detergents which will injure neither the finished article nor metal in process.

Classified cleaners as: "Safe"—those useful upon bare or Alumilite-coated surfaces in any concentration without injury to the surface. Solvents such as toluene, naphtha, and kerosene are in this group, as well as stabilized chlorinated hydrocarbon solvents and even aqueous solutions of ordinary soaps or alkaline detergents. Soda ash or trisodium phosphate can be placed in this class when sufficient corrosion inhibitor is added. Water or organic solvent solutions of many of the newer synthetic soaps, wetting agents, or sulfonated oils are usually in this class, especially if a small amount of a suitable inhibitor is added.

"Partially safe"—those cleaners which will injure bare or Alumilite-coated metal under some conditions but may safely be used in a fairly wide range of concentrations.

"Harmful cleaners"—those which are used to remove uniformly small amounts of metal from the surface of the aluminum. These cleaners may be either chemical solutions which etch or dissolve surface layers or abrasive pastes or powders which remove surface layers by mechanical action. Most common etching type are hot, dilute NaOH solutions. Usual surface-renewing treatment employs a solution containing 10 per cent nitric acid plus 1 per cent HF at room temperature. Another contains 10 per cent sulfuric acid and 1 per cent NaF at room temperature.

(136) Compound, Cleaning; For Painted Surfaces, Bureau of Ships Ad Interim Specification 51C20 (INT), March 15, 1941.

Tests include measurement of reduction in gloss of painted panels and the photometric measurement of cleaning efficiency utilizing a special washability apparatus. A standard soil comprising metallic brown, kerosene-carbon tetrachloride, Nujol, forced-feed lubricating oil, and hydrogenated vegetable shortening is applied to panels, baked at 100 to 105 C for 1/2 hr.

(137) "Armco Paintgrip," American Rolling Mill Co., Middletown, Ohio, p. 14 (1941).

Removal of lubricant by (1) vapor degreasing, usually with trichloroethylene, (2) continuous spray cleaning with kerosene soap emulsion followed by hot water rinse, then a rinse in dilute chromic acid solution (1 lb per 100 gal). Or cleaning by combination soap emulsion spray and a mild alkali followed by same rinse, or (3) hand cleaning or dipping in organic solvent such as kerosene or benzene.

(138) A. M. Berkenheim and M. A. Berkenheim, "The Application of Emulsion from Shale Products for Cleaning Aluminum," *Aviapromyshlennost*, Vol. 4, No. 3, pp. 122-123 (1941); *Chemical Abstracts*, Vol. 37, p. 4675 (1943).

Concentrated emulsions of "avtol" and of machine oil were prepared using the sodium salts of shale sulfonic acids and this used to replace kerosene in the mechanical treatment of aluminum. The emulsions contain potassium dichromate as a corrosion inhibitor.

(139) George D. Collingridge, "Modern Detergents," *Chemical Age*, Vol. 44, pp. 151-152, 163-164 (1941).

A definite place for polyphosphates and synthetic detergents as well as the older alkalis and soap. Thoroughly discusses sodium metaphosphate, tetrasodium pyrophosphate, sodium metasilicate, and sodium sesquisilicate, sulfated and sulfonated detergents.

(140) J. B. Crowe, "Sulfated Fatty Alcohol in Metal Cleaning and Plating Baths," *Products Finishing*, Vol. 6, No. 2, pp. 56-59 (1941).

The use of lorol sulfate for metal cleaning, acid dipping and plating, as well as rinsing after plating, is discussed.

(141) Detergents, Special; (for Aluminum Ware, Dishwashing Machines, and Manual Cleaning), Federal Specifications P-D-236 (1941).

B-1 detergents for aluminum ware shall be of the following types and classes: Type I—detergent for use in mechanical dishwashing machine; Type II—detergent for

manual cleaning, Class A—Nonabrasive cleaner, Class B—Abrasive cleaner.

F methods of sampling, inspection, and tests. Methods are given in detail for the following: F-2b Type I, F-2b Type II, Class A, F-2c Foaming Type I, F-2d Water-softening capacity (Type I), F-2e Water-softening capacity (Type II), F-2f (1) Corrosion (Type I), F-2f (2) Corrosion (Type II), Class A, F-2f (3) Corrosion (Type II), Class B, F-2g Hydrogen-ion content and buffer index (Type I), F-2h Hydrogen-ion content (Type II, Class B), F-2 Abrasion (Type II, Class B), and F-2j Rinsability (Type II, Class B).

(142) Edward Finnie, "Cleaning Lead Castings Prior to Plating," *Products Finishing*, Vol. 5, No. 11, pp. 60-61 (1941).

Because of the present shortage of zinc for domestic use, the zinc-base die castings are being replaced by 12 to 14 per cent antimony-lead castings; this forces platers to change their cleaning cycle to meet the change in casting metal composition. Each of the following five cycles gives satisfactory results: (1) Degrease, clean cathodically in a mild cleaner at 70 C (changing the cleaner often), rinse, soak for 5 min in a 10 per cent NaCN solution at room temperature, transfer directly to a high-speed copper bath for 5 min at 35 amp per sq ft, rinse, acid dip, and nickel-plate. (2) Degrease, clean cathodically in a mild cleaner for 1 min, rinse, dip in 5 per cent by volume AcOH, rinse, copper-strike in a Rochelle salt copper bath at 2 v or less for 10 min, rinse, acid dip, and copper- or nickel-plate. (3) Wash in washing machine, clean anodically in a mild cleaner for 5 to 20 sec, rinse, dip in 3 per cent H₂SO₄ for 2 sec, rinse, copper-strike in a Rochelle salt bath at 10 amp per sq ft for 5 min, rinse, and copper- or nickel-plate. (4) Degrease, clean in a mild cleaner cathodically, rinse, reverse current in a 55 deg Bé bath in H₂SO₄ for 15 to 30 sec, rinse, and copper-strike for 15 to 30 sec at 5 v. (5) Clean cathodically, rinse, soak in hot water for 5 min, and transfer directly to nickel solution.

(143) F. W. Gilcreas and J. E. O'Brien, "Laboratory Studies of Methods for Cleaning of Eating Utensils and Evaluating Detergents," *American Journal of Public Health*, Vol. 31, pp. 143-150 (1941); *Chemical Abstracts*, Vol. 35, p. 2244 (1941).

Definition of an effective detergent for cleaning of eating, drinking, and cooking utensils resulting from this study is: a substance or compound soluble in water, which at a temperature of approximately 120 F will provide complete removal of all types of characteristic soiling material in a short period of time; will produce free-rinsing surface; will reduce to a minimum the formation of a film of precipitated mineral salts and similar substances on the

washed surface; and will function effectively in waters of varying hardnesses. Lists several soil formulas. Cleansing index set up, and detergents are classified as to cleansing ability.

(144) B. S. Haller, F. M. Grant, and C. J. Babcock, "The Corrosive Effect of Chlorine and Lye Solutions on Metals Used in Dairy Equipment," Technical Bulletin No. 756, U. S. Dept. of Agriculture, 27 pp., January, 1941.

Investigated aluminum and aluminum alloys containing magnesium and chromium, and an alloy of manganese and aluminum. Sodium hypochlorite and buffered sodium hypochlorite solutions had considerable corrosive effect upon aluminum and its alloys. Less corrosion was produced when Chloramine T was used. Aluminum tends to dissipate chlorine to the greatest extent of the many metals tested, when the solutions were contained in aluminum, or when the metal was immersed in the solution.

(144A) E. E. Halls, "Modern Nickel Plating. I, II," Machinist, (European Edition), Vol. 85, pp. 244-245E, 263E (1941); Metal Abstracts (Journal, Inst. Metals), Vol. 9, p. 20 (1942); Chemical Abstracts, Vol. 36, p. 5710 (1942).

Composition of cleaning baths for copper, brasses, and steels given.

(144B) E. E. Halls, "Bright Nickel Plating," Metal Treatment, Vol. 7, pp. 11-13 (1941); Chemical Abstracts, Vol. 35, p. 5798 (1941).

Stresses the necessity for careful cleaning of basis metal.

(145) G. Russell Hersam, "Efficient Cleaning for Better Metal Finishing," Industrial Finishing, Vol. 17, No. 7, pp. 34-36, 38, 40, 42, 44 (1941); Chemical Abstracts, Vol. 35, p. 4517 (1941).

General recommendations as to types and upkeep of equipment for most effective metal cleaning.

(146) Cleaner, Alkaline, Heavy Duty for Hot Tank Parts and Radiator Cleaning, Holabird Ordnance Motor Base Specification ES-382a, February 6, 1941.

Includes solubility and rinse tests.

(147) W. M. Humphrey and Robert E. Lee, U. S. Patent No. 2,257,960, October 7, 1942 (1941).

Relates to cleaning of aluminum cooking utensils and cleaning and removal of various oxides from the surface of aluminum and aluminum alloys. The composition is compounded from phosphoric acid, cryolite, and bentonite, the fluorine cleaning the surface.

(147A) C. Johnson, "Cleaning Composition Suitable for Use on Various Materials,"

U. S. Patent No. 2,250,379, July 22, 1941; Chemical Abstracts, Vol. 35, p. 7071 (1941).

A dry composition releasing hydrogen chloride when mixed with water. Comprises reaction product of urea sulfate and sufficient water-soluble metal chloride as sodium chloride to form urea chloride.

(148) P. D. Liddiard, "Alkalies in Cleaning Processes," Chemistry and Industry, Vol. 60, pp. 480-482, 684-688, 713-716 (1941).

General principles of cleansing and comparison of alkalies as to wetting and emulsifying agents, rinsability, and active alkali content. Mentions that the chemical action of alkalies on metals such as aluminum, zinc, tin, and a few others varies to a greater or lesser extent. Gives a table showing time for removal of mineral and vegetable oils from brass disks at varying temperatures and concentrations of alkali. Aluminum and its alloys require special consideration since they are readily attacked by NaOH and in fact by even mild alkalies such as borax. Silicates are used to overcome this difficulty, the formation of a molecular layer of hydrated silica against the metal surface preventing further attack. Considers alkalies according to the following analysis: (1) active and inactive alkali content, (2) buffering, (3) wetting and emulsification, (4) stability, (5) rinsing, (6) effect of agents with hard water, (7) colloidal properties, (8) miscellaneous special features, and (9) principal applications.

(149) Ernest H. Lyons, Jr., "Contamination and Electrolytic Cleaning of Cold Rolled Steel," Transactions, Electrochemical Soc., Vol. 80, pp. 367-386 (1941).

Electrolytic cleaning of oil and dirt from lengths of cold-rolled strip steel is of considerable commercial importance, not only before hot tinning but also preliminary to electroplating the strip. The author discusses solutions, details of design, and operating requirements. From a consideration of the cold-rolling operation, it is suggested that thermal decomposition of the coolant oils on the strip is responsible for the very resistant films sometimes noted; adsorption of fatty acids may also be troublesome. These contentions are supported by experimental evidence, by citing experiences in the rolling and electrolytic cleaning of such steel, by conclusions reached by an investigation in an English laboratory, and by analogies. The best conditions for the electrolytic removal of oil and dirt from the steel are indicated.

(150) P. Mabb, "Alkaline Cleaners for Cleaning Metal Components," Metallurgia, Vol. 23, pp. 81-83 (1941).

Properties of ideal alkaline cleanser are: (1) must be completely and easily soluble in

water; (2) effective at as low a concentration as possible; (3) should be chemically stable to heat and aeration; (4) must be capable of immediately wetting the article; (5) should possess high emulsifying power; (6) should have high deflocculating power; (7) should not attack the base metal to the detriment of the appearance, dimensions, or mechanical strength; and (8) should not produce vapors irritant to the operators.

Wise selection of cleaners is required for aluminum and aluminum-base alloys, tin, tin plate, soldered articles, zinc or zinc-coated metals, and zinc-base alloys.

Mentions 50/50 metasilicate-soda ash mixture in 1 to 2 oz per gal concentrations for machine cleaning of magnesium and aluminum-base alloys as well as copper, brass, steel, etc. For zinc-base alloys special procedures are resorted to, and electrolytic cleansers are used wherever practical, otherwise solvent cleansers are used. Typical cathodic process uses a solution of 4 1/2 oz trisodium phosphate and 1 1/2 oz metasilicate per gallon of water at the boil. Immersion time is kept to a minimum and current density adjusted to just cause free gassing over the surfaces. Work then water rinsed and pickled for a minimum immersion time (few seconds to 1 min) in cold 8 per cent hydrochloric acid solution.

(150A) F. A. Maurer, "Cleaning and Bright-Plating Iron and Steel Parts of Electric Irons," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 28, pp. 695-707 (1941); *Chemical Abstracts*, Vol. 35, p. 7837 (1941).

Lubricants and oils used in processing chosen with view toward easy removal. Anodic rather than cathodic cleaning used on automatic conveyors.

(151) O. M. Morgan and J. G. Lankler, "A Quantitative Method for the Evaluation of Metal Cleaning Compounds," *National Aniline Division, Allied Chemical and Dye Corp.* (1941).

Method of oiling metal.—Two- by 4-in. test strips are scrubbed in 0.050 per cent Nacconol NR solution at 110 F, rinsed in warm water, rinsed in alcohol, and allowed to dry. Strips of wood flannel 1 7/8 by 3 7/8 in. are saturated with mineral oil composition (containing Fluorescent Oil Green HW) as used in brass rolling. These strips are alternated with metal strips to form a stack with metal plates and protecting oil-saturated wool strips above and below the experimental strips. The stack of strips is placed in the hydraulic press, the edges of plates being carefully squared up. A pressure of 500 psi is applied and maintained until no more oil oozes from the edge of the stack, the edges being constantly wiped with a clean cotton cloth. The pressure is released and the stack removed and retained in perfectly horizontal position until taken

from the stack one at a time for cleaning experiments. Oil adhering to the surface of the metal does not vary more than 3 per cent by weight.

Method of cleaning.—A soaking operation was used. The strips were suspended from hooks into 800 ml of solution at constant temperature in one-liter beakers. Metal strips are withdrawn, rinsed for one minute in running water at 100 F, and then air dried.

Method of recording.—The strips are either examined visually or photographically under ultraviolet light. The remaining oil (and fluorescent dye) fluoresces under this light in proportion to the amount remaining on the surface. Using a Hanovia Analytic Model Quartz Lamp situated 30 in. from the strips and incident to the surface of the subject at an angle of 45 deg, a camera is equipped with a Wratten K-2 filter, Tri-X film and a picture is taken at f 4.5 with 10-min. exposure. The film is developed using DK-60A for maximum contrast.

(152) O. M. Morgan and J. G. Lankler, "Improved Aluminum Cleaning with Nacconol NR," *National Aniline Division, Allied Chemical and Dye Corp.* (1941).

A 95-5 mixture of sodium metasilicate and Nacconol NR gives optimum removal from aluminum of a mineral oil composition such as that used in brass rolling. Technique used is described in "A Quantitative Method for the Evaluation of Metal Cleaning Compounds" by these authors. See Reference 151.

(153) Compound, Paint Stripping (Silicate Type), *Navy Aeronautical Specification C-67d*, September 23, 1941.

Tests include stripping and rinsing properties.

(154) Compound, Paint Stripping, Non-inflammable, *Navy Aeronautical Specification C-113*, September 22, 1941.

Tests include stripping properties and corrosiveness.

(155) M. E. Parker, "Role of Acid Cleaning Agents in Dairy Detergency," *Milk Plant Monthly*, No. 9, pp. 49-52 (1941).

Alkaline detergents have certain disadvantages when used for churn washing; for example, they give rise to the formation of milk stone, which acts as a nutrient medium with consequent survival of proteolytic and oxidative bacteria. Even when such churns contain large numbers of acid producers, the foul odors are definitely of proteolytic origin. The action of gluconic and levulinic acids injected with the steam into churns previously washed with a reliable alkaline proprietary detergent is definitely superior to that of the alkaline detergent alone. Organic acids such as these give pH 6.0 to 6.5

in the churn, with negligible corrosion. High counts of spoilage bacteria were suppressed, odors eliminated, and clean surfaces obtained.

(155A) N. E. Promisel, "Solvent-Degreasing and Health," *Products Finishing*, Vol. 5, No. 5, pp. 48-57 (1941); *Chemical Abstracts*, Vol. 35, p. 2241 (1941).

Use of trichloroethylene and proper equipment design indicate no health hazards in solvent degreasing.

(156) E. Rausser, "Electrocleaning of Metals," Swiss Patent No. 215,410, September 16, 1941; *Chemical Abstracts*, Vol. 42, p. 3683 (1948).

Clean metallic surfaces are obtained on metal objects by spraying them with clean electrolyte, the workpiece forming one electrode and the clean electrolyte the other. After striking the workpiece the electrolyte flows to a sump where it passes through a filter, to be recirculated by pumping back through the spray nozzle.

(157) Raymond R. Rogers, "Preparing Metal Surfaces for Electroplating," *Canadian Chemistry and Process Industries*, Vol. 25, pp. 7-10 (1941); *Chemical Abstracts*, Vol. 35, p. 2075 (1941).

Best results obtained by removal of about 95 per cent of the grease and solid particles by solvent, and the remainder by treatment in an aqueous alkaline solution, preferably with the work either as anode or cathode, conditions for which are outlined.

(158) G. Rogner, "Cleaning and Degreasing of Metals Before Applying Organic or Inorganic Coatings," *Korrosion und Metallschutz*, Vol. 17, No. 6, pp. 204-207 (1941); *Journal, Inst. Metals*, Vol. 10, p. 159 (1943).

Elementary account of the principles and methods for degreasing and cleaning metal surfaces with organic solvents, alkaline degreasing baths, electric cleaners, and mechanical methods.

(159) Paul A. Salz, "Liquid Cleansing Composition Suitable for Use on Metals, Glass, etc.," U. S. Patent No. 2,245,052, June 10, 1941; *Chemical Abstracts*, Vol. 35, p. 6026 (1941).

A mixture of glycerol 0.125, oxalic acid 5.625, potassium chromate 0.25, and water 94 per cent.

(160) Lewis Shere, "Factors Causing and Methods of Preventing Milkstone Formation," *Milk Dealer*, Vol. 30, No. 6, March, 1941, pp. 33, 56-64.

After discussing briefly the causes of milkstone formation, its control is considered from two angles: (1) that of minimizing the formation, and (2) proper steps for removing the deposits. General recommenda-

tions are made, since different kinds of equipment require different types cleansers.

(161) W. F. Sherman, "Metal Cleaning," *The Iron Age*, Vol. 148, July 24, 1941, pp. 38-40.

A description is given of Kolene Cleaner (Kolene Corp., Detroit, Mich.) which is a molten bath process of catalyzed salts. The action of the cleaner is the oxidation of all materials on the surface to a readily removable substance. The first action is degreasing by oxidation and the second is conversion of insoluble scale to the soluble state.

(162) Z. I. Shneiderman and G. B. Rozenboim, "Chemical Degreasing and Phosphatization of Boiler Tubes," *Sudostroenie*, Vol. 11, pp. 171-173 (1941); *Chemical Abstracts*, Vol. 35, p. 7601 (1941).

Experiments have shown that tubes having films of oxides can be degreased and phosphated successfully by cleaning in steam at 3 to 5 atmospheres with caustic soda and trisodium phosphate.

(163) Solvay & Cie., "Mixture for Degreasing," French Patent No. 861,366, February 7, 1941; *Chemical Abstracts*, Vol. 42, p. 6024 (1948).

A mixture of chlorinated aliphatic hydrocarbon having no more than six carbon atoms, and a ketone corresponding to the alcohol is used for degreasing. Waxes to give the metal a protective coating, or soap, or sulfonated alcohols can be added. The solvent mixture may be used directly in an aqueous emulsion.

(164) Wm. Stericker, "Use of Silicates as Corrosion Inhibitors," *Proceedings, Am. Water Conf., Engineering Soc. of Western Pa.*, Vol. 2, pp. 59-69 (1941); *Chemical Abstracts*, Vol. 38, p. 6267 (1944).

The history and mechanism of silicate protection are discussed.

(165) Paint, Stripper, Alkali, Tank-Automotive Center, Tentative Specification ES-No. 452a, February 6, 1941.

Tests include surface tension, hydrogen-ion concentration, rinsing, solubility, and stability.

(166) J. F. J. Thomas, "The Effect of Dishwashing Compounds on Aluminum," *Canadian Journal of Research*, Vol. 19, No. 7, p. 153 (1941).

Several proprietary dishwashing compounds in 0.5 per cent solution were found to appreciably attack commercial aluminum and aluminum utensils. Curves are shown to illustrate this attack, also the corrosive action on commercial aluminum (2S 1/2 H) of 0.5 per cent aqueous mixtures, in various proportions, of the salts usually present in such compounds. Sodium metasilicate was

found to be a more effective inhibitor than either trisodium phosphate or sodium pyrophosphate. Replacement of soda ash by either trisodium phosphate or sodium pyrophosphate so as to give a final soda ash content of 40 to 45 per cent was required before less sodium metasilicate than about 20 per cent produced inhibition of attack. The author concludes that the addition of about 25 per cent sodium metasilicate to such proprietary compounds is advisable.

Technique.—Immersion of panels in aqueous 0.5 per cent solutions at $60 \pm 2^\circ\text{C}$ for 60 min. Ratio of area of exposed metal to the volume of test solution was generally 2 sq dm per liter. Panels etched 2 min in an aqueous 10 per cent NaOH solution prior to testing. Loss in weight determined. Discoloration of panels gave no indication of degree of attack.

1942

(167) "Magnesium Data," American Magnesium Corp., September 1, 1942.

After machining and prior to coating or painting, magnesium can be cleaned with solvents or hot alkaline cleaners. Compounds containing mineral or organic acids are to be avoided. Mild cleaners for aluminum may be used, but steel cleaners are more rapid and efficient.

Suggested formulation follows: 3 oz soda ash, 2 oz NaOH, 1 oz soap, and water to make 1 gal.

This formulation should be used boiling hot and the work should be rinsed thoroughly to remove soap. For cleaning parts already coated, the use of organic solvents or soap-free alkali solutions is recommended.

(168) "Proposed Methods of Chemical Analysis of Industrial Metal Cleaning Compositions," Proceedings, Am. Soc. Testing Mats., Vol. 42, pp. 407-422 (1942).

Suggested methods of analysis are proposed as a means for chemical evaluation and control of cleaning compositions.

(169) Tentative Standards and Recommended Practices and Procedures for Spot Welding of Aluminum Alloys, Am. Welding Soc. (1942).

Surfaces may either be mechanically or chemically cleaned. The first step is removal of extraneous soil followed by removal of the resistance film of oxide so that uniform contact resistance will ensue, providing controlled extent of fusion. Removal of extraneous soil may be accomplished by degreasers or alkaline cleaners. Oxide film may be removed, preferably by acids, since the operation can be controlled more closely than by using caustic soda.

(170) Compound, Carbon Removal (for Engine Parts), Army Air Force Specification 20025, June 15, 1942.

Carbon removal test from a portion of a carbon-covered aircraft engine piston, and a corrosion test.

(171) "Metal Cleaning as of To-day," Automotive and Aviation Industries, Vol. 86, April 1, 1942, pp. 44, 70-75.

"W.P.B. No. 399" release is interpreted as a warning that an impending shortage of chlorinated solvents may make a decided difference in metal cleaning processes in war production plants. The following recommendations are made:

1. W.P.B. release suggests that about 30 per cent of the cleaning operations now being done with chlorinated solvents could be accomplished with the use of other commercially available cleansers such as mineral spirits, alkalies, and nonchlorinated-solvent-water emulsions.

2. Several prominent suppliers of chlorinated solvents and degreasing equipment have ventured the statement that the overloading and overcrowding of machines beyond original capacity cause considerable waste.

3. Focus of attention on the problem should provide a new incentive for a better understanding of metal cleaning in all its ramifications.

Reports from several specialists are summarized, the general opinion being that each plant should make a study of its metal cleaning problems by placing them in the hands of a competent staff metallurgist or chemist. Then follow this with a survey and recommendations by the specialists in the metal cleaning field.

(172) Harold S. Bavister and Vauxhall Motors Ltd., "Electrocleaning Baths," British Patent No. 547,592, September 2, 1942; Chemical Abstracts, Vol. 37, p. 5914 (1943).

An electrocleaning solution for cleaning metal articles prior to electroplating is made of Na_2SiO_3 and soda ash about 77 per cent, 19 per cent NaOH, 3 per cent sodium oxalate, and 1 per cent powdered glue.

(173) C. J. Bushrod, "General Review of Corrosion of Magnesium and Magnesium-Base Alloys," Magazine Reviews and Abstracts, Vol. 3, No. 1, pp. 19-26 (1942); Metal Industries, Vol. 61, No. 21, pp. 324-326 (1942).

Discusses corrosion resistance of pure magnesium and of magnesium-base alloys containing (a) manganese, and (b) aluminum, zinc, and manganese, toward atmosphere, sea water, acids, and alkalies. Protective processes and precautions are described. Bibliography of 29 references.

(174) Wilfred J. Clifford and Henry H. Adams (to The Pyrene Co., Ltd.), "Cleaning Metals or Other Surfaces," British Patent

No. 543,770, March 12, 1942; Chemical Abstracts, Vol. 36, p. 6274 (1942).

The metals or other surface are cleaned by spraying the surface with an aqueous solution of a weak acid or salt at a temperature above 120 F and stopping the spraying when the surface is clean. The pH of the solution should be between 2.5 and 4. As an acid is used H_3PO_4 or an acid phosphate.

(175) Richard Cosway and Imperial Chemical Industries, Ltd., "Degreasing of Metals," British Patent No. 548,116, September 25, 1942; Chemical Abstracts, Vol. 37, p. 6242 (1943).

Metal and like nonabsorbent articles are treated to bring them to a dry degreased condition, by immersing the articles in a bath of the vapor of a volatile grease solvent, such as trichloroethylene. The solvent vapor is maintained at a temperature of 10 to 50 F above the boiling point of the solvent.

(176) C. F. Dinley, "Stabilization of Chlorinated Solvents for Metal Degreasing," Products Finishing, Vol. 6, No. 10, pp. 24-26 (1942); Chemical Abstracts, Vol. 36, p. 4931 (1942).

Stabilizers of the organic-base type are soluble in the chlorinated solvent. Volatilize with the solvent vapor during distillation, and condense with the vapor. The boiling point and vaporizing rate of the organic base must be such that the reaction of the chlorinated solvent is always basic regardless of the number of times the solvent undergoes distillation.

(177) J. Edgell, "Corrosion of Aluminum Utensils," The Electric Times, Vol. 102, pp. 44-45 (1942); Chemical Abstracts, Vol. 37, p. 4042 (1943).

Corrosion was due to galvanic action between the aluminum and traces of copper dissolved from the piping. An anodic finish obtained by immersing the utensil in 5 per cent H_2CrO_4 at about 38 C provided satisfactory protection.

(178) H. J. Fahrney and R. B. Mears, "Protective Measures for Aluminum Equipment," Chemical and Metallurgical Engineering, Vol. 49, No. 7, pp. 86-89 (1942).

Protective measures are discussed. These include: (1) cathodic protection: zinc strip attached to the wall of the vessel is useful in neutral or acid solutions and sometimes in weakly alkaline solution to prevent corrosion; (2) inhibitors: three widely used inhibitors are chromates, silicates, and soluble oils; (3) protective coatings: phenolic coatings are discussed; (4) periodic cleaning: cleaning periodically with a warm solution of 47 g tartaric acid and 3 g sodium fluoride per liter is useful, or where the vessel is of small size steel wool and soap are likewise useful in the removal of surface imperfections.

(179) Compound, Grease-Cleaning, Solvent-Emulsion-Type, Federal Specification P-C-576, November 6, 1942.

Includes stability and kerosene and water-solubility tests. Aluminum panels are treated with an S A E No. 70 lubricating oil to which sufficient talcum powder is added to form a paste. The panels are then baked at a temperature of 290 to 300 F for 3 hr, cooled, then cleaned under standard conditions.

(180) Edward Finnie, "Tin Coating of Aluminum," Products Finishing, Vol. 6, No. 6, pp. 42-44 (1942).

The pistons are first cleaned by immersion in a 3 oz per gal solution of Na_3PO_4 at 175 to 185 F until gas bubbles form on the Al, since the surface of pistons remaining too long in the solution would be etched. The pistons are then rinsed in cold water, dipped in a 3 per cent HNO_3 solution for 30 sec to prevent any alkali of the cleaning solution from contaminating the Sn bath, rinsed thoroughly in cold water.

(181) P. Flament, "Cleaning of Metallic Surfaces, Trichloroethylene," Metallurgie, Vol. 74, No. 7, pp. 15-17; No. 8, pp. 15-16 (1942). *Chemisches Zentralblatt*, I, p. 1929 (1942); Chemical Abstracts, Vol. 38, p. 4554 (1944).

Review of practical measures for cleaning iron, steel, copper, brass, aluminum, and light metal alloys with trichloroethylene.

(182) Wm. Franklin, "Degreasing or Cleansing Agents," British Patent No. 549,375, November 18, 1942; Chemical Abstracts, Vol. 38, p. 818 (1944).

A composition for cleaning or degreasing metals as a preliminary to anodic electroplating consists of 233 ml oleic acid, 472 ml. sulfonated castor oil, 26 oz sodium orthosilicate, and 1 gal water.

(183) H. R. Hanley, "Electrolytic Cleaning of Metals," Metal Progress, Vol. 41, February, 1942, pp. 179-183.

Depending upon polarity there are three methods: (1) cathodic, (2) anodic, (3) alternate current. Pickling in hydrochloric acid does not cause embrittlement. No hydrogen environment is present and consequently no embrittlement results from anodic cleaning. Describes several commercial processes, among which are the Bullard-Dunn, the Blant-Long process (U. S. Patent 2,115,005), and the S.F. Urban process (U. S. Patent 2,172,041). Also discusses inhibitors.

(184) G. Russell Hersam, "Cleaning Steel Shells," Industrial Finishing, Vol. 18, No. 5, pp. 19-23 (1942); Chemical Abstracts, Vol. 36, p. 2829 (1942).

Machines for such cleaning consist of three spray compartments, an alkaline

cleaning material being used in the first and rinses in the others. Cleaning usually done at 190 to 200 F. Rust preventives may be used in the last rinse.

(185) E. R. Irwin and J. Teres, "Metal Finishing for Military Aircraft," *Proceedings, 30th Annual Convention, Am. Electroplaters' Soc.*, pp. 134-139 (1942); Discussion, pp. 139-141.

Methods of preparing aluminum and magnesium alloys for surface-protection treatment, such as anodizing, plating, and painting, are described, and brief accounts are given of standard practice in the cadmium plating, lead plating, phosphatizing, and painting of steel.

(186) A. Jacobi, "Degreasing and Deoiling Metals," *Belgian Patent No. 447,381*, October 31, 1942; *Chemical Abstracts*, Vol. 39, p. 903 (1945).

Sulfite liquor 55 is emulsified with an alkali hydroxide 40, with the help of an emulsifier, 5 parts of triethanolamine.

(187) F. Jelenik, "Degreasing and Pickling. IV. The Inhibitors. V. Electrolytic Pickling," *Oberflächentechnik*, Vol. 19, pp. 83-84, 95-96 (1942); *Chemisches Zentralblatt*, I, p. 443 (1943); *Chemical Abstracts*, Vol. 38, p. 2911 (1944).

Theories of the action of inhibitors and patents in this field are reviewed. The amount of inhibitor added to the bath is mostly below 1 per cent. The effectiveness of an inhibitor is tested by determining the loss of weight of a pure iron plate for a definite temperature and time with and without inhibitor, or by determining the liberated hydrogen, or by determining the electrical resistance of the inhibitor layer absorbed by the metal. Electrolytic pickling methods can consist in cathodic pickling, anodic pickling and alternating cathodic and anodic pickling with alternating current, and pickling in molten electrolytes.

(188) F. Jelenik, "Degreasing and Pickling. VI," *Oberflächentechnik*, Vol. 19, pp. 102-104 (1942); *Chemisches Zentralblatt*, I, p. 1612 (1943); *Chemical Abstracts*, Vol. 38, p. 3582 (1944).

Pickling is discussed, not only for removal of scale, but to improve the appearance of the surface. Recipes are given for rust-proof steel, copper and copper alloys, aluminum, phosphor bronze, nickel silver, constantan, monel, nickel, tungsten, and metals containing tungsten and molybdenum.

(189) W. F. Jesson, "Solvent Economy in Trichlorethylene Degreasing Plants," *Metal Industry*, Vol. 60, pp. 254-257 (1942); *Metallurgia*, Vol. 25, pp. 177-178 (1942). Originally presented to the *Electrodepositors' Tech. Soc.*

The development of degreasing plants is reviewed briefly. Recommendations are made for central control of degreasers and practical suggestions outlined for various ways of preventing waste of the solvents.

(190) J. M. L. Lombard-Gerin and L. C. Lombard-Gerin, "Detergent for Metals," *Belgian Patent No. 446,472*, August 31, 1942; *Chemical Abstracts*, Vol. 39, p. 691 (1945).

At least one iron-passivating salt is added to a wetting agent.

(191) "Metal Cleaning in War-Time. Magnus Cleaners," *Magnus Chemical Co., Garwood, N. J.* (1942).

A 50-page booklet outlining in detail the metal cleaning problems of production for war and indicating the Magnus product best suited for use in each.

(192) R. B. Mears and J. R. Akers, "The Design and Maintenance of Aluminum Brewing Equipment," presented at a meeting of *Am. Soc. Brewing Chemists*, May 25, 1942.

Describes methods of cleaning and maintaining aluminum equipment. Contains a description of cleaners, disinfectants, and beer-stone removers. Methods of cleaning aluminum beer barrels are given special attention.

(193) Max Metzinger and Alfred Long (to Blockson Chemical Co.), "Detergents Suitable for Use on Metal-Ware with Tin Surfaces," *U. S. Patent No. 2,285,676*, June 9, 1942; *Chemical Abstracts*, Vol. 36, p. 6707 (1942).

A noncaustic alkaline detergent such as Na_2CO_3 and Na_2HPO_4 is used with about 0.5 to 1.5 per cent of a chromate salt of an alkali metal such as $\text{Na}_2\text{Cr}_2\text{O}_7$ and up to 15 per cent of an alkali metal fluosilicate.

(194) L. H. Minor, "Selection of Detergents," *Southern Dairy Products Journal*, Vol. 32, No. 5, November, 1942, pp. 22, 24.

A short discussion of the various types of dairy cleansers concludes that "the wide variation in the mineral content of water along with the many different types of cleaning to be done makes a universal detergent next to impossible." Points that make a satisfactory detergent are: (1) softens the water; (2) prevents precipitation of water minerals which build film and scale formation; (3) increases the wetting ability of the water; (4) dissolves or softens the milk residues so that they can be removed; (5) does not corrode the metal surfaces of the equipment; (6) does not attack the hands if it is to be used in hand cleaning; (7) is nontoxic; (8) does not encourage development of off-flavors to dairy products; (9) rinses freely; (10) economical to use.

(195) O. M. Morgan and J. G. Lankler, "Evaluation of a Surface Active Agent for Metal Cleaning," *Industrial and Engineering Chemistry*, Vol. 34, pp. 1158-1161 (1942). See Reference 152.

(196) O. M. Morgan and J. G. Lankler, "Evaluation of Metal-Cleaning Compounds," *Industrial and Engineering Chemistry, Analytical Edition*, Vol. 14, pp. 725-726 (1942). See Reference 151.

(197) Fred Morris, "Cleaning Alclad for Production," *Aviation*, Vol. 41, April, 1942, pp. 85, 205-206; *Welding Journal*, Vol. 21, April, 1942, pp. 197-198.

One phase of the problem of production spot welding of Alclad involved the development of a method of preparing the surfaces of the metal to secure a satisfactorily low surface resistance between the parts to be welded and to do it consistently. A satisfactory method was developed which permits the parts to be welded at any time within three days after the cleaning operation, and also gives consistent results as far as weld strengths are concerned. The details of the operation are given.

(198) Compound, Engine Cleaning, and Paint Stripping, Navy Aeronautical Specification C-114, Amendment 1, March 10, 1942.

Tests include corrosiveness, stripping properties, rinsing properties, oil removal (SAE No. 50 oil), and carbon removal from a carbonized aluminum piston.

(199) Cleaner, Metal Silicate-Soap, Navy Aeronautical Specification C-109a, March 31, 1942.

Tests include surface properties, solubility, cleaning properties (against mineral oil on an aluminum panel), rinsing properties, and corrosiveness.

(200) Compound, Carbon Removal, for Aircraft Engine Parts, Navy Aeronautical Specification C-118, May 16, 1942.

Tests include corrosiveness, carbon removal from a heavily carbonized aluminum alloy piston, oil removal properties (SAE No. 50 oil), and rinsing properties.

(201) Compound, Carbon Removal for Aircraft Engine Parts (Cresol Type), Navy Aeronautical Specification C-86b, June 24, 1942.

Corrosion test for anodized aluminum alloy, polished aluminum alloy, polished copper, and steel strips. An enamel and varnish stripping test is outlined, as is a test for evaluating the removal of SAE No. 50 oil. A test for rinsability is included.

(201A) Ether, Alkylated, Phenolic (For Cleaning Aircraft), Navy Aeronautical Specifi-

cation RM-70, Amendment No. 2, June 27, 1942.

Product intended for use in aqueous solution for hand cleaning of aircraft and accessory parts. Detail requirements for product are nonvolatile 26 per cent minimum, mineral spirits 30 per cent minimum, water 42 per cent maximum, other aqueous solvents 2 per cent maximum. Chemical analysis requirements for the nonvolatile portion are given. Physical property requirements cover appearance, odor, weight per gallon, solubility in water, tension values, deflocculation, pH, and stability.

Application qualities include cleaning properties at 4 oz per gal dilution for cleaning panel prepared with finely divided carbon, rinsing properties, and nondeleterious properties toward certain finishes.

(201B) Compound, Cleaning (For Aircraft Surfaces), Navy Aeronautical Specification C-120, August 24, 1942.

Intended for use in fresh or seawater for hand cleaning and washing of painted or unpainted aircraft surfaces. Detail requirements include fresh water solubility and stability, seawater solubility, alkalinity and acidity, odor, pH, surface tension, deflocculation, cleaning and rinsing properties of prepared and oil-soiled panels, corrosiveness, attack on paint finish and plastics.

(202) Claudius Nielsen, "Streamlined Cleaning of Metal Surfaces in War Production," *Industrial Finishing*, Vol. 18, No. 2, pp. 31-40 (1942).

Examples are given in which trisodium phosphate is used. Suggests compositions to be tested at 6 oz per gal at 212 F. Panels dipped in SAE No. 50 lubricating oil, removed, drained 1 hr at room temperature, then immersed in boiling cleaning solution. Must also strip zinc chromate primer and lacquer without attacking aluminum. Gives two formulas, one for power washers and one for still tanks.

(203) T. E. Piper, "Preparation of Aluminum Alloy for Spot Welding," *Welding Journal*, Vol. 21, No. 10, pp. 661-664 (1942); *Journal, Inst. Metals*, Vol. 10, p. 61 (1943).

Describes method for cleaning and etching of aluminum alloy assemblies as a unit, using phosphoric acid with a cleaning agent.

(204) R. S. Pratt, "Heat-Treating Brass Cartridge Cases," *Steel*, Vol. 111, No. 9, pp. 48-49 (1942).

Curves show mechanical properties resulting from various combinations of cold working and annealing. Cleaning with alkalis is necessary to prevent corrosion by powder stored within the case in fixed ammunition.

(205) Gilbert Robinson, "Hot-dip Gal-

vanizing Technique. Part III: Soap Removing and Degreasing," *Wire Industry*, Vol. 9, pp. 373-375 (1942); *Chemical Abstracts*, Vol. 36, p. 6991 (1942).

A schematic drawing of a continuous hard soap drawn-wire degreasing bath is shown and features of the degreasing bath and the daily solution check are discussed.

(206) C. C. Ross, U. S. Naval Engineering Experiment Station, Annapolis, Md., Communication, April 2, 1942.

Duralumin panels were soiled by the following method, developed at the Station: (1) heat duralumin to near the softening point, (2) plunge the specimen into the bath containing 1 per cent of Oildag in N.S. 1100 oil, (3) burn off oil and bake residue at lower temperature, and repeat several times, and (4) allow the specimen to cool in the bath. The above methods produce a uniform soil which is impervious to ordinary soap and water. The efficiency of several cleansers was determined using this soil.

(207) Soc. anon. Savonneries Pierre Ney, Belgian Patent No. 442,358, February 28, (1942); *Chemical Abstracts*, Vol. 39, p. 636 (1945).

Describes a washing, cleansing, and degreasing product composed of anhydrous or crystalline soda ash and sodium chloride in sufficient quantity to increase fat-emulsifying power of the soda ash.

(208) F. M. Scales, "Acid Detergent Makes Cans More Sanitary," *Food Industries*, Vol. 14, No. 4, pp. 51-53, 97 (1942); *Chemical Abstracts*, Vol. 35, p. 6678* (1941).

Use of an acid detergent, "Mikrosan," proved superior to the usual alkaline types in washing milk equipment.

(209) Hermann Schubert Societe, "Cleansing Agent," Belgian Patent No. 444,156, February 28, 1942; *Chemical Abstracts*, Vol. 39, p. 636 (1945).

Residual lignin from hydrolysis of wood treated with aqueous alkaline liquid and residue separated from liquor is dried and used as such for cleaning metals.

(210) Lewis Shere, "How to Prevent and Remove Milk Deposits," *Food Industries*, Vol. 14, July, 1942, pp. 63-66.

Describes suitable cleansing routine to remove milk-stone deposits and prevent their subsequent deposition.

(211) Henry Strow, "Metal Cleaning in Wartime," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 29, pp. 995-1002 (1942).

Two basic cleaning problems for aluminum prior to spot welding are preparation for anodizing and for welding. Attack on metal is controlled to give slight attack to help in carbonized oil removal. For frost-

ed finishes strong alkalies are used and the degree of etch is controlled carefully.

Nitric acid has been used to remove the black smut from aluminum, after treatment in alkali, and addition agents have been marketed to give a clear white color to the surface. In spot welding, the oil and grease must first be removed, then the oxide film is acid removed. Magnesium is cleaned by "steel" cleaners because of its resistance to alkali.

(212) Albert Sulfrian, "The Pickling and Washing of Wire in a Steel Wire Drawing Plant," *Draht-Welt*, Vol. 35, pp. 35, 36, 252, (1942); *Chemisches Zentralblatt*, II, p. 2528 (1942); *Chemical Abstracts*, Vol. 38, p. 2600 (1944).

Describes the customary methods of pickling and washing, the washing to be followed by a sulfuric acid treatment to remove remnants of scaling.

(213) Metal Conditioner, Acid, Concentrated, Tank-Automotive Center, Tentative Specification HQMB ES-No. 431b, August 7, 1942.

Includes tests for sedimentation, flash point, and etching action.

(214) J. F. J. Thomas, "Corrosion Resistance," *Canadian Chemistry*, Vol. 26, pp. 169-171 (1942); *Journal, Inst. Metals*, Vol. 10, p. 15 (1943).

Investigation of laboratory corrosion test methods. Interpretation of laboratory results for actual service conditions discussed. Types of attack on various metals considered, with specific reference to aluminum alloys. Inhibition of corrosion investigated and methods of protection of various alloys recommended.

(215) J. F. J. Thomas, "Inhibition of Corrosion of Aluminum and Other Metals in Soda Ash," *Canadian Journal of Research*, Vol. 21, No. 2, B, pp. 43-53 (1942); *Metal Abstracts*, Vol. 9, p. 280 (1942); *Journal, Inst. Metals*, Vol. 10, p. 211 (1943).

Immersion for two hours at 60 C in solutions of soda ash to which are added various inhibitors, total salt concentration of 0.5 per cent. Inhibitors were various sodium silicates, sodium silicofluoride, organic bodies.

Sodium orthosilicate had no inhibiting effect on aluminum or duralumin; sodium metasilicate (Metso) gave complete freedom when concentration was 17.5 per cent and upward of total concentration. Sodium silicofluoride effective at 7.5 per cent and upward of total concentration.

Attack of galvanized iron inhibited by metasilicate, but not by silicofluoride. Higher concentration of silicofluoride (40 to 60 per cent) needed for tin plate. At higher

temperatures higher percentages of inhibitor are needed.

(216) Robert T. Wood (to I. G. Farbenind., A.-G.), "Cleaning Fluid for Magnesium and Its Alloys," German Patent No. 729,604, November 26, 1942; Chemical Abstracts, Vol. 38, p. 324 (1944).

The cleaning fluid contains inorganic acids and polyhydric alcohols.

1943

(217) "Corrosion Prevention, Processing and Packaging (for Depots, Arsenals, and Manufacturers)," Army Service Forces, Headquarters Manual M-406, December 11, 1943.

Methods of cleaning are listed:

1. Solvent immersion and brush cleaning,
2. Solvent spray cleaning,
3. Solvent vapor degreasing,
4. Removal of perspiration and similar residues,
5. Alkaline immersion cleaning,
6. Alkaline spray cleaning,
7. Alkaline electrocleaning,
8. Emulsion spray cleaning (with emulsified solvents only), and
9. Emulsifiable solvent soak cleaning.

Choice and application of cleaners depends upon:

1. Composition of part to be cleaned,
2. Nature of part's surface,
3. Complexity of construction,
4. Nature of contaminants to be removed,
5. Degree of cleanliness required,
6. Availability of cleaning materials and equipment, hazards involved, and
7. When to clean.

Specific directions, precautions, and sequence of operation given.

(218) Alfred Arnold (to Alexander Wacker Gesellschaft fur elektrochemische Industrie G.m.b.H.), "Degreasing Metals," German Patent No. 742,548, October 21, 1943; Chemical Abstracts, Vol. 39, p. 2483 (1945).

Metal objects are degreased by treating them with hot volatile solvents, such as trichloroethylene, carbon tetrachloride, tetrachlorethylene, benzene, etc. The clean metal is conveyed from the degreasing tank to an adjacent compartment where the vapors of the solvent are drawn off by suction.

(219) Atlas Preservative Co., Ltd., Charles L. Keegan, and British Arca Regulators Ltd., "Degreasing of Structures," British Patent No. 556,635, October 14, 1943; Chemical Abstracts, Vol. 39, p. 1947 (1945).

Oily matter removed from inaccessible surfaces by directing a mixture of steam

and oil solvent on these surfaces, allowing them to condense, then removing the condensate. The solvent selected is a chlorinated hydrocarbon.

(220) S. H. Barmasel, "Surface Protection of Magnesium," Iron Age, Vol. 151, No. 16, pp. 44A-44D, 1943; Chemical Abstracts, Vol. 37, p. 3387 (1943).

Any of the well-known methods of solvent or alkali cleaning can be used to degrease magnesium surfaces. Alkaline cleaning can be accomplished either by boiling or by a cathodic electrolytic process in an alkaline solution. The following solution is recommended: 4 oz of Na_3PO_4 , 4 oz of Na_2CO_3 , and H_2O to make 1 gal. This solution should be kept at 194 to 212 F when in use, and can be used without agitation and at temperatures below the boiling point in the electrolytic cleaning process. The magnesium object is the cathode, current density is 10 to 20 amp per sq ft. For solvent cleaning, gasoline, trichloroethylene, naphtha, and CCl_4 are good. Alkaline solutions containing soap should not be used unless the magnesium surface is subsequently to receive a dichromate treatment. When exposure to sea air or saline solutions is expected, chemical surface protection should be provided. For this purpose the magnesium part can be dipped in a solution containing 1.5 lb $\text{Na}_2\text{Cr}_2\text{O}_7$, 1.5 pt concentrated HNO_3 , and H_2O to make 1 gal used at room temperature or up to 150 F is desired. The time required is 30 sec to 2 min, depending on the age of the solution. After this treatment the part should drain for 5 to 20 sec and be rinsed in cold water to 180 F. If the time of dipping has been correct, the magnesium will have a yellow or a red-yellow iridescent hue. The dipping solution can be revived by addition of HNO_3 . Resistance of magnesium alloys to salt water is considerably increased if the metal parts are simply boiled for 45 min in a 10 per cent dichromate solution. This can be preceded by a dip in 15 to 20 per cent HF solution. Dichromate treatment should not be applied to alloys containing manganese. When the alloys contain magnesium they should be anodized. They are first given a dip in HF solution, washed in cold water, and then anodized at 2 to 10 amp per sq ft in a bath containing 3 per cent $(\text{NH}_4)_2\text{SO}_4$, 3 per cent $\text{Na}_2\text{Cr}_2\text{O}_7$, and 0.25 per cent NH_4OH (sp gr 0.880). After this treatment the parts are boiled for five or more minutes in H_2O containing 1 per cent As_2O_3 by weight. This gives a black or dark brown coat.

(221) W. Bolzau, "New Oils and Compounds for Metal Working," Oel und Kohle, Vol. 39, pp. 416-418 (1943); Chemical Abstracts, Vol. 38, p. 1868 (1944).

A sulfonic acid obtained from hydrocarbons of the Fischer-Tropsch synthesis (Fettsäure D) and its derivatives (Emulgator H and M) are used for the preparation of water-soluble cutting oils. Oxidation products of synthetic paraffin wax are proposed as emulsifiers for the manufacture of cutting oils and drawing compounds; "Emulgierwachs PS" is less highly oxidized than "Emulgierwachs PHS" and "Emulgierwachs PVS" is a saponified product.

(222) Wm. E. Booth and Imperial Chemical Industries Ltd., "Degreasing of Metal Articles," British Patent No. 550,703, January 20, 1943; Chemical Abstracts, Vol. 38, p. 1465 (1944).

A process is provided for degreasing metal and like nonporous articles with a bath of a liquid chlorinated aliphatic hydrocarbon solvent capable of forming with water an azeotrope containing a major proportion of water. The azeotrope has a boiling point below that of water, for example, trichloroethylene.

(222A) C. A. Campbell and Solventol Chemical Products, Inc., "Cleaning of Metal Parts and Baths Therefor," British Patent Nos. 593,899 and 593,890, December 13, 1943; British Abstracts, Part B1, Section 5, p. 367 (1949).

Cleaning is accomplished by spraying with a mixture comprising an emulsified solvent such as mineral spirit, and a cleaning solvent containing butyl cellosolve, pine oil, oleic acid, and an amine such as ethanalamine emulsified with water, then acidified to a pH of 2.5 to 3.5. Other examples are given.

(223) F. A. Champion, "New Methods for the Examination of Corroded Metals," Journal, Inst. Metals, Vol. 10, pp. 47-66 (1943).

Scheme of classification:

General corrosion	{ even		
	{ uneven		
Local corrosion	{ even	{ wide	
	{ uneven		
	{ pitting		{ medium
	{ cracking		{ narrow

Used macro and microscopic means for the observation with charts for comparison.

Description of radiographic means for examination and application of photometric measurement of corroded area. Neither fully exploited as yet, but their use offers quantitative means for measurement.

(224) G. C. Close, "Different Processes for Cleaning Metal. I, II," Industrial Finishing, Vol. 20, No. 2, pp. 46, 48, 50, 55 (1943); No. 4, pp. 42, 44, 46 (1944).

The necessity for cleaning all metal surfaces in preparation for painting is emphasized. Different processes for accomplishing this are outlined. Included are: emulsion degreasing, anodic cleaning, steam vapor cleaning, vapor degreasing and phosphatizing. Mechanical cleaning processes are listed as hand wiping, grit blasting, rolling and tumbling, and shot blasting. Chemical cleaning processes are classified as hot still tank, emulsion degreasing, electrocleaning, steam vapor cleaning, acid pickling, and phosphatizing.

(225) T. J. Coleman (to Canadian National Carbon Co., Ltd.), "Metal-Cleaning Composition," Canadian Patent No. 412,896, June 1, 1943 (1943); Chemical Abstracts, Vol. 37, p. 5522 (1943).

A composition for removing scale, oxide impurities, grease, and oil from metal surfaces while preventing acid attack on surfaces of aluminum, brass, copper, tin, and antimony consists of a mixture of about 85 per cent of a water-soluble bisulfate, 6 per cent of a water-soluble organic sulfonation product, 5 per cent of a water-soluble sulfate, and about 4 per cent of $(\text{NH}_4)_2\text{HPO}_4$.

(226) Timothy J. Coleman (to National Carbon Co.), "Compositions Suitable for Cleaning Various Metals and Removing Scale from Them," U. S. Patent No. 2,326,837, August 17, 1943.

An acid cleaning composition stable in solid form and adapted in aqueous solution to remove scale, oxide impurities, grease, and oil from ferrous and non-ferrous metal surfaces, while inhibiting acid attack upon surfaces of aluminum, brass, copper, tin, and lead, comprises a solid alkali metal salt, such as sodium bisulfate, adapted in aqueous solution to hydrolyze and yield a free inorganic acid, together with a solid water-soluble salt, such as the sodium sulfonate derivative of tetradecyl phenol or other sulfonation product of alkylated phenols or cresols having 9 to 16 C atoms in the alkyl group or sulfonation product of an alkylated benzene having 9 to 16 C atoms in the alkyl group or of sulfonation or sulfation products of monohydric aliphatic alcohols having 8 to 17 C atoms in the molecule.

(227) John W. Dammers, "The Operation of Modern Degreasers," Proceedings, Am. Electroplaters' Soc., Vol. 30, pp. 113-116 (1943); Chemical Abstracts, Vol. 38, p. 2616 (1944).

Special greases and oils used in present-day metal fabrication operations, such as cutting, drawing, and stamping, impose difficult cleaning problems. Solvent degreasing alone is not capable of removing many of these compounds. Details of design of solvent vapor degreasers are discussed.

(228) Herbert K. De Long (to The Dow Chemical Co.), "Cleaning Rolled Magnesium Articles," U. S. Patent No. 2,302,939, November 24, 1943; Chemical Abstracts, Vol. 37, p. 2332 (1943).

A method is employed for removing carbonized oil containing oxide mill scale from the surfaces of rolled articles of magnesium and magnesium alloys which involves subjecting the article to the action of an aqueous solution of a water-soluble organic carboxylic acid such as acetic, citric, or tartaric acid for a time sufficient to remove the scale but insufficient to permit any substantial attack on the metal.

(229) András Domony, "Corrosion of Light Metals and Its Prevention," *Bányászati Kohászati Lapok*, Vol. 76, pp. 221-230 (1943); *Chemisches Zentralblatt*, II, p. 1846 (1943); Chemical Abstracts, Vol. 38, p. 6266 (1944).

Various types of corrosion (chemical, electrochemical, and intercrystalline) occurring in light metal alloys and the effect of alloying elements, impurities, and heat treatment are discussed. Protective methods are described in detail and operating suggestions are given for anodic oxidation, chemical oxidation, plating, galvanizing, and lacquering.

(230) A. Douty and E. Snyder, "Cleaning Steel for Finishing," *Metal Finishing*, Vol. 41, No. 11, pp. 754-757 (1943).

"Clean" surfaces may have visible contaminants removed, but invisible contaminants, as from alkaline materials in the rinse bath, may remain and ruin adhesion of painted coatings. Even undisclored, silvery white surfaces while still damp should be suspected. Invisible contaminants, classified as immediately and latently harmful materials, may be:

1. Alkalies and alkaline salts.
2. Alkaline earth metals (hard water).
3. Salts of iron, such as chlorides and sulfates from pickling operations.

Cleaning methods and relative merits:

- A. Mechanical.—Pits not cleaned.
- B. Vapor Degreasing.—Leaves film of iron chloride.
- C. HCl or Sulfuric Acid Pickling.—Iron salts remain as a rust. "Blush" unless given final rinse in alkali.
- D. Alkaline cleaning.—Traces remaining deleterious to paint life.
- E. Phosphoric acid type cleaning.—Highly desirable because traces of remaining phosphoric acid are beneficial to paint life.

Final rinse is highly important and simple tap water rinse is never satisfactory. Proper rinsing conditions given as follows:

1. Contain either phosphoric acid or chromic acid in very dilute solutions in 0.01 to 0.10 per cent concentration.
2. pH value between 3 and 5.
3. Presence of a suitable agent to cause suitable draining of rinse water.
4. Should be controlled to contain minimum amount of soluble iron salts.
5. Should be hot, preferably boiling, and articles left in long enough to attain this temperature.
6. Arrange work for complete drainage.
7. If work does not dry immediately after removal it should be artificially dried.

(230A) E. I. du Pont de Nemours & Co., "Materials or Compositions Suitable for Cleaning Metal Articles and for Other Purposes," British Patent No. 557,530, November 24, 1943; Chemical Abstracts, Vol. 39, p. 3245 (1945).

Oxide scale and other surface impurities removed from metal articles by contact with a molten composition consisting of one or more alkaline metal hydroxides containing dissolved alkali metal hydride, such as molten caustic soda containing 1 to 20 per cent by weight of sodium hydride.

(231) A. Edeler, "Ground Glass for Spot Testing in Solvent Extractions," *Industrial and Engineering Chemistry, Analytical Edition*, Vol. 15, p. 282 (1943).

Depends upon spot or line produced when a solvent containing oil is allowed to evaporate on ground glass plate of photographic grade. Sensitivity of 0.005 per cent. Test surface gives a transparent spot or circular hair line.

(232) Paul Effing, "Rust Remover," German Patent No. 742,477, October 14, 1943; Chemical Abstracts, Vol. 39, p. 2484 (1945).

Iron or iron-containing surfaces are cleaned of rust with an aqueous solution of lactic acid containing one or more metal double salts.

(233) Ernst Gotte (to Deutsche Hydrierwerke A.-G.), "Metal Cleaning Agent," German Patent No. 732,834, February 11, 1943; Chemical Abstracts, Vol. 38, p. 715 (1944).

For cleaning metals an emulsion of fat solvents and acid substances capable of removing metal oxide films is used. This mixture is emulsified with organic salts of cation- and anion-active compounds.

(234) "Cleaners for Effective Metal Cleaning," Bulletin C-105, Hanson-Van Winkle-Munning Co. (1943).

Describes laboratory apparatus for the evaluation of either soak or electrified cleaners. The equipment provides for positive circulation (by pump) and an overflow bath. Recommends a titration method for

determining the effective remaining alkali in the cleaning bath. Use of a laboratory centrifuge (to remove insoluble soil from the used cleaning bath), the control cleaning apparatus, and the titration analysis serve to decide the period at which the bath should be discarded. The effects of variation of current density, temperature, and concentration upon the cleaning rate of electric cleaning are illustrated.

(235) Walter Heimberger, "Cleaning Metal Surfaces," German Patent No. 733,470, February 25, 1943; Chemical Abstracts, Vol. 38, p. 1052 (1944).

The metal immersed in a cleaning liquid is subjected to the action of ultrasonic waves.

(236) K. D. Kahn, "Metal Cleaning Before Processing," Iron Age, Vol. 152, No. 11, pp. 62-65 (1943); Journal, Inst. Metals, Metal Abstracts, Vol. 11, Part I, p. 32 (1944).

Summary of research and development since 1917 of advantages and disadvantages, equipment, and functions of principal cleaning methods. Solvent vapor degreasing process is discussed.

(237) T. J. Kearney, "Economical Degreasing with Chlorinated Solvents," Products Finishing, Vol. 8, No. 3, pp. 20-22, 24, 26, 28, 30 (1943).

A description of the use of chlorinated solvents, their economical use in three basic types of degreasing machines, various types of solvent degreasing machines, and of solvents recommended. Vapor degreasing, vapor slush degreasing, immersion degreasing, vapor-spray-vapor degreasing solvent stills, and the testing of solvents are discussed and specifications are given for highly stabilized trichloroethylene and for C_2Cl_4 .

(238) H. O. Klinke, "Surface Treatment of Aluminum Alloy Assemblies Prior to Spot Welding," Welding Journal, Vol. 22, August, 1943, pp. 602-604.

It is desirable to treat the surface of aluminum alloy assemblies rather than the individual components, and a series of tests to determine the production possibilities is described. The aluminum alloy parts were held by a few rivets or small bolts and cleaned at room temperature in a phosphoric acid solution (50 per cent nominal) plus a wetting agent. Spot welds made after such cleaning gave satisfactory test figures, and it was apparent that the solution crept between the faying surfaces. Contact resistances were measured and curves reproduced for Alclad 24S-T assemblies for 0.064 and 0.030-in. material.

(239) Vernon A. Lamb, "Cleaning and Pickling," Metals and Alloys, Vol. 17, January, 1943, pp. 86-87.

A review of developments during 1943, with a bibliography of 17 references.

(240) P. D. Liddiard, "Determining the Cleanliness of a Metal," Metal Industry, Vol. 63, August 27, 1943, pp. 130-131.

Tests developed and used in the study of degreasants are summarized. Although many of them are applicable in certain circumstances, they will, nonetheless, be of considerable interest to those engaged in the treatment of metal surfaces. The term "degreasing" is defined and considered in two stages: (1) the removal of surface deposits of oil from the solid surface and (2) the removal of adsorbed layers of oil. Tests for grease freedom are discussed under headings: direct observation; surface tension; selective staining; solvents; decomposition; and electroplating. A brief reference is made to the residues of degreasants.

(241) R. B. Mears and G. G. Eldredge, "The Use of Inhibitors for Aluminum Chemical Equipment," Transactions, Electrochemical Soc., Vol. 83, 15 pp. (1943).

A classification of inhibitors according to their effectiveness and their influence on the intensity and area attacked is given. The electrochemical behavior of inhibitors is discussed and the factors that cause an inhibitor to be safe or dangerous are outlined. A series of laboratory tests to determine the effectiveness of various chemicals as inhibitors of the attack of aluminum and the aluminum-base alloys in acid, alkaline, and neutral solutions are described. Organic substances such as soluble oils, alkaloids, and organic sulfur compounds proved to be effective inhibitors in HCl. Chromates, soluble oils, and commercial wetting agents appeared to be the best in H_3PO_4 . No highly effective inhibitors for H_2SO_4 were found. In alkaline solutions, the silicates were the most promising inhibitors. Chromates and soluble oils were the most effective inhibitors found for nearly neutral solutions. However, even these substances were not effective for preventing galvanic attack by waters containing appreciable concentrations of chlorides. Service applications of inhibitors for protecting aluminum chemical equipment are described, particular attention being given to the inhibiting action of an alcohol cooling fluid. Hot Na_2CO_3 solutions require 22 per cent by weight of $Na_2O \cdot 2SiO_2$. Hot Na_3PO_4 solutions require 30 per cent by weight of $Na_2O \cdot 2SiO_2$.

(242) R. W. Mitchell and Marcel T. Zinty, "Metal-Cleaning Solutions. What They Are, How to Use Them, and Why," Machinist, European Edition, Vol. 87, pp. 105-107 (1943).

Metal cleaning solutions are grouped into four major classes: alkaline cleaners, sol-

vent cleaners, petroleum spirit cleaners, and the newest development, emulsifiable cleaners. The advantages and disadvantages of each, and its ability to meet the requirements of a metal cleaner, are described.

(243) Oliver M. Morgan (to Allied Chemical & Dye Corp.), "Cleaning Metal Surfaces such as Those of Iron or Steel," U. S. Patent No. 2,314,285 (1943); Chemical Abstracts, Vol. 37, p. 5010^a (1943).

For removing greasy residues, the metal to be cleaned is immersed in a hot aqueous alkaline cleansing bath such as one of NaOH, Na₂PO₃, Na₂CO₃, and Na₂SiO₃ containing per gallon of water, 0.125 to 1.0 oz of Na heptyl-naphthosulfonate or other alkyl aromatic sulfonate having at least 7 C atoms in an alkyl radical, as a cleansing assistant and as an emulsifying agent for the residues, while an electric current is passed through the metal as an electrode.

(243A) K. M. Morse and L. Goldberg, "Chlorinated-Solvent Exposure at Degreasing Operations," *Industrial Medicine*, Vol. 12, pp. 706-713 (1943); Chemical Abstracts, Vol. 38, p. 4060 (1944).

Study of 108 degreasing units of the condensing and non-condensing types. Recommendations given for tank design, operation, location, and ventilation for best health considerations.

(243B) C. Nielsen, "A Quick Positive Test to Show When Metal Surfaces Are Chemically Clean," *Steel*, Vol. 113, No. 14, pp. 106-108, 132-136 (1943); Chemical Abstracts, Vol. 37, p. 6630 (1943).

Use of water-break method. Cleaner considered effective if a solution containing 1 oz per gal will remove film of SAE 50 lubricating oil in 1 min at 165 F in a power washing machine.

(244) Corrosion Prevention; Processing and Packaging, Ordnance Department Tentative Specification TM 38-305, August 1, 1943.

A 60-page specification which includes instructions for solvent cleaning by immersion, spray, vapor degreasing, and removal of perspiration and similar residues. Alkaline cleaning specifications include immersion cleaning using formulas exemplified by the following:

I

85 per cent sodium orthosilicate
10 per cent sodium carbonate (anhydrous)
5 per cent sodium resinate

II

46 per cent sodium carbonate (anhydrous)
32 per cent trisodium phosphate
16 per cent sodium hydroxide
6 per cent rosin.

Alkaline spray cleaning can be done with single compounds such as:

Sodium orthosilicate,
Sodium metasilicate,
Tetrasodium pyrophosphate,
Trisodium phosphate.

Alkaline electrocleaning can be carried out using formulations I or II above, for alkaline immersion cleaning.

Emulsion spray cleaning and emulsifiable solvent soak cleaning methods and precautions are described.

Directions include sections on general directions, materials, control conditions, control and operation of rinses, and procedure for cleaning.

Specific precautions are given regarding the cleaning of aluminum, magnesium, zinc, and their alloys by alkaline cleansers.

(245) M. E. Parker, "Acid Detergents in Food Sanitation," *Industrial and Engineering Chemistry*, Vol. 35, January, 1943, pp. 100-105.

The discovery of organic acids with relatively low corrosiveness and inherent inhibiting effects upon the quality-defective types of microorganisms first pointed the way to developing acceptable types of acid cleaners. The effective combination of such acids with surface-active agents and corrosion retarders has resulted in the development of acid cleaning compounds possessing a detergency superior to that of most alkaline products, as well as providing an incidental wash water treatment, both corrective and curative for the problem of water stone and other calcareous formations. Therefore, acid cleansers promise not only a revision but an even greater improvement in the sanitary practices of food industries.

(246) M. E. Parker, "Manual of Dairy Detergents and Cleaning Practices," *Food Industries*, Vol. 15, July, 1943, pp. 78-80, 135; August, 1943, pp. 71-72, 131; September, 1943, pp. 66-67.

Part I discusses the attributes and shortcomings of the various types of dairy washing compounds. A table giving average water hardness in the United States and Canada is included in this part. Part II considers wetting agents, polyphosphates, and abrasives. The trade names and manufacturers of dairy cleaners are listed. Part III gives practical directions for cleaning cream cans, separators, and farm utensils. These include step-by-step instructions for this important phase of dairy sanitation.

(247) Karl J. A. Partisch and Fraser & Fraser, Ltd., "The Degreasing of Metal and Other Nonporous Articles," British Patent No. 551,559, March 1, 1943; Chemical Abstracts, Vol. 38, p. 2309 (1944).

A continuous degreasing plant is described for degreasing metal and other articles by

the use of volatile solvents, such as trichloroethylene, perchloroethylene, carbon tetrachloride, and gasoline.

(248) W. B. Pings, E. I. du Pont de Nemours & Co., Inc., "Composition for Use in Dry Cleaning and in Degreasing Metals," U. S. Patent No. 2,317,112, April 20, 1943; Chemical Abstracts, Vol. 37, p. 5811 (1943).

A dry cleaning solvent of a liquid chlorinated aliphatic hydrocarbon such as trichloroethylene or carbon tetrachloride is used with an admixture of 0.01 to 10 per cent of N- β -hydroxyethylauramide or other N-hydroxyalkylamide of an aliphatic monobasic monocarboxylic acid of at least 9 C atoms having the hydroxyl on a C not more than one C removed from the amido N and having in the hydroxylalkyl group not more than 2 C atoms, which serves to give improved detergent power.

(249) T. E. Piper, "One-Step Assembly Etching for Spot Welding Aluminum Alloys," Iron Age, Vol. 152, pp. 72-75 (December 2, 1943); Abstract Bulletin 23-24, Aluminum Company of America, p. 178 (1942-1943).

Use of a new technique of etching and cleaning aluminum alloy sheet assemblies prior to spot welding has resulted in the saving of thousands of manhours and over 100 per cent gain in production of spotweld assemblies at Northrup Aircraft, Inc., by obviating the need for disassembly to etch detail parts and reassemble prior to welding. The quality of spot welds has been increased, exceeding Army shear strength specifications. In addition, almost unlimited production runs of detailed parts have been obtained without cleaning the electrodes.

(250) H. P. Quadland, "Industrial Degreasing Agents," Metal Finishing, Vol. 41, July, 1943, pp. 463-465; Metal Industry, Vol. 63, p. 220 (1943).

A short review of fire and explosion hazards, toxicity, availability, and costs involved in the principal methods of degreasing.

(251) Edwin C. Rinker, "The Effect of Various Anions in Metal Cleaners," Proceedings, Am. Electroplaters' Soc., Vol. 30, pp. 109-112 (1943).

Several hundred tests with various types of alkaline cleaners for metals indicate that cleaners containing rosin soaps and silicates give the best results. The immersion method of application was employed with a solution temperature of 95 F. Acid-type cleaners comprising surface-active agent and phosphoric acid effective in spray-type washing machines are effective in removal of light films of oil and solid matter from steel. Combined alkaline wash and spray rinse with acid cleaner recommended.

Same type process used for preparation of aluminum for spot welding.

(252) Campbell Rutledge, Jr. (to General Chemical Co.), "Detergent Composition," Canadian Patent No. 411,280, March 23, 1943 (1943).

A detergent, particularly for aluminum and tin articles, consists of an aqueous solution of Na_3PO_4 , Na_2SO_4 , and sodium silicate having a SiO_2 , Na_2O ratio of 2 to 4. Strips of aluminum weighed, then immersed in the cleaner solution at 150 F for 1/2 hr in solution from 0.10 to 5.00 per cent by weight. The strips then are removed, weighed, and loss calculated in milligrams per square inch per 1/2 hr at 150 F.

(253) Ray Sanders, "Chemicals That Aid in Aircraft Production," SAE Journal, Vol. 51, January, 1943, pp. 23-30.

Methods for protecting alloys 17S-T, 24S-T, and Alclad 24S-T from corrosion and the determination of the relative adhesion of paints on the same alloys including a discussion of cleaning treatments. The value of precleaning in removing the greater part of the soil, oils, and lubricants before entering the final cleaning tanks is pointed out. Emulsion degreasing, vapor degreasing, mechanical washing machines, and auxiliary hot tanks are also discussed. The differences in cleaning and treating methods to be employed with aluminum and magnesium alloys are brought out and the preparation of steel, copper, or brass for cadmium plating and of aluminum alloys for spot welding is discussed at some length.

(254) R. Saxton, "Acid-Cleaning Metals," Sheet Metal Industry, Vol. 18, pp. 2094-2095 (1943).

Submerged-combustion heating is discussed. Lower temperatures, a saving of 20 per cent acid, and long life of the pickle is shown for one installation.

(255) Robert C. Scheib (to Camille Dreyfus), "Composition for Cleaning Aluminum," Canadian Patent No. 416,965, December 7, 1943; Chemical Abstracts, Vol. 38, p.1052 (1944).

Aluminum is treated with a hot aqueous solution of an aluminum salt, for example, potassium, sodium, or ammonium alum, about 6 to 25, a detergent, for example, sulfonated castor oil, about 0.2 to 0.5, and water, about 100 parts by weight.

(256) Charles Schwartz (to Hall Laboratories, Inc.), "Alkaline Detergents," U. S. Patent Nos. 2,303,397-8-9-400, December 1, 1943.

An alkaline detergent suitable for use on soft metals such as aluminum or tin is formed of an alkali metal metasilicate about

60 to 95 per cent, about 35 per cent or less of an alkali metal hydroxide, and about 10 per cent or less of a water-soluble salt of barium or strontium such as barium chloride which serves as a corrosion inhibitor. Otherwise similar compositions containing a mercury salt such as mercuric chloride instead of the barium or strontium salt. Compositions containing about 5 per cent or more of an arsenic compound or of an antimony compound, such as halide, based on the weight of alkali metal silicate used. Similar use of 5 per cent or more of a water-soluble lead salt such as lead nitrate to inhibit corrosion of soft metals.

(257) H. Silman, "Industrial Metal Finishing. Descaling and Pickling Processes," *Sheet Metal Industry*, Vol. 17, pp. 1199-1205, 1385-1390 (1943); *Chemical Abstracts*, Vol. 38, p. 1461 (1944).

Cleaning and pickling of steel, stainless steel, and non-ferrous metals and the utilization of pickling wastes are discussed.

(258) H. Silman, "Industrial Metal Finishing," *Sheet Metal Industry*, Vol. 18, pp. 1759-1763, 1770, 1935-1940, 2121-2125 (1943); Vol. 19, pp. 309-317, 467-473 (1944).

Mechanical and electrolytic polishing and the degreasing and cleaning of metals before electroplating, etc., are discussed.

(259) W. S. Simmie, "Inspection of Cleaning Methods for Light Alloy Sheets," *Welding*, Vol. 11, November, 1943, pp. 462-463.

Aluminum alloy sheets required to be cleaned prior to spot welding and also in order to obtain a surface to which paint will adhere. Chemical methods are used largely for such pretreatment, and a new method of testing the efficacy of the treatment is described. The apparatus consists of a low-reading cross-coil ohmmeter, a 10-amp, 2-v battery, and a pair of copper electrodes, the bottom die being fixed and the upper capable of controlled movement. The test piece is placed between the electrodes and the resistance is measured. Typical results are included.

(260) Robert Szelove, "Development of Cleaning Materials in 1942," *Monthly Review*, *Am. Electroplaters' Soc.*, Vol. 30, pp. 54-56 (1943).

Shell fuse parts of aluminum cleaned either by degreasing or by mild alkali soaking. Alkalies preferable because of deleterious action of aluminum upon degreasing solvent, but this may be eliminated by proper operation of the degreaser.

(261) "New Alkaline Cleaner for Aluminum," *Steel*, Vol. 113, p. 97 (October, 1943); *Abstract Bulletin*, Aluminum Company of America, Vol. 14, p. 371 (December, 1943);

Abstract Bulletin 23-24, Aluminum Company of America, p. 179 (1942-1943).

The Colonial Alloys Co. of Philadelphia has introduced a new aluminum cleaning substance known as "Deox-Aluminum." The aluminum object is immersed in a solution of Deox from 10 sec to 1 min, until a gray coating is formed over the surface. After rinsing, the object is dipped in a bath of nitric acid (30 to 50 per cent) at room temperature. This removes the gray coating and leaves the metal chemically clean. The coating originally formed in Deox bath may be left if desired for it is galvanically protective to aluminum, and also may be used as a base for subsequent painting or soldering.

(262) Maxwell Stiles, "Cleaning Steel, Brass, Bronze, and Copper," *Industrial Finishing*, Vol. 19, No. 4, pp. 38-48; No. 6, pp. 14-18 (1943).

Directions are given for cleaning steel, magnesium alloys, brass, bronze, and copper, using the electrolytic cleaning method, sand blasting, brushing, pickling, vapor degreasing, passivating treatment, and hydrocarbon and aqueous solvents. Aluminum cleaned prior to anodic treatment in an inhibited alkaline cleaning preparation, then through a hot water rinse, through the chromating or anodizing bath, followed by a final rinse (containing chromic acid for neutralization), then to a drying station. In other cleaning processes the final rinse is neutralized and the pH of the rinse water is held below 6.8 by use of chromic acid. Details are given for cleaning procedures prior to other operations such as welding or paint coating.

(263) Henry Strow, "Evaluation of Metal Cleaners," *Metals and Alloys*, Vol. 18, September, 1943, pp. 503-505.

Significant factors for evaluating cleaning efficiency are considered briefly under pH, emulsifying power, surface tension, and buffering action. The test for cleaners recently developed by Morgan and Lankler is described briefly as being the most satisfactory at the present time. Determination of the life of a metal cleanser is also an evaluating factor.

(264) Cleaner, Carburetor, Tank-Automotive Center, Tentative Specification TAC ES-No. 645a, March 17, 1943.

Includes corrosion, solubility, emulsification, and homogeneity tests.

(265) Compound, Vapor Cleaning, Tank-Automotive Center, Tentative Specification TAC ES-No. 542b, May 1, 1943.

Includes tests for insoluble matter, solubility, solution stability, stability at 75 C, water-softening ability, surface tension,

hydrogen-ion concentration, and rinsing properties.

(265A) U. C. Tainton, "Treating Articles of Metal such as Iron, Steel, or Steel Wire, to Remove Oxides, Scale, etc.," U. S. Patent No. 2,311,099, February 16, 1943; Chemical Abstracts, Vol. 37, p. 4357 (1943).

Use of molten caustic soda bath.

(266) Robert Twynning and Edwin M. Baker, "Rate of Saponification in Metal Cleaning, A Preliminary Study," Proceedings. Am. Electroplaters' Soc. Vol. 30, pp. 105-108 (1943).

The rates of saponification of several fats and fatty acids by a solution of 28.8 g per liter sodium hydroxide were measured at 65 F. Commercial stearic acid, yellow beef tallow, hydrogenated stearin pitch, and a proprietary fat and fatty acid were used. The results are expressed in terms of the time required to saponify a given thickness of grease film on a metal surface. For a film 0.005 in. thick, stearic acid requires 8 min for solution, tallow, 1.4 min; hydrogenated stearin pitch, 1.3 min and the proprietary fat and acid, 2.5 and 1.8 min, respectively. The relation of these results to metal cleaning and the effect of agitation and electrolytic cleaning are discussed.

(267) F. W. Van Antwerpen, "Surface Active Agents Manufactured in America and Commercially Available," Industrial and Engineering Chemistry, Vol. 35, January, 1943, pp. 126-130.

A tabulated list which has appeared before in this journal. See Vol. 31, January, 1939, pp. 66-69 and Vol. 33, January, 1941, pp. 16-22.

1944

(268) Compound, Plater's Electrocleaning, Army Air Forces Specification 14126, March 23, 1944.

A mixture comprising ground caustic soda, or causticized soda ash, sodium carbonate, trisodium phosphate, and a wetting agent of the alkyl aryl sulfonate type with the alkyl group containing not less than 9 nor more than 12 C atoms. This composition is intended for use in the preparation of a solution for electrocleaning ferrous, brass, and magnesium parts prior to plating.

(268A) Compound; Carbon Removal (For Engine Parts), U. S. Army Air Forces Specification 20038, October 2, 1944.

Detailed requirements cover odor and toxicity, specific gravity of distillate, content of water, minimum corrosion characteristics, water seal, package stability, flash point, distillation, undissolved matter, practical carbon removal test, laboratory carbon

removal test, and rinsability. Control comparison formula of following composition is used:

	Parts by Weight
Ethylene dichloride	630.0
Cresol	250.0
Oleic acid	72.0
Potassium hydroxide (100 per cent equivalent)	13.8
Water	30.0

(269) Kreigh B. Ayers (to Wingfoot Corp.), "Cleaning Magnesium and Its Alloys," U. S. Patent No. 2,357,991, September 12, 1944; Chemical Abstracts, Vol. 39, p. 491 (1945).

An aqueous solution of chromic acid and chromic fluoride (suitably at about its boiling point) is used as a cleaning agent.

(270) Max I. Bowman and Howard Packer, "Composition for Cleaning Machinery Parts or the Like," U. S. Patent No. 2,356,747, August 29, 1944; Chemical Abstracts, Vol. 39, p. 210 (1945).

A composition for application to facilitate removal of carbon, dirt, grease, paint, and the like from hard surfaces, is formed of ingredients such as neutral coal-tar oil 40, monoethanolamine 15, oleic acid 15, ethylene glycol 15, *o*-toluidine 15, ethyl silicate 0.5, and phosphoric acid 0.5 parts.

(271) "Solvent Emulsion Cleaner," Chemical & Metallurgical Engineering, Vol. 51, p. 139 (1944).

A solvent emulsion cleaner, Pennsalt E. C. No. 10 developed by the Pennsylvania Salt Manufacturing Co., is of the self-emulsifying, nonphenolic type.

(272) G. C. Close, "Cleaning, Surface Treating and Protectively Coating That New, Lightest Metal—Magnesium," Industrial Finishing, Vol. 20, No. 9, pp. 30-42; No. 10, pp. 38-55 (1944).

Precleaning accomplished by vapor degreasing or emulsifiable solvent. Good practice to use final rinse in organic liquor prior to immersion in the alkaline cleaners. Recommends: soda ash, 5 oz; NaOH, 2 oz; soap, 1 oz; water to make 1 gal. Immersion in boiling cleaner bath for 5 to 15 min, remove, rinse immediately in hot water (140 to 180 F). Final rinse in cold water. Suggested electrocleaning bath: TSP, 4 oz, soda ash, 4 oz, water to make 1 gal. Work is made the cathode at a temperature near the boil, and the current density is controlled at 6 v between 10 to 20 amp per sq ft. The strength of the bath is controlled by analysis.

(273) Louis J. Comaschi, Campbell-Taggart Research Corp., "Aluminum Oxide-Surfaced Metal Ware," U. S. Patent No. 2,350,592, June 6, 1944; Chemical Abstracts, Vol. 38, p. 4902 (1944).

A corrosion-inhibiting composition for use in forming cleaning baths for metal ware

with tin surfaces having tin oxide coatings or aluminum surfaces with aluminum oxide coatings is formed comprising Na metasilicate 50 to 60 parts; Na silicate of the formula Na_2O , 3.22, SiO_2 , 20 to 30 parts, and also 20 to 30 parts of a Na acid phosphate, Na acid sulfate, or NaHCO_3 .

(274) Richard Cosway and Imperial Chemical Industries Ltd., "Cleaning Metal and Like Nonabsorbent Articles," British Patent No. 560,865, April 25, 1944; Chemical Abstracts, Vol. 40, p. 3916 (1946).

The interiors of drums, condensers, and similar structures are treated to remove oil or grease and solids contaminating their surfaces by applying to them the spray from a steam-pressure sprayer to which a volatile grease solvent such as trichloroethylene is supplied at the liquid-inducing passages.

(275) T. Davis, "Cleaning Aircraft Parts (Before Welding)," Welding Engineer, Vol. 29, No. 8, pp. 38-40 (1944); Journal, Inst. Metals, Vol. 12, p. 34 (1945).

Two methods of cleaning and etching outlined. In one plant 1 per cent hydrofluoric acid was used, with a time of 10 to 30 sec followed by cleaning in 6 per cent soap solution. In a second plant the etch solution is sodium bisulfate at $180 \pm 10^\circ\text{F}$.

(276) Herbert K. DeLong (to The Dow Chemical Co.), "Removing Oil from Articles Made of Mg or Mg Alloys," U. S. Patent No. 2,346,562, April 11, 1944.

A cleaning solution for removing oil from articles made of magnesium or magnesium alloys is made of alkali metal tartrates such as sodium tartrate, sodium bitartrate, and Rochelle salt 1 to 5, and a base such as Na_3PO_4 , Na_2CO_3 , tetramethylammonium hydroxide, and especially NaOH , 1 to 5 per cent by weight, the rest H_2O . A solvent detergent, such as a soap or a salt of a sulfated higher aliphatic alcohol or of a sulfonated aromatic hydrocarbon, may be added in amounts of 0.5 to 2.0 per cent by weight. The alkaline tartrate solution is maintained at 90 to 100 F while the article is dipped in it for 15 sec to 2 min.

(277) Camille Dreyfus, Canadian Patent No. 416,965, December 7, 1943; Soap, Vol. 20, No. 2, p. 67 (1944).

A liquid for cleaning aluminum contains 6 to 25 parts of soda alum, 0.2 to 5.0 parts of a detergent, and about 100 parts water.

(278) Edward Engle, "Metal Cleaning and Solvent Degreasing," Metal Finishing, Vol. 42, pp. 80-81, 85 (1944).

Solvent degreasing suitable for: (a) inter-process handling; (b) painting; (c) prior to alkaline cleaning or acid pickling; and (d) inspection, repairs, and maintenance. Three types of solvent degreasers: (1) no flash point

solvents (chlorinated solvents, water emulsion); (2) safety solvents (flash point over 100 F, and emulsifiable type); (3) Red Seal (flash point under 100 F, benzene, gasoline). Precleaning of non-ferrous metals with solvent degreaser to reduce time of contact with final alkaline solution.

(278A) E. Engle, "Corrosion-Resistant Materials in Pickling, Cleaning, and Plating Operations," Products Finishing, Vol. 8, No. 9, pp. 68-72, 74, 76, 78, 80 (1944); Chemical Abstracts, Vol. 38, p. 3939 (1944).

Includes tables showing solution potentials of various metals and alloys in sodium chloride solution and suitable linings for processing tanks.

(279) N. L. Evans, "Cleaning and Descaling Steel by Electrolytic Pickling in Molten Caustic Soda," Journal, Iron and Steel Inst. (London), Advance Copy, April, 1944, 24 pp. Chemical Abstracts, Vol. 38, p. 4869 (1944).

The cleaning results are better as the time, temperature, and current density are increased. Gives conditions for type of scale encountered, for wire, and for stainless steel.

(280) Philip M. Fisk and Francis F. Poliak, "The Use of Wetting Agents in the Degreasing of Sheet Steel," Sheet Metal Industries, Vol. 19, p. 427 (1944); Chemical Abstracts, Vol. 38, p. 6253 (1944).

With pressure of war production, it became necessary to reduce alkaline degreasing time to 1 min. The oil film on the steel sheet was 15 per cent saponifiable and 85 per cent mineral oils. It proved impossible to get consistently good degreasing. Addition of about 3 g per liter Permalin N (a sulfonated mixture of alkyl naphthalenes) to the alkaline solution produced perfect degreasing.

(280A) H. N. Gilbert (to Du Pont), "Removal of Oxide from Ferrous Metal Articles," U. S. Patent No. 2,353,026, July 4, 1944; Chemical Abstracts, Vol. 38, p. 5792 (1944).

Immersion in a bath of molten caustic soda containing 1 per cent or more each of sodamide and sodium hydride or the like (suitably at 350 C) and then water-quenched. Other auxiliary compounds are mentioned.

(281) Jay C. Harris, "Corrosion Testing of Water-Soluble Aluminum Cleaners," ASTM Bulletin, No. 129, pp. 21-29 (1944).

The principal features of approximately 23 published corrosion tests dealing with the corrosion of aluminum by cleaning agents are outlined. The apparatus, metal preparation, test method, and expression of results are considered. The survey indicates that there is no standardized procedure for the corrosion testing of aluminum. An immer-

sion test is suggested and described in detail. Precleaned specimens of aluminum or aluminum alloys are tested for quantitative weight loss and qualitative surface attack after a 2-hr exposure period in boiling aqueous cleaner solutions at concentrations of 0.125, 0.25, 0.5, 1.0, 4.0, 8.0, and 16.0 per cent. Samples are weighed to 0.0001 g before and after testing to determine loss in weight, which is expressed in mg per square decimeter per 2 hr.

(282) W. F. Hess, R. A. Wyant, and B. L. Auerbach, "The Surface Treatment of Alclad 24S-T Prior to Spot Welding," *Welding Journal* (Suppl.), Vol. 23, pp. 402s-413s (1944); *Chemical Abstracts*, Vol. 38, p. 5485 (1944).

The effect of various proprietary and other cleaning solutions upon Alclad 24S-T was determined by measurement of surface resistance. A solution based upon sodium, potassium, or ammonium bisulfate plus a wetting agent is capable of producing low contact resistance within a wide operating limit. A hot alkaline degreaser based on sodium carbonate, trisodium phosphate, or sodium silicates is satisfactory for pre-cleaning. Trichloroethylene vapor degreasing is satisfactory if paint is swabbed off. Neither bright nor matte-finished products by alkaline etches are as consistent as that produced by bright acid treatment.

(283) Harry H. Hull and Lewis Shere (to the Diversey Corp.), "Detergent," U. S. Patent No. 2,360,135, October 10, 1944; *Chemical Abstracts*, Vol. 39, p. 1070 (1945).

A nonfoaming and nongelling detergent solution is composed of caustic soda 0.25 to 10, a water soluble sodium octyl-phosphoric acid ester 0.05 to 1 per cent and water. This solution is particularly suitable for automatic washing equipment for bottles, pans, etc.

(284) "One-Dip Cleaner for Aluminum," *Industrial and Engineering Chemistry, News Edition*, Vol. 22, p. 2042 (1944).

Nielco 1926, an alkali powder cleaner is readily soluble in tepid water and withstands constant boiling without losing effectiveness. Its purpose is the economical cleaning of non-Alclad ST and SO sheet aluminum in a minimum of time. The aluminum presented a cleaning problem, as it was protectively coated with an oil, principally paraffin, containing 4 per cent fish oil. Nielco 1926 also opens the possibility of reducing operating cost in the cleaning of other types of sheet aluminum prior to spot welding by eliminating the need for special deoxidizers.

(285) "Cleaning Aircraft Parts," *Iron Age*, Vol. 154, pp. 54-55 (July 27, 1944).

Degreasing as a precleaning operation is outlined, trichloroethylene being the usual

solvent, care being taken to have the work free from water. In alkaline cleaning, both agitated tank cleaning and electrolytic cleaning are used. Hot water rinse, near boiling, is recommended.

(286) Compound Dishwashing, Jersey City Quartermaster Depot, Specification 1016A, September 1, 1944.

Comprises two types Type I for use in water above 120 ppm hardness, and Type II for use in water zero to 120 ppm hardness. These are designed for use in mechanical dishwashing, and shall produce no abrasion or undue wear. Requirements to be met are turbidity, foaming, water-softening capacity, corrosion (aluminum), hydrogen-ion content and buffer index, fineness, rate of solution, gelation, film formation, and cleaning efficiency.

(286A) Compound, Cleaning, Baking Pans, Jersey City Quartermaster Depot, Quartermaster Corps Tentative Specification 1009, October 24, 1944.

Type I for tank cleaning and Type II for hand cleaning are given. Intended only for tinned and black iron pans, and not for aluminum. Types I and II, detailed requirements include cleaning ability with available or artificially burned-out metal, tests for corrosion, foaming, and relative cost.

(287) Arthur S. Kohler, "Aluminum-Cleaning Methods," *Welding Engineering*, Vol. 29, No. 3, pp. 46-48 (1944); *Chemical Abstracts*, Vol. 38, p. 6265 (1944).

A discussion of improved chemical cleaning technique involving removal of oil, grease, and marking ink, followed by the removal of oxide coating (deoxidation). Recommends degreasing of heavily oil-covered surfaces prior to aqueous removal. Chemical deoxidation may be acid or alkaline types.

(288) Christopher J. Krogel (to Western Electric Co.), "Cleaning Metal Surfaces Such as Copper Wire," U. S. Patent No. 2,325,957, August 3, 1944; *Chemical Abstracts*, Vol. 38, p. 306 (1944).

Apparatus and method employed are described for immersion in an aqueous solution containing an alkaline electrolyte, such as sodium orthosilicate and a foaming agent such as soap, saponin, or a sulfonated alcohol, and passing an alternating current through the bath using the metal to be cleaned as one electrode.

(289) T. W. Langer (to The Texas Company), "Soluble Oil" Compositions Suitable for Use with Water in Various Metal-Working Operations," U. S. Patent No. 2,328,727, September 7, 1944; *Chemical Abstracts*, Vol. 38, p. 947 (1944).

A petroleum oil is used in mixture which may contain mahogany sulfonates (5 to 15 per cent) and a water-soluble alkali metal soap (2 to 6 per cent), and an alkyolamine, for example, triethanolamine (0.5 to 4 per cent).

(290) P. D. Liddiard, "Application of Alkaline Silicates. The Cleaning of Solid Surfaces," *Chemical Age* (London), Vol. 51, pp. 317-20, 341-5 (1944); *Chemical Abstracts*, Vol. 39, p. 1069 (1945).

A review concerning the physics, chemical activity, and nature of the silicates. The protective effect on metals is indicated as usually an advantage.

(291) P. D. Liddiard, "Electrolytic Cleaning: Phenomena Observed in Alkaline Silicate Solutions," *Metal Industries*, Vol. 65 (14), pp. 210-211 (1944); *Journal, Inst. Metals*, Vol. 12, p. 35 (1945).

A rapid falling-off of degreasing is frequently observed in electrolytic degreasing with silicate solutions, due to decrease in current caused by build-up of silicate ions around the anode. The more silicious silicates should therefore be avoided for electrolytic cleaning and even with the more alkaline ones certain precautions should be taken. These precautions for ferrous metals indicate that the work should be made the anode, but with non-ferrous work which cannot be made anodic due to a tarnishing by oxygen, the anodes should be of relatively large area and should be cleaned periodically. Addition of other anions such as phosphate, carbonate, or free hydroxide may overcome the difficulty by increasing the permeability of the anodic film.

(292) C. S. Lowe, "Precleaning (Metals) with Solvent Emulsions," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 31, pp. 29-40 (1944).

Solvent emulsions for cleaning metals eliminate hand scrubbing by wetting and loosening adhering solid particles so that they can subsequently be readily flushed away. The methods described are: (1) spraying or dipping with undiluted emulsion. Moderate agitation is preferred. After contact for $\frac{1}{2}$ to 3 min, the work is rinsed with a hot water spray. (2) The diluted emulsion is used in a pressure spray washing machine. (3) The dilute emulsion is used in a soak tank, with or without addition of alkali. A high temperature is desirable. This is the least effective method. These treatments remove gross contamination and leave a physically clean surface. The high efficiency of this type of cleaner results in a long life for an alkaline cleaning bath used subsequently to obtain chemically clean surfaces. The theory of solvent emulsion action and methods of operating control are discussed.

(293) Louis McDonald, "Metal-Cleaning Composition," U. S. Patent No. 2,362,284, November 7, 1944; *Chemical Abstracts*, Vol. 39, p. 2419 (1945).

A mixture of bentonite 10-30, glucono-delta-lactone 10-20, a wetting agent approximately 2 parts, and enough tripoli and infusorial earth to make a total of 100 parts is used for removing oxide, tarnish, or scale from metals.

(294) "Modern Metal Cleaning Processes," *Metal Treatment*, Vol. 11, Autumn, 1944, pp. 179-188.

This article describes cleaning problems encountered in everyday production and is especially valuable to those actually concerned with the cleaning of bulk output. Cleansers are considered from the viewpoint of suitability, efficiency, cost, availability, and safety.

(295) "Cleaning Non-ferrous Metal Parts," *Engineering File Facts* No. 59, *Metals and Alloys*, Vol. 20, September, 1944, pp. 657, 659.

Presented concisely in tabular form this data sheet gives the type of material to be cleaned, the cleanser used, cycle of operations, and a few pertinent remarks on the various processes.

(296) Walter R. Meyer, "Anodic or Cathodic Electrocleaning of Steel?" *Monthly Review, Am. Electroplaters' Soc.*, Vol. 31, pp. 511-514 (1944).

Experimental data are presented showing the time required to clean soiled steel panels electrolytically. The panels were smeared under pressure with lanolin, a lubricant for deep-drawing operations which contains a chlorinated compound, and a pigmented drawing compound containing palm oil. The oils were baked on at 175 F. Several proprietary cleaners and a solution of Na_4SiO_4 were tested. In eight experiments out of ten the panels were cleaned more rapidly when anodic than when cathodic. In the other two experiments the rates were the same. When anodic cleaning was used with panels smeared with the chlorinated oil, the steel was deeply pitted. It is concluded that anodic cleaning of steel is more efficient than cathodic except in the rare case when the soil contains a chlorinated compound. Advantages for anodic cleaning other than greater cleaning speed are the absence of hydrogen embrittlement, and freedom from the possibility of deposition on the work of a metallic smut, which can deposit in cathodic cleaning if a contaminated bath is used.

(297) F. M. Morris, "Chemical Cleaning Practices for Spot-Welding Al Alloys," *Aluminum and Magnesium*, Vol. 1, No. 2, pp. 26-30 (1944); *Chemical Abstracts*, Vol. 39, p. 688 (1945).

The cleaning practices employed by 30 airplane companies were studied. The survey covers vapor degreasers for heavily soiled parts made in mechanical dies where lubricants are used, and also 17 different alkaline types of precleaners and 9 acid types of oxide removers. It reveals widely varying practices by different companies, such as immersions for different lengths of time of the same aluminum alloy and the number of spot weldings made from one cleaning, and the lack of uniform results in the use of oxide removers.

(297A) Compound; Carbon Removal, For Aircraft Engine Parts (Cresol Type), Navy Aeronautical Specification C-86c, April 5, 1944.

Product intended for the removal of carbon from engine parts. Composition as "compound," water 8 per cent maximum, soap 25 per cent maximum, cresol or cresylic acids mixture 67 per cent minimum, as "soap" fatty acids 85 per cent minimum, alkali as K_2O 15 per cent maximum. Requirements include form as liquid at ordinary temperatures, specific gravity, absolute viscosity, acidity, solubility in water and kerosene, performance properties in water solution to conform to stability, corrosiveness, stripping properties, rinsing properties, and oil removing characteristics.

(298) Milton E. Parker and Paul W. Bonewitz (to The Rex Company), "Cleaning Metal Surfaces Such as Those of Large Milk Cans or Other Dairy Equipment," U. S. Patents Nos. 2,338,688-9, June 4, 1944.

A composition for chemically reacting with and releasing calcareous films including calcium and magnesium and calcareous films including protein and fat is formed containing one or more of the acids levulinic, gluconic, and hydroxyacetic acids and a wetting agent, such as an alkyl aryl sulfonate which is compatible but chemically non-reactive with the acid used, such cleaning composition, in aqueous solution, penetrating the films and reacting with their calcareous constituents to solubilize them and release the adherent films but being substantially nonreactive with the metal surfaces being cleaned, and the organic acid mentioned being the sole effective acid cleaning agent in the composition. The use of such compositions in cleaning containers such as milk cans.

(299) Thomas Piper, "Surface Conditioning for Spot Welding Aluminum," *Light Metal Age*, Vol. 2, pp. 12-13 (July, 1944).

A description of the technique developed by Northrop Aircraft Co. for cleaning and etching in one operation as the preparatory step to production spot welding.

(300) T. E. Piper, "Effective Cleanser for Aluminum Prior to Spot Welding," *Metal Progress*, Vol. 46, No. 3, p. 485 (1944); *Journal, Inst. Metals*, Vol. 12, p. 34 (1945).

Single stage cleaning and etching liquid for aluminum and light alloys. Consists of phosphoric acid dissolved in petroleum derivative.

(300A) C. Schwartz, "Alkaline Detergents," U. S. Patent No. 2,359,587, October 3, 1944; "Dishwashing Detergents and Dishwashing Machines," *Bibliographic Series No. 5*, Quartermaster Research and Development Laboratories, p. 10 (1949).

An alkaline detergent composition used in the washing of dairy equipment, milk cans, cake, pie, and other baking pans. Detergent comprises:

	Per Cent
Alkali-metal metasilicate	30-90
Alkali-metal hydroxide	20-40
Alkali-metal perborate	3-20
Water-soluble zinc salt	1-10
Water-soluble calcium salt	1-10

(301) G. W. Scott, Jr., and E. B. Charles, "Contact Resistance Measurements as Control for Preweld Cleaning of Al Alloys," *Welding Journal (Suppl.)*, Vol. 23, pp. 1s-7s (1944); *Chemical Abstracts*, Vol. 38, No. 6, p. 1200 (1944).

Measurement of the contact resistance between test specimens of Alclad 24S-T or 61S-W Al alloys is used as a production control of the chemical cleaning operation used prior to spot welding. The apparatus is described and the results obtained are discussed.

(302) G. W. Scott, Jr., R. V. Ingram, and A. A. Burr, "Factory Preweld Cleaning of 24S-T Alclad and 61S-W Al Alloys with Hydrofluosilicic Acid Solution," *Welding Journal (Suppl.)*, Vol. 23, pp. 443s-454s (1944); *Chemical Abstracts*, Vol. 38, p. 6265 (1944).

The results of plant tests on a 1.18 per cent by weight hydrofluosilicic solution containing 0.1 per cent wetting agent (Nacconol NR) are given. This concentration is not suitable for 61S-W. Laboratory tests indicate that a 0.5 to 0.7 per cent hydrofluosilicic solution is satisfactory for 61S-W. Plant tests show that this concentration is better than the 1.18 per cent solution for Alclad 24S-T. Fuselage panel assemblies are satisfactorily cleaned with the weaker solution.

(303) E. C. Seabright, "Methods for Testing Cleaner Solutions," *Journal, Am. Ceramic Soc.*, Vol. 27, pp. 90-95 (1944).

A "sheet-cleaning" method of test comprising evaluation of die lubricant-soiled sheets of enameling iron is described. Two sets of six sheets 8 by 9 in. were immersed in the bath to be tested. The activity of the bath was determined by removing one sheet

and rinsing under specified conditions after 10 min. If waterbreak occurred, other sheets were removed at specified longer periods for like examinations.

Cleaning tests of three different baths showed that their lives varied, and that only one could be refortified by the addition of rosin soap. Increased amounts of chemicals did not improve cleaning once the baths attained a certain maximum cleaning time, with the exception noted.

While the throughput of surface cleaned is one criterion of bath age, and analysis for available alkali another, the "sheet-cleaning" test proved superior as a method for evaluation. No true relationship was found between the area of surface cleaned and the available alkali, nor between hours of bath worked and the available alkali.

(303a) G. W. Scott, Jr., R. V. Ingram, and A. A. Burr, "Factory Preweld Cleaning of 24S-T Alclad and 61S-W Aluminum Alloys with Hydrofluosilicic Acid Solution," *Welding Journal* (Suppl.), Vol. 23, September 1944, pp. 443s-454s.

A description of the laboratory development of this method and the subsequent commercial tests by Armstrong Cork Co. Results were so favorable that Armstrong drew up specifications for use in their factory.

(304) H. Silman, "Wetting Agents—Their Use in Electroplating and Allied Processes," *Journal, Electrodepositors' Tech. Soc.*, Vol. 19, pp. 131-146 (1944); *Chemical Abstracts*, Vol. 38, p. 6207 (1944).

Alkaline cleaners improved by the addition of wetting agents. Also recommended for use in pickling solutions. Phosphoric acid and wetting agent for pickling preparation of aluminum or its alloys for spot welding. Best results with 5 to 10 per cent phosphoric acid and lists best wetting agents tested.

(305) V. S. Sorenson and S. G. Andrews, "Surface Protection of Aircraft Parts," *Iron Age*, Vol. 153, No. 20, pp. 74-77 (May 18, 1944).

Although this is concerned mainly with steel, some suggestions are made for cleaning aluminum part preparatory to Parkerizing.

(306) E. P. Spruance, "Cleaning House Practice," *Wire and Wire Products*, Vol. 19, pp. 671-675, 678-679 (1944); *Chemical Abstracts*, Vol. 39, p. 260 (1945).

Mainly concerned with pickling and inhibitors.

(307) "Improved Cleaning of (Aluminum) Forgings," *Steel*, Vol. 114, No. 18, pp. 112-

114 (1944); *Journal, Inst. Metals*, Vol. 12, p. 379 (1945).

Use of conveyor system for cleaning aluminum forgings in which immersion in hot 20 per cent caustic soda, which removes graphite picked up from the forging dies, then washed with nitric acid solution to remove the black copper oxide formed in the first operation.

(308) S. G. Thornburg, "Surface Preparation for Spot Welding Aluminum," *Iron Age*, Vol. 154, No. 13, pp. 46-49 (September 28, 1944).

A new type of etchant developed by Consolidated Vultee Aircraft Corp. removes soil and oxide film without attacking the subsurface metal and produces uniform surface contact resistance desirable for consistent spot welds.

(309) R. F. Tylecote and R. W. Pittaway "The Pickling of Alclad D.T.D. 390 and Duralumin B.S.S. 5L3 Prior to Spot Welding," *Quarterly Transactions, Inst. Welding* (London), Vol. 7, pp. 129-135 (1944); *Chemical Abstracts*, Vol. 39, p. 2955 (1945).

Pickling prior to spot welding showed decrease in the surface resistance of the sheets and sheet-to-sheet contact by removal of oxide film. The most suitable pickling agent for aluminum alloys was a 5 per cent phosphoric acid solution with a suitable wetting agent chosen from a series comprising Teepol, Lissapol LS and C, Permal WA, Fixanol C, Tergitol 7 and 4, and Calsalene Oil. The temperature of the bath should be kept below 100 F.

(310) Wingfoot Corp., "Cleaning Articles of Magnesium or Magnesium Alloys," *British Patent No. 561,046*, May 3, 1944.

See reference No. 269.

1945

(311) "Aluminum Tank Cleaner," *Aero Digest*, Vol. 50, No. 3, p. 182 (August 1, 1945).

Rapid cleaning action within the pH range which is safe for aluminum is the outstanding feature of an improved form of KDL No. 1, Kelite material for the hot tank cleaning of aluminum. The improved material removes tough stamping inks such as those which are now being frequently encountered in airframe construction and helps to provide a superior surface for spot welding. It is supplied in powdered form by Kelite Products, Inc., Los Angeles, Calif.

(312) J. Albin, "Sodium Hydride Process for Descaling Steel," *Iron Age*, Vol. 156, No. 19, pp. 58-63 (1945); *Chemical Abstracts*, Vol. 40, p. 308 (1946).

Discussion of the development of the process for the descaling of alloy steels, particularly stainless, through the use of sodium hydride in a fused caustic bath. Practical data for large-scale application are included, the virtues being descaling without hydrogen embrittlement or loss of metal and generally in less time than by other pickling methods.

(313) American Chemical Paint Co., "A Cleaning Composition for Metal Surfaces," British Patent No. 571,976, September 18, 1945; Chemical Abstracts, Vol. 41, p. 4323 (1947).

See U. S. Patent No. 2,396,776, Reference No. 368.

A concentrated, dilutable metal cleaning composition comprising phosphoric acid and water-soluble nonionic emulsifying agent.

(313A) Compound; Steam Cleaning, U. S. Army Air Forces Specification 14128-A, February 21, 1945.

This compound is intended for use in flash boiler type machines for cleaning aircraft surfaces. Detailed requirements include specifications for the absence of resin soap or fatty acids, minimum corrosion, pH, total alkalinity as Na_2O of not less than 22 per cent, solubility, stability, wetting power, and foaming ability from synthetic agent.

(314) Compound; Cleaning, Washing Machine (for Aircraft Metal Parts), U. S. Army Air Forces Specification 14131-A, March 5, 1945.

Detail requirements include water solubility, freedom from fatty acid, rosin soap and objectionable odor, corrosion, pH, minimum total alkalinity as sodium oxide of 22 per cent, stability, interfacial tension against mineral oil, noncaking, minimum of lather, and adequate cleaning.

Material shall satisfactorily clean representative aircraft surfaces soiled in routine operational service.

(315) Compound; Cleaning (for Aircraft), U. S. Army Air Forces Specification 20015-D, July 24, 1945.

Detail requirements include solubility and dispersability tests, odor and toxicity, stability of emulsion, corrosion, flash point, cold test, volatile matter, laboratory cleaning test, practical cleaning test, and package stability.

The laboratory control formulation comprises butyl alcohol, 12 per cent (by weight); Duponol G, 33 per cent (by weight); toluene 55 per cent (by weight).

The standard soil consists of asphalt 43 g, kerosene 100 ml, grade 1120 engine oil 15 ml, and xylene 350 ml. Fifteen milliliters of this solution is spread over an 18-sq in. panel of Alclad 24S-T aluminum alloy and baked in a horizontal position for 3 hr at $195 \pm 5^\circ\text{C}$.

The laboratory test comprises pouring a 10 per cent solution of the cleaner over standard soiled panels (in duplicate), aging for a standard period, and then scrubbing for a given period.

(315A) Preservation and Packaging; Parts and Equipment (General Specification for); Army-Navy Aeronautical Specification AN-P-13a, April 13, 1945.

See Reference 337B, Joint Army-Navy Specification, JAN-P-116.

(315B) Trichloroethylene; Stabilized Degreasing, Army-Navy Aeronautical Specification AN-T-37a, November 26, 1945.

Describes characteristics required, including acidity after accelerated oxidation and the stabilizer, which, if not of the amine type, shall be compatible with equal parts of properly stabilized fluid with aliphatic amine.

(315C) Compound, Grease Cleaning, Non-phenolic Base, U. S. Army Office, Chief of Ordnance-Detroit, Specification TAC ES-No. 398b, February 22, 1945.

Solvent shall be non-corrosive and not attack aluminum, must be soluble in kerosene, and have high penetrating and dispersing action on tar, grease, road dirt, oil, and wax. Must be readily rinsed to form emulsion with water to remove tarry and grease-like material from surfaces which shall be free of oily film and surface residue.

(315D) Compound, Cleaning, Vapor, U. S. Army Office, Chief of Ordnance-Detroit, Specification TAC ES-No. 542b, February 22, 1945. See Reference 265.

Compound intended for use in vapor cleaning machine for cleaning chassis and engines of motor vehicles. General requirements are freedom from vapors of disagreeable odor or taste and non-inflammability; it must emulsify and remove oil, grease, and dirt from metal surfaces when used in hot solution and in concentrations not exceeding $\frac{1}{2}$ per cent by weight to volume. In cold 4 per cent solution the compound should satisfactorily clean cement floors.

Product to contain 3.5 per cent minimum silicate as silica, maximum of 16 per cent carbonate as carbon dioxide and minimum of 6 per cent phosphate as phosphorous pentoxide.

(315E) Compound, Cleaning, U. S. Army Office, Chief of Ordnance-Detroit, Specification TAC ES-No. 734b, February 22, 1945.

Cleaning compound and neutralizer to remove metal oxides, greases and dirt from average 4 gal capacity cooling systems of motor vehicles and to completely neutralize cleaning solution remaining in the system without injury to metal and rubber surfaces. The cleaning to be accomplished in one ap-

plication of compound and neutralization of residual cleaner and second operation followed by adequate flushing.

Base of cleaning compound to be oxalic acid, bisulfate, or a combination of these, with suitable grease detergents. Grease detergents to be other than a hydrocarbon or chlorinated hydrocarbon type. Base of neutralizer to be mild alkali of specified available alkalinity.

(316) W. E. Booth and Imperial Chemical Industries Ltd., "Degreasing Apparatus," British Patent 567,785, March 2, 1945; Chemical Abstracts, Vol. 41, p. 2286 (1947).

Apparatus for degreasing metal and similar nonabsorbent articles by immersion in a heated, volatile solvent zone.

(317) Alfred W. Bromberg, "Cleaning Stainless Steel," U. S. Patent No. 2,389,838, November 27, 1945; Chemical Abstracts, Vol. 40 p. 827 (1946).

Heavy pickling to remove slivers from strip can be eliminated by coating the strip with an aqueous solution containing 1.3 per cent sodium fluoride and 8.3 per cent sodium chloride and passing it through a furnace having a reducing atmosphere. The strip, from which the coating blisters and partially flakes off, is then cleaned from scale by pickling in 15 to 25 per cent hydrochloric acid.

(318) Gilbert C. Close, "Selecting a Liquid Metal Cleaner," *Finish*, Vol. 2, No. 10, pp. 17-19 (1945); Chemical Abstracts, Vol. 40, p. 1128 (1946).

Discussion of cleaning requirements, difficulties from drawing compounds in metal forming operations, mechanics of cleaning, types of cleaners and their characteristics.

(319) Gilbert C. Close, "Pretreating Metals for Quality Finish," *Industrial Finishing*, Vol. 21, No. 10, pp. 24-28 (1945).

Stresses necessity for pretreatment of metal before application of an organic finish for permanence by (1) providing a chemically clean surface, (2) a mechanical roughening of the metal surface to increase mechanical adhesion, and (3) rustproofing as by bonderizing or Parkerizing.

(319A) R. C. Crowley, C. B. Ford, and A. C. Stern, "Perchloroethylene Degreasing," *Journal, Ind. Hyg. Toxicology*, Vol. 27, pp. 140-144 (1945); Chemical Abstracts, Vol. 39, p. 4830 (1945).

Precautions in using which include use only when equipment is fitted with condenser and local exhaust ventilation.

(320) E. I. duPont de Nemours & Co., British Patent No. 557,530, November 24, 1943; Chemical Abstracts, Vol. 39, p. 3245 (1945).

See Reference No. 328, H. N. Gilbert, U. S. Patent No. 2,377,876.

(321) G. G. Eldredge and R. B. Mears, "Inhibitors of Corrosion of Aluminum," *Industrial and Engineering Chemistry*, Vol. 37, No. 8, pp. 736-41 (1945).

Chromates are effective in phosphoric acid, water, alcohol, and dilute nitric acid solutions but tend to cause pitting if present in insufficient amounts. Nitrogen compounds and steel pickling inhibitors are usually most effective in hydrochloric acid. No very effective inhibitors have been found for sulfuric acid or sodium or potassium hydroxide solutions though agar agar, gum arabic, glucose, and gelatin are reasonably effective in the latter. Silicates and fluosilicates are very effective in alkali carbonate or phosphate solutions, but higher concentrations are required at the boil.

(322) Edward Engel, "Metals, Finishes, and Finishing Processes," *Iron Age*, Vol. 156, No. 10, pp. 70-79; No. 11, pp. 64-71; No. 12, pp. 74-83; No. 13, pp. 65-68 (1945); Chemical Abstracts, Vol. 39, p. 5237 (1945).

Comparisons are shown for pickling-degreasing-cleaning procedure, solvent removal of cutting and drawing oils, electrolytic cleaning, and surface treatment of aluminum and magnesium.

(323) U. R. Evans, "Soluble Inhibitors," *Industrial and Engineering Chemistry*, Vol. 37, pp. 703-5, 706 (1945); Chemical Abstracts, Vol. 39, p. 4175 (1945).

If the immediate corrosion product is sparingly soluble, attack is liable to be stifled whereas if soluble, but a secondary product only sparingly soluble, attack will continue.

(324) P. Flament, "Preparing the Metal Surface for Electroplating: Degreasing with Trichloroethylene," *Galvano*, Vol. 14, No. 102, pp. 6-7 (1945); Chemical Abstracts, Vol. 39, p. 4287 (1945).

A review with particular emphasis on the properties of the solvent.

(325) Cleaner, Alkaline, Frankford Arsenal Tentative Specification FED-1310, July 20, 1945.

Covers one grade and two classes of cleaner comprising sodium orthosilicate plus synthetic detergent and sodium metasilicate pentahydrate plus synthetic detergent. The method for evaluation of the cleaners comprises a standard method for applying either a hydraulic mineral oil of viscosity index 80-100 (viscosity at 100 F of 460 to 490 sec Saybolt Universal Viscosity) and a sulfurized lard oil containing approximately 12 per cent sulfur, this dissolved in toluol 9 parts to one part oil. Soil removal is attained in a constant temperature bath, im-

mersing the oiled panels in the bath and rotating them at 10 rpm for 5 min. The degree of cleanliness is determined by atomizing a spray of water onto the panel, and the regions retaining water droplets are sketched on paper ruled into 100 equal squares. The number of squares covered with water, or the percentage of panels cleaned shall be counted for each side of the panel. The results obtained with five panels, resulting in ten observations, shall be averaged, and called the Cleaning Index. Statistical analysis is applied to ascertain the validity of the results.

(326) Wm. Franklin, British Patent No. 571,171, August 9, 1945.

Cleaning agent intended for preliminary cleaning prior to anodic, electroplating or other treatment, comprising

Water	142 ml
Sulfonated castor oil	20 ml
Roast oil	8 ml
Sodium orthosilicate	40 g
With or without acetic acid up to	15 ml

(327) Jean Gauthier, "Metal Cleaning Before Silver Brazing," *Iron Age*, Vol. 155, No. 12, pp. 565-568 (1945); *Chemical Abstracts*, Vol. 39, p. 2278 (1945).

Alkaline and acid cleaning solutions used with proper pH control can consistently provide chemically clean surfaces necessary for joining any metal surfaces.

(328) H. N. Gilbert (to E. I. du Pont de Nemours & Co.), "Metal Cleaning Process and Composition," U. S. Patent No. 2,377,876, June 12, 1945; *Chemical Abstracts*, Vol. 39, p. 3782 (1945).

Sodium hydride is fused in caustic soda at 350 to 500 deg in 1 to 20 per cent solution but 2 to 5 per cent preferred. Ferrous and non-ferrous metals are treated 15 min in fused caustic, quenched in water, and then flash pickled.

(328A) H. N. Gilbert, "Sodium Hydride Descaling Process," *Metal Finishing*, Vol. 43, pp. 492-495, 533 (1945); *Chemical Abstracts*, Vol. 40, p. 822 (1946).

Describes the procedure and application to various steels.

(329) G. W. Gregg (to Bendix Aviation Corp.), "Cleaning Composition," U. S. Patent No. 2,388,789, October 16, 1945.

The cleaners require no special equipment and have no injurious effects on the metal or metal parts, including those which have been subjected to dichromic or anodic treatment such as zinc die castings and aluminum castings. May be employed as surface cleaners or immersion baths and may be used cold.

	Per Cent
Solvent (2/3 ethylene dichloride, 1/3 propylene dichloride)	20.0
Soap (vegetable oil)	10.0
Penetrant (tar acid oil containing not less than 50 per cent tar acid)	33.0
Coupling agent (butyl alcohol)	8.0
Antifoaming agent (denatured alcohol)	6.0
Preservative (finely powdered rosin)	1.0
Blending and thinning agent (sodium bichromate)	2.0
Water (sufficient to dissolve the soap)	20.0

(330) V. Gruendler, "Cleaning Aluminum Munition Components," *Die Casting*, Vol. 3, No. 4, pp. 68-69, 70 (1945).

As a result of extensive experimentation with all types of cleaning, vapor degreasing was chosen for aluminum die-casting work.

(330A) E. E. Halls, "Cleaning and Electroplate Finishing of Beryllium Copper Components," *Metal Treatment*, Vol. 12, No. 42, pp. 71-85 (1945); *Chemical Abstracts*, Vol. 39, p. 5183 (1945).

Discussion of removal of machine lubricants and heat treating scale. Preferred treatment is liquid vapor degreasing with trichloroethylene plus an alkaline cell where soap-base products are removed. Gives a number of acid solutions for removal of oxide film.

(331) P. Hamer, L. Powell, and E. W. Colbeck, "Emulsions of Oil in Water as Corrosion Inhibitors," *Journal, Iron and Steel Inst.* (London), Advance Copy, February, 1945, 18 pp.; *Chemical Abstracts*, Vol. 39, p. 3513 (1945).

Use of an oil emulsion made from a proprietary product comprising mineral oil, the sodium salt of a sulfonated mineral oil, and water. A concentration of 0.5 per cent of this emulsion in water effectively inhibits corrosion of aluminum.

(332) Jay C. Harris, "Trends in Aluminum Cleaning," *Aluminum and Magnesium*, Vol. 1, No. 7, pp. 28-32 (1945).

The trends in usage of alkaline and acid detergents, synthetic detergents, and corrosion inhibitors are traced. Tables are given covering the patent literature, use of wetting agents, corrosion inhibitors, and pertinent specifications.

(333) Jay C. Harris, "Metal Cleaning: I—Indirect Performance Tests," *ASTM Bulletin*, No. 133, pp. 23-28, March, 1945.

Indirect performance tests are given for pH and titration values, colloidal properties, water softening, conductivity, solvent action, surface and interfacial tension measurements, emulsification, rinsability, and stability under conditions of usage covering five general types of cleaning.

(334) Jay C. Harris, "Metal Cleaning: II—Soil Removal Performance Methods,"

ASTM Bulletin, No. 136, pp. 31-39, October, 1945.

An "ideal" outline to be followed for metal cleaning was applied to seventeen published methods, arbitrarily classified by the method of soil removal as: oil removal, solvent emulsion method, electrolytic method, carbon removal, friction removal, paint stripping. Evaluation of the seventeen methods indicates the need for closer control of all factors. The need for more accurate and more sensitive methods is indicated.

(335) Joseph F. Hart (Kelite Products, Inc.), "Composition for Cleaning Metal such as Aluminum and Magnesium," U. S. Patent No. 2,381,124, August 7, 1945; Chemical Abstracts, Vol. 39, p. 5246 (1945).

Compounds, capable of cleaning aluminum and magnesium surfaces without etching them, consist of mixtures of sodium acid phosphates and sodium metasilicates in which, for each mole of P_2O_5 and SiO_2 , there are present, respectively, 3 moles and 0.5 mole of Na_2O . Minor variations (about 10 per cent) from these proportions may be tolerated without imparting etching qualities to the alkaline compounds which are used at concentrations of 2 to 8 oz. per gallon in aqueous solution, preferably at 180 to 212 F. For removing zinc chromate primer from aluminum, the alkaline compounds may be used together with starch, surface-active agents, and a solvent, for example Butyl Cellosolve.

(336) A. J. Hereford, "Practical Information about Cleaning and Cleaners," Southern Power and Industry, Vol. 63, pp. 112-115 (1945); Chemical Abstracts, Vol. 39, p. 2278 (1945).

This discussion of metal cleaning covers the function of the bath constituents and bath control. Newer cleaning compositions include newer wetting agents and detergents. Indicates need for pH control to prevent etching.

(337) Bjorn Israelson, "Inhibitors for the Protection of Iron in Acid Cleaning," Teknisk Tidsskrift, Vol. 75, pp. 983-989 (1945); Chemical Abstracts, Vol. 40, p. 5378 (1946).

A review with many references.

(337A) C. A. Jensen, "Cleaning, Penetrating, and Corrosion Loosening Composition," U. S. Patent No. 2,472,298, September 6, 1945.

Claims a composition consisting essentially of phosphorous trichloride and a liquid petroleum hydrocarbon consisting essentially of lube oil and kerosene 25-75, and the chlorine of the phosphorous trichloride in approximate proportion of 0.3 to 1.0 g-atoms to one liter of composition.

(337B) Packaging and Packing for Overseas Shipment, Preservation, Methods of, Joint Army-Navy Specification, JAN-P-116, May 8, 1945.

Includes methods of cleaning and drying before application of preservatives, on pp. 15 to 43. Choice and application of cleaners include composition of part to be cleaned, nature of parts surface, nature of contaminant to be removed, degree of cleanliness required, availability of cleaning materials and equipment, and hazards involved. Methods of cleaning include any petroleum solvent method, petroleum solvent immersion in two steps, petroleum solvent applied by scrubbing or wiping, two solvent method (with perspiration removal), petroleum solvent spray cleaning, solvent vapor degreasing, removal of perspiration and similar residues, alkaline immersion cleaning, alkaline spray cleaning, alkaline electrocleaning, emulsion spray cleaning, and emulsifiable solvent soak-cleaning.

(338) Aaron D. Johnson (to E. I. du Pont de Nemours & Co.), "Metal Cleaning Composition and Process," U. S. Patent No. 2,383,800, August 28, 1945; Chemical Abstracts, Vol. 39, p. 5246 (1945).

A composition for cleaning steel sheet or automobile radiators consists of 10 to 90 parts of 18 deg Bé hydrochloric acid and 90 to 10 parts of impure aqueous lactic acid (containing 22 to 44 per cent lactic acid), especially the dark colored residual acid obtained as a byproduct of fermentation lactic acid.

(339) Georgia Leffingwell and Milton A. Lesser, "Soap in Aluminum Finishing and Maintenance," Aluminum and Magnesium, Vol. 1, No. 12, pp. 15, 21, 28, 34 (1945); Chemical Abstracts, Vol. 39, p. 5360 (1945).

The use of soap is recommended for the finishing and maintenance of aluminum. The chemical composition of various aluminum polishing pastes and cream is given.

(340) Charles S. Lowe (to the Pennsylvania Salt Manufacturing Co.), "Solvent Emulsion Cleaner," U. S. Patent No. 2,374,113, April 17, 1945.

A solvent emulsion cleaner composition comprising a mixture in parts by weight of 40 to 60 of talloel; 7.6 to 11.4 of triethanolamine; 20 to 30 of 50 per cent potash solution; 12 to 18 of ethylene glycol monobutyl ether; 6.4 to 9.6 of pine oil, the parts by weight of potash being so selected that it will be present in excess after reacting with all of the talloel in the composition.

(341) Ernest H. Lyons, Jr., "What Is a 'Clean' Surface?" Transactions, Electrochemical Soc., Vol. 88, 10 pp. (Preprint) (1945); Chemical Abstracts, Vol. 39, p. 4010 (1945).

Even though few surfaces ever enter an electroplate bath in a truly clean condition even after careful treatment, objectionable films can be replaced by ones more suitable to electroplating. Gives much practical data to support this stand.

(341a) S. Ya. Mogilevskaya, "Improving Working Conditions in Degreasing (Metals) with Trichloroethylene," *Hig. i Sanit.* (U. S. S. R.), Vol. 10, No. 12, pp. 25-31 (1945); *Chemical Abstracts*, Vol. 40, p. 7138 (1946).

Discusses effects of over-exposure and recommends completely enclosed apparatus.

(341A) C. M. Moore, "Treatment of Metal Bodies in Chemical Baths," *British Patent No. 572,336*, October 3, 1945; *Chemical Abstracts*, Vol. 42, p. 509 (1948).

Cleaning bath comprising a solution of glycerol and bisulfate used for removing deposits of metal oxide or flux from metal articles.

(342) F. M. Morris, "Survey of Chemical Cleaning Practices for Spot Welding Aluminum Alloys," *Welding Journal (Suppl.)*, Vol. 24, April, 1945, pp. 61s-64s.

A review covering a survey of the cleaning methods of thirty-nine aircraft companies. Vapor degreasers were used for removing heavily soiled parts where lubricants were used. Seventeen different alkaline types of precleaners were used for removing light oil films, dust, and identification ink markings from parts prior to immersion in the oxide remover. Answers to the questionnaires also showed that nine types of oxide removers were used on Alclad 24S-T and two alkaline types on bare 24S-T. Results and opinions varied so that no specific recommendations are made.

(342A) Compound; Grease-Cleaning, Solvent-Emulsion-Type, Navy Aeronautical Specification C-147, June 11, 1945.

Type I intended for general cleaning of painted as well as unpainted aircraft surfaces and parts. Type II intended for heavy duty cleaning and should be used with caution on painted surfaces.

General requirements include flash point, neutralization number, free alkali, pour point, volatile matter, solubility in kerosene and water, stability of emulsion, cleaning performance against panels soiled with talc, Norit A and SAE No. 70 lubricating oil applied in standard manner, and corrosion. Detail requirements for type I are freedom from phenols and for type II not less than 15 per cent nor more than 25 per cent phenolic material by volume.

(342B) Cleaner; Silicate-Soap Metal, Navy Aeronautical Specification, NAVAER C-109b, October 9, 1945.

Compound intended for use on naval aircraft in cleaning aluminum, magnesium or

other metal surfaces prior to application of organic or inorganic surface coatings. Approximate chemical composition 41 per cent sodium metasilicate, 54 per cent sodium trisilicate and 5 per cent synthetic detergent. Other detailed requirements include pH, surface properties, solubility, cleaning properties in 4 or per gal dilution against metal surfaces soiled in standard manner with light mineral oil, rinsing properties, and corrosiveness.

(343) J. M. Payne, "Vapor Phase Degreasing. Part 1," *Die Casting*, Vol. 3, No. 1, pp. 67, 69, 71-73 (1945).

Discussion of eleven optimum solvent characteristics, the four most common solvents, and the equipment used.

(344) W. H. Petering and A. G. Aitchison, "Degreasing Process," *U. S. Patent No. 2,371,644*; *Official Gazette*, March 20, 1945.

Method improvement in degreasing aluminum and its alloys having decomposing effect upon chlorinated hydrocarbon solvents. The improvement comprises the addition of a minor amount of an oxygen-containing compound having the formula $-X-R-OH$, wherein R is a divalent aliphatic radical, X is hydrogen, alkyl, amino-alkyl, alkoxy, and hydroxy groups which restrain decomposition of chlorinated hydrocarbons in the presence of aluminum or its alloys.

U. S. Patent 2,371,645 claims ethers.

U. S. Patent 2,371,646 claims oximes.

U. S. Patent 2,371,647 claims carboxylic acid ester.

(344a) A. N. D. Pullen (to Aluminum Corporation of America), "Removal of Smudge Film from Brightened Aluminum," *U. S. Patent No. 2,376,082*, May 15, 1945; *Chemical Abstracts*, Vol. 39, p. 3782 (1945).

Aluminum or alloys treated in alkaline bath are given second or acid treatment to produce reinforced film. First or outer film, an undesirable powdery smudge, cracked in water at 80 C and then removed by dipping in a solution containing sulfuric acid 7, aluminum sulfate 0.1, sodium fluoride 0.02, and gelatin 0.2 per cent for about 5 min.

(344A) Compound, Electrolyte and Cleaner (for Can Reconditioning), Jersey City Quartermaster Depot, Quartermaster Corps Tentative Specification 1038, October 3, 1945.

A compound consisting largely of silicate and carbonate with a small percentage of a phosphate. Solubility, pH, specified electric resistivity, and cleaning requirements are given. Cleaning requirement is one of satisfactory usage in practice.

(345) Ray Sanders, "Chemistry of Surface Cleaning," *Iron Age*, Vol. 155, No. 15, pp. 62-67 (1945).

Cleaning is a complex phenomenon involving in various combinations such actions as wetting, emulsification, saponification, colloidal activity, solvent power, pH, buffer action, total alkalinity and acidity, and water conditioning. Much of the enormous amount of time and labor expended in the removal of the common forms of dirt and paint can be cut by a knowledge of the basic factors involved in each surface cleaning job.

(346) Ray Sanders, "Surface Chemistry Declares War on Dirt," *Products Finishing*, Vol. 9, No. 10, pp. 54, 58, 60, 62, 64 (1945).

An article of general interest, which points out that surface chemistry is intimately involved in cleaning and water conditioning, and that this is an expanding field.

(347) Ralph A. Schaffer (to the Cleveland Graphite Bronze Co.), "Cleaning and Etching Ferrous Metal Articles," British Patent No. 566,538, January 3, 1945; Chemical Abstracts, Vol. 41, p. 652 (1947).

Covers a method for cleaning the oxides, scale, grease, and dirt from the surface of ferrous metals and also to etch the surface lightly but uniformly without hydrogen embrittlement. Bath is operated electrolytically, using the work as anode immersed in a hydrochloric acid bath containing ferrous chloride and water.

(348) Arthur P. Schulze, "Cleaning, Conditioning Steel for Painting," *Industrial Finishing*, Vol. 22, No. 1, pp. 64, 66, 68, 70, 72, 74 (1945); Chemical Abstracts, Vol. 40, p. 308 (1946).

Thorough cleaning prior to phosphate coating and followed by painting offers better paint adhesion and greatly improved resistance against rusting or the spread of rust wherever a painted surface is scratched or cut to expose bare metal.

(349) Charles Schwartz, "Alkaline Detergents," U. S. Patent No. 2,391,647, December 25, 1945; Chemical Abstracts, Vol. 40, p. 5273 (1946).

Detergent comprising sodium or potassium metasilicate 60 to 93 per cent, alkali metal perborate 3 to 20 per cent, water-soluble salts of zinc and magnesium 0.1 to 10 per cent each, and low-ratio alkali metal silicate 1 to 10 per cent, is effective for cleaning tin without causing corrosion.

(351) Norman H. Simpson and Kenneth E. Dorcas, "Cleaning of Magnesium Welds," *Aero Digest*, Vol. 48, No. 2, pp. 107, 212 (1945).

To clean magnesium alloys for spot welding, immerse in 5 to 10 per cent NaOH at 150 F for 5 min, rinse thoroughly in cold running water, immerse in 20 per cent chromic acid at 150 F for 2 min, rinse as above

and dry by air blast. Freshly exposed wire-brushed surfaces oxidize rapidly to form an electrically resistant film, which in a few hours becomes sufficiently strong to prevent spot welding and must be removed again. The chemically cleaned metal is relatively inert. If the magnesium alloy has been hot-formed, a somewhat different cleaning process must be used. Chemically cleaned surfaces greatly reduce electrode pick-up and thus increase the life of the electrodes.

(352) C. W. Smith, "Cleaning Aluminum," *Modern Metals*, Vol. 1, No. 7, pp. 16-17 (1945).

Surface contaminants and oxides must be removed before spot welding or paint-bond treatments by (1) either solvent degreasing or alkali precleaning and (2) alkali tank cleaning. Practical methods are described for removal of usual contaminants prior to surface treatment.

(352A) U. C. Tainton, "Removing Oxide Films from Metals and Metal Alloys (Stainless Steels)," British Patent No. 625,089, June 7, 1945; British Abstracts, Part BI, Section 5, February, 1950, p. 212.

Metal immersed in fused caustic soda containing less than 10 per cent of oxidizing agent such as sodium nitrate, sodium peroxide, or sodium chlorate to remove at least part of the oxide film, remaining film being readily dissolved in dilute mineral acids.

(353) F. Tauber, "Avoiding 'Smuts' from Aluminum Etchants," *Iron Age*, Vol. 156, No. 5, p. 57 (1945); *Journal, Inst. Metals* Vol. 12, p. 419 (1945).

"Smuts," the black film left on the surface of aluminum etched by fluoride solutions, is caused indirectly by alloying metals that are dissolved in solution. Smut can be avoided by recovering alloying metals as they are dissolved by allowing them to precipitate on the lead lining of the tank.

(354) Charles D. Townsend, "Selection of Metal-Cleaning Methods," *Materials and Methods*, Vol. 22, pp. 1411-1417 (1945); Chemical Abstracts, Vol. 40, p. 822 (1946).

Cleaning procedures for blasting and tumbling and by alkali, electrolytic, solvent, and vapor degreasing methods are given for carbon alloy, and stainless steels, cast iron, and alloys of copper, zinc, tin, lead, and nickel.

(355) L. W. Townsend, "Sodium Hydride Descaling," *Steel*, Vol. 117, No. 20, pp. 122-123, 180-184 (1945); Chemical Abstracts, Vol. 40, p. 44 (1946).

Pickling at 700 F is rapid, efficient, and not hazardous. Operation of commercial installation is described.

(356) E. P. Troeger, "Vapor Degreasing of Aluminum Parts," *Products Finishing*, Vol. 9, No. 8, pp. 32-40 (1945).

Forming lubricant requires removal prior to surface finishing. Vapor degreasing is suitable for removal of oils, greases, resins, waxes, rouges, and metal chips after hydro-press forming, stamping, threading, grinding, or polishing prior to finishing treatments. Mentions stabilized trichloroethylene and avoidance of "sour" condition. Describes degreaser operation.

(357) Wm. M. Tucker and Robert L. Flint, "The Effect of Various Surface Treatments in Cleaning and Preparing Copper, Nickel, and Steel for Chromium-Plating," *Transactions, Electrochemical Soc.*, Vol. 88, 21 pp. (Preprint) (1945).

The Hull cell was utilized as a quantitative device to study the reluctance of copper or steel cathodes to accept chromium deposits. The commercial methods of surface were considered adequate, provided that oxide and other interfering films were removed from the cathode surface and use of precautions to prevent reforming of these films.

(358) Wayne E. White (to Aluminum Company of America), "Cleaning Aluminum," Canadian Patent No. 428,487, July 3, 1945; *Chemical Abstracts*, Vol. 39, p. 4838 (1945).

An aluminum article is immersed in a bath consisting of molten ammonium fluoride and a molten diluent at a temperature of at least 240 F for at least 5 sec.

1946

(358A) Compound; Cleaning, Fingerprint Removal, For Metal, U. S. Army Air Forces Specification 14156, March 4, 1946.

Intended for removal of fingerprints in cleaning metal surfaces on parts prior to preparation for storage or coating with lacquer. Detail requirements include odor, removal of compound with naphtha, 10 per cent maximum water by volume, stability, flash point, viscosity, metal protection, removal of synthetic fingerprint stain as well as real fingerprints, ability to suppress corrosion by fingerprints, and minimum corrosion characteristics.

(359) A. Ashburn, "How to Work Magnesium Alloys," *American Machinist*, Vol. 90, No. 23, November 7, 1946, pp. 117-132.

Galvanic corrosion is most severe hazard in handling this metal and removal of imbedded foreign particles thus is important. Although emulsion and solvent degreasing can be used, alkaline cleaning, including electrolytic, is most satisfactory. Cleaners of strongly alkaline type for ferrous metals are desirable. Acid cleaning with chromic acid solution is effective in removal of oxide layer. Chemical coatings and graphite lu-

bricants are not removed by other methods. Acid cleaning with sulfuric acid after sand blasting, with three parts per hundred of concentrated acid, is successful but should be followed by acid cleaning or chrome-pickle.

(360) G. Black, "Vapor Degreasing," *Materials and Methods*, Vol. 24, No. 1, pp. 95-97 (1946).

Discusses the properties of trichloroethylene and perchloroethylene. Reviews health problems and the limitations of vapor degreasing process as applied to textiles, plastics, leather, wood, wood products, carbon removal, and drawing and buffing compounds.

(360A) J. Bockman, "Rust Removal and Metal Conditioning," *Organic Finishing*, Vol. 7, No. 2, pp. 15-22, 35 (1946).

Alkaline salt and solvent methods of soil removal present difficulties when used prior to painting or etching, respectively. Rust and scale removal can be accomplished variously with varying degrees of effectiveness. Chemical methods using sulfuric or hydrochloric acid pickling are widely used for removal, but their use may be objectionable. Parts are not allowed to dry between the rust-removal tank and the first water rinse to prevent any further chance for rusting.

(360B) W. E. Booth and Imperial Chemical Industries, Ltd., "(Metal) Degreasing Apparatus," British Patent No. 608,110, February 2, 1946; *British Abstracts*, Part BI, Section 4, p. 479 (1949).

Description of apparatus for use with trichloroethylene, and a method for prevention of overheating.

(360C) British Thomson-Houston Co., Ltd., "Cleaning and Electroplating Processes," British Patent No. 615,110, July 24, 1946; *British Abstracts*, Part BI, Section 7, p. 615 (1949).

Rust, scale, and grease are removed from bearing backings before coating with babbitt metal by electrolytic treatment at 400 to 500 C in a fused salt bath comprising caustic soda with about 10 per cent copper oxide. Articles are first made anodic to oxidize grease, then cathodic to cause rust to flake off, again anodic to dissolve spongy copper, and finally again cathodic to deposit an adherent film of copper.

(361) J. S. Brady, "Aluminum Cleaning Procedures," *Iron Age*, Vol. 158, No. 25, pp. 76-79 (1946).

Lists the properties of a cleaner which should include (1) an inhibitor which will avoid insoluble film formation, (2) presence of calcium or magnesium sequestering agents, (3) no free caustic or high carbonate content, (4) selection of a proper pH, (5) use

of an efficient, stable wetting agent, (6) slight gassing during the induction period, (7) presence of a thin, easily removable inhibitor film after the induction period, (8) cleaner components should be easily soluble and removed in the rinse, and (9) hydrophilic, chemically clean surface should be the result of the cleaning operation.

Discusses in some detail the materials and methods for obtaining properly cleaned surface according to the properties listed.

Includes a check list of eight common aluminum cleaning troubles, their causes, and remedies.

(362) Allen D. Brandt, W. J. McConnell, and R. H. Flinn, "Composition of Some Trade-name Solvents Used for Cleaning and Degreasing, and for Thinning Paints," U. S. Public Health Reports, Vol. 61, pp. 132-143 (1946); Chemical Abstracts, Vol. 40, p. 1953 (1946).

Approximately 200 representative products were selected for chemical analysis. Comprises useful information on the composition and relative toxicities of many of the trade-name solvent products used.

(362A) Compound, Grease Cleaning, Solvent-Emulsion, Bureau of Ships, Specification 51 C65 (Ships), August 15, 1946.

A potash soap emulsion of hydrocarbon of specific flash and fire points, given pour point, solubility in kerosene, stability of emulsion and corrosion. A concentrated material which on dilution with kerosene, diesel fuel or similar distillate, or with water is intended in facilitating removal of grease, oil or other surface contamination, except rust and corrosion of metal parts.

(363) R. H. Burns, "The Chemical Descaling of Boilers," Journal, Inst. Heating Ventilating Engrs., Vol. 14, pp. 376-403 (1946); Chemical Abstracts, Vol. 41, p. 7591 (1947).

Object in chemical cleaning of boilers is to obtain maximum removal of scale with minimum of attack on ferrous parts. Characteristics of scale suitable for removal by chemical means are described, and the action of inhibitors explained. Inhibitors reduce hydrogen embrittlement and prevent attack on ferrous parts. Most satisfactory of all the inhibitors tested were hexamine, glue, and sizing.

(363A) B. B. Button, Jr., and J. Janota, Jr. (to Diversey Corp.), "Aluminum Treating Composition," U. S. Patent No. 2,398,078, March 9, 1946; British Abstracts, Series B1, Vol. 6, February, 1950, p. 223.

Oxide film is removed in a few seconds without corrosion from the surface of aluminum to produce a smut-free surface of long-lasting low electrical resistance, by treatment with a 10 per cent solution of a

79:1:20 mixture of sodium bisulfate, sodium silicofluoride, and sodium chromate.

(364) Charles A. Campbell (to Blanche E. Campbell, Rita B. Fossee, Jean M. Ballew, and Charles A. Campbell, Jr.), "Cleaning Process," U. S. Patent No. 2,399,205, April 30, 1946; Chemical Abstracts, Vol. 40, p. 7671 (1946).

Metal parts cleaned after buffing and drawing operations by a two-phase cleaning fluid consisting of an aqueous emulsion of a suitable solvent and unemulsified solvent. Cleaning effected either by dipping or spraying the work. For dipping, the cleaner bath consists of a layer of solvent on top of a layer of emulsion, whereas a mechanical mixture of water, emulsifier, and an excess of solvent is used for spraying. Formulation contains triethanolamine, 2 parts; oleic acid, 4 parts; methyl amyl ether, 2 parts; pine oil, 15 parts; and petroleum solvent, 95 gal. For dip cleaning, 4 parts of water are added to one part of the mixture; while for spraying, 30 to 40 parts of water are added. An apparatus for spraying is described.

(365) "Products and Processes. Removing Films of Silicone Lubricants," Chemical and Engineering News, Vol. 24, p. 2268 (1946).

The recommended procedure is: (1) fill the apparatus with warm decahydronaphthalene (decalin) and allow to stand for 2 hr or more if necessary. (2) Drain and rinse once or twice with acetone and dry with a stream of filtered air. (3) The decahydronaphthalene can be reused several times before it becomes ineffective.

(366) Bradford J. Cotey, "Boiler-scale Removal by Chemical Cleaning," Power Plant Engineering, Vol. 50, No. 8, pp. 75-77, 124 (1946); Chemical Abstracts, Vol. 40, p. 6722 (1946).

Knowledge of the chemical composition of the scale and the presence of oil is essential. For oil removal, alkaline boiling is necessary. Acids and inhibitors must be carefully selected. Methods of operation are described.

(367) Wm. J. Davis, "Chemical Cleaning of Refinery Equipment," Petroleum Engineer, Vol. 17, No. 9, pp. 51-54 (1946); Chemical Abstracts, Vol. 40, p. 5555 (1946).

Both alkaline and acidic agents are used for cleaning purposes, but mostly hydrochloric acid where chemical cleaning is concerned. Inhibitors and wetting agents are often used in conjunction with acid.

(368) Alfred Douty and Ferdinand Heller (to American Chemical Paint Co.), "Cleaning Composition," U. S. Patent No. 2,396,776, March 19, 1946.

A solution for cleaning metal preparatory to painting including water, phosphoric acid, and tertiary alkylarypolyglycol.

(369) E. I. du Pont de Nemours & Co., "Cleaning of Metals and Metal Articles," British Patent No. 575,103, February 4, 1946; British Chemical Abstracts, BI, June, 1946, p. 212.

Metals other than zinc are treated with a molten bath of alkali cyanide and hydroxide at 300 to 500 F. The melt may also contain 20 to 50 per cent of a diluent which does not react with alkali hydroxides and cyanides, such as alkali and alkaline-earth halides, borates, phosphates, or sodium carbonate. The cyanide content is 40 to 60 per cent by weight.

See U. S. Patent No. 2,380,284, Chemical Abstracts, Vol. 39, p. 5246 (1945).

(370) Enthone, Inc., "Brass Cleaner," Products Finishing, Vol. 11, November, 1946, p. 104.

Alkali brass cleaner claimed to have high cleansing action without harmful effect on active metals.

(371) Enthone, Inc., "Enthone Emulsion Cleaner," Products Finishing, Vol. 11, November, 1946, p. 112.

An emulsifiable solvent cleaner recommended for the removal of soils from all types of metals including those active ones such as aluminum or zinc. Will not harm alkali cleaners when it is dragged into them, but claimed actually to increase cleaning ability.

(372) E. W. Feller and Guy F. Williams, "Chemical Cleaning Takes the Bull Work out of Scale Removal, I," Power, Vol. 90, No. 9, pp. 74-78 (1946); Chemical Abstracts, Vol. 40, p. 6722 (1946).

When solvents can be used, scale is easily removed. A comparison is made of acids, and inhibitors are tabulated and discussed. Various elements and compounds that tend to corrode even in the presence of inhibitors are cited. The use of wetting agents for speeding up solvent action and getting uniform and speedy contact and penetration is discussed.

(373) E. W. Feller and Guy F. Williams, "Chemical Cleaning Takes the Bull Work out of Scale Removal, II," Power, Vol. 90, No. 10, pp. 71-74 (1946); Chemical Abstracts, Vol. 40, p. 7458 (1946).

The cleaning procedure is outlined in detail.

(374) Edwin S. Garverich and William L. Martin (to the Pennsylvania Salt Manufacturing Co.), "Process of Preparing a Detergent Composition," U. S. Patent No. 2,411,090, Official Gazette, November 12, 1948.

The process for preparing a composition, containing by weight 5 to 25 per cent tall oil, 25 to 45 per cent of an alkali metal subsilicate capable of saponifying said oil, at least 5 per cent of an alkali metal phosphate and 25 to 75 per cent of bentonite, which comprises mixing the oil and clay to cause absorption of the oil by the clay and then admixing the alkali metal subsilicate.

(375) Charles P. Given (to Virginia-Carolina Chemical Corp.), "Phosphoric Acid Detergent Composition," U. S. Patent No. 2,413,495, Official Gazette, December 13, 1946.

Aqueous solution of phosphoric acid containing an aqueous emulsion of di-isobutyl phenyl diglycol ether sulfonate, and triamylamine, characterized by high noncorrosive property toward metals due to the synergistic corrosion-inhibiting property of the ether sulfonate and triamylamine. The composition comprises 4 to 15 per cent by weight of the ether sulfonate emulsion, from 20 to 53 per cent phosphoric acid, and 0.1 to 0.3 per cent triamylamine, the ether sulfonate emulsion containing 30 per cent of the ether sulfonate.

(376) Natacha Goldowski (to Welding Research, Inc.), "Cleaning Aluminum," U. S. Patent No. 2,409,271, October 15, 1946; Chemical Abstracts, Vol. 41, p. 374 (1947).

Nonporous oxidic film for good welding characteristics produced on aluminum by immersing the metal in an aqueous solution of 20 per cent sodium sulfate and 10 per cent nitric acid. Time and temperature have no effect upon the thickness of the film produced by immersion.

(377) D. Grant, "Vapour Blast: Some Recent Developments," Machinery Lloyd (London), Vol. 18, No. 22, pp. 67-72; No. 25A, pp. 37-41 (1946); Journal, Inst. Metals, Vol. 15, p. 118 (1947).

Difficulties in maintaining an "electro-clean" surface during the scouring of a 40 by 60-ft steel sieve prior to copper plating were overcome by using a technique known as "copper multicoating." In this process, both the cleaning of the steel and the work hardening of the deposit were carried out with a low-velocity, heavy-sand abrasive stream, the plating proceeding at the same time.

(378) Allen G. Gray, "Modern Finishing of Light Metals," Light Metal Age, Vol. 4, No. 3, pp. 18-20, 22-23 (1946); Chemical Abstracts, Vol. 40, p. 4646 (1946).

Discussion of magnesium cleaning and surface preparation for aluminum brazing sheet.

(379) Allen G. Gray, "Modern Finishing of Light Metals," Light Metal Age, Vol. 4,

No. 8, pp. 8, 16-17, 26-27 (1946); Chemical Abstracts, Vol. 40, p. 6396 (1946).

A discussion of chemical treatments for magnesium, and the improvement of aluminum finishes by soft water rinses.

(380) Allen G. Gray, "Modern Finishing of Light Metals," *Light Metal Age*, Vol. 4, No. 11, pp. 20-21, 23 (1946); Chemical Abstracts, Vol. 41, p. 1590 (1947).

The precleaning of light metals with solvent emulsions is discussed.

(381) A. G. Gray, "Finishing Clinic: Applications of Solvent Emulsion Cleaners," *Products Finishing*, Vol. 10, No. 5, pp. 76, 78 (1946).

Solvent emulsion cleaners were developed to eliminate hard scrubbing prior to electroplating. Thus, they are no substitute for alkaline metal cleaners or for vapor degreasing but supplemental to improve work economically. Usually sold as a concentrate and diluted for use. The solvent used for dilution should be that recommended by the manufacturer, but those often used are kerosene, safety naphthas or benzene, Stoddard solvent, mineral spirits, chlorinated benzene, or hydrogenated naphtha such as Solvesso No. 2. Three general methods of use are: (1) sprayed, dipped, or otherwise contacted with the work, then rinsed, preferably by spraying with hot water; (2) dilute materials used in pressure spray machine at temperature of 140 to 190 F; (3) as soak tank operation, but this is considered the least effective means.

Value of these products lies in their reduction of contamination of subsequent cleaning baths, as for electroplating. Outstanding advantage for precleaning lies in lack of action on sensitive metals, such as aluminum or die castings.

(382) A. G. Gray, "Finishing Clinic," *Products Finishing*, Vol. 10, No. 8 pp. 52, 54, 56 (1946).

Necessity for the removal of soil prior to subsequent processing noted, and indicated that solvent cleaning is useful only as precleaning. Says that the electrolytic or dip-type alkaline cleaning must follow solvent not only for oil but to remove chrome-pickle coating normally present on castings and wrought forms. Strongly alkaline cleansing as in soak or electrolytic cleaning of the following formula:

TSP	4 oz
Washing soda	4 oz
Soap	1 oz
Water	to make 1 gal

As soak at the boil. As electrolytic at 160 to 180 F with the work cathodic at 10 to 20 amp per sq ft for 1 to 3 min or longer. Oxide layers, graphite-base drawing and

forging lubricants, and other water-insoluble or nonemulsifying substances not removed by solvent or alkaline cleaning. Cleaning in a solution of chromic acid preferred since it will remove oxide and hydroxides, a film of which is always present. Immerse for 1 to 15 min at 190 to 212 F in

Cr ₂ O ₃	1.5 lb
Water	to make 1 gal

Use water low in chloride or sulfate to prevent coating on metal.

(383) A. G. Gray, "Scientific Evaluation of Metal Cleaners," *Products Finishing*, Vol. 10, No. 10, pp. 62-64 (1946).

Reviews criteria of surface cleanliness, such as waterbreak, fluorescent oil, and spray waterbreak.

(384) A. G. Gray, "Finishing Clinic: Vapor Degreasing Offers Efficiency and Economy in Finishing Operations," *Products Finishing*, Vol. 10, No. 12, September, 1946, pp. 68, 70.

Advantages lie in economy of space as a result of design and penetration of close-fitting parts without disassembly, and in reduction in the amounts of chemicals used in subsequent cleaning operations. Gives requirements of machine for optimum operation and rules for successful operation from standpoints both of health and economy.

(384A) E. A. Gulbransen, R. T. Phelps, and J. W. Hickman, "Oxide Films Formed on Alloys at Moderate Temperatures," *Industrial and Engineering Chemistry, Analytical Edition*, Vol. 18, pp. 640-652 (1946).

Use of the electron microscope and electron diffraction data to reveal the structure of oxide films.

(385) Jay C. Harris, "Principles of Metal Cleaning," *Metal Progress*, Vol. 50, No. 5, pp. 1063-1064 (1946).

Review of progress in metal cleaning, covering improvements in scheduling of work, new machines and cleaning compositions, and methods for evaluation.

(386) F. Hazel and W. Stericker, "Electrolytic Cleaning of Zinc and Zinc Alloys in Alkaline Baths," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 33, No. 4, pp. 373-388 (1946).

Describes the corrosive effects of several silicates of varying Na₂O to SiO₂ ratios, indicating that the 1:1 and 3:2 ratios are most satisfactory under either anodic or cathodic conditions. 3 per cent solutions of meta-, sesqui-, and sodium carbonate can safely be used for anodic cleaning; the same concentration of the same silicates and of TSP, TSPP, and hexametaphosphate are safe for cathodic cleaning. Lower temperature

or lower concentrations increase the probability of the formation of anodic deposits. 9 per cent concentration of metasilicate causes brown streaks on the cathode and darkens anodes at 8 to 12 per cent. A definite minimum concentration of each chemical required to prevent the formation of anodic coatings on zinc. Higher current densities increase tendency for deposits to form on anodes. Preferable current densities of not over 10 amp per sq ft, 5 to 10 amp sufficient and higher current densities feasible with cathodic cleaning. Interval between washing and rinsing should be reduced to a minimum to prevent air oxidation.

(387) E. F. Houghton & Co., "Houghton-Clean 200 Series Cleaners," *Products Finishing*, Vol. 11, December, 1946, p. 107.

A series of seventeen cleaner formulations for general metal cleaning work claimed to contain new synthetic detergents, as well as new alkalis.

(388) J. E. Hyler, "Metal-Cleaning Equipment and Methods," *Organic Finishing*, Vol. 7, No. 3, pp. 9-16, No. 4, pp. 25-31, No. 5, pp. 9-17 (1946); *Chemical Abstracts*, Vol. 43, p. 544 (1949).

A detailed discussion of the methods of operation of vapor degreasers, steam guns, tumbling and burnishing barrels, and centrifugal washing.

(388A) C. H. Jeglum, "Tips on Cleaning of Zinc Die-Castings," *Materials and Methods*, Vol. 24, No. 2, p. 425 (1946); *Metallurgical Abstracts*, Vol. 16, Part 7, p. 434 (1949).

(388B) J. Karle, "The Scattering of Electrons by Hydrocarbon Films," *Journal, Chemical Physics*, Vol. 14, No. 5, pp. 297-305 (1946).

Electrons are ideal for the study of thin layers of hydrocarbon films because of their low penetrating value. Useful for films at boundary lubrication.

(389) G. Leffingwell and M. A. Lesser, "Soap in Metal Products Finishing," *Products Finishing*, Vol. 11, No. 2, November, 1946, pp. 80-82, 84, 86, 88.

Describes properties of soaps which make them useful to the metal trades. Much used in various cleaning processes, generally in various combinations with other materials, especially with alkalis. Especially useful for aluminum, brass, and die castings. Gives several examples of formulas used in electrocleaning. Other usages suggested are in lapping compounds, ball burnishing, and for their lubricating qualities in special finishes.

(390) Milton A. Lesser, "Aluminum Cleaners," *Soap*, Vol. 22, No. 9, pp. 44-47, 169 (1946).

A review containing fifteen formulas, as well as industrial and home usage information.

(391) Milton A. Lesser, "Metal Polishes," *Soap*, Vol. 22, No. 12, pp. 147, 149, 151, 153 (1946).

A review which includes data on all types of polishes, particularly those effective by chemical and abrasive action.

(392) Lowell R. McCoy (to Wyandotte Chemicals Corp.), "Cleaning Composition for Aluminum and Aluminum Alloys," U. S. Patent No. 2,413,365, December 31, 1946; *Chemical Abstracts*, Vol. 41, p. 4089 (1947).

Composition for cleaning prior to spot welding which consists of a dilute aqueous solution of a mixture of ammonium fluosilicate and sodium bisulfate, ammonium sulfate, and a small amount of wetting agent.

The treated surface is suitable for spot welding any time within the next 24 hr in factory practice, or within the week in places where contamination by handling is not apt to occur.

(393) W. R. Meyer, "Electroplating upon Aluminum," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 33, 163, pp. 269-277 (1946).

Discusses cleaning prior to plating. Cleaners which contain silicates may leave an absorbed film upon surface that interferes with proper plating. Alkalies such as caustic soda, trisodium phosphate, tetrasodium pyrophosphate, and sodium carbonate in various combinations are satisfactory. Presence of surface-active agents, especially those not affected by calcium, magnesium, or aluminum salts, useful to increase detergency and create foam to reduce hydrogen-caustic spray.

(393A) M. A. Miller and W. E. White (to Aluminum Company of America), "Removal of Oxide Coating from Aluminum Surfaces," U. S. Patent No. 2,399,134, March 23, 1946; *British Abstracts*, Part BI, Section 6, February, 1950, p. 223.

Oxide film removed from the surface of aluminum without corrosion of underlying metal by immersion for about 10 min in a mixture of water (1 to 5 per cent), hydrofluoric acid (5 to 40 per cent), and an alcohol (55 to 94 per cent) such as methanol, glycol, glycerol, or partly etherified polyhydric alcohols melting below 40 C.

(394) Rick Monsel, "Survey of Methods for Cleaning Metal," *Industrial Finishing*, Vol. 22, No. 11, pp. 26-28, 30, 32, 34, 38-39 (1946); *Chemical Abstracts*, Vol. 40, p. 7138 (1946).

Factory methods, materials, and equipment used for cleaning metal surfaces.

(394A) Cleaner, Steam, Navy Aeronautical Specification NAV AER C-152, July 29, 1946.

Intended use on aircraft in cleaning aluminum, magnesium, and other metal surfaces prior to application of organic or inorganic surface coatings and cleaning of surfaces to remain unpainted.

Detail requirements include silicates as SiO_2 , 8 to 12 per cent by weight, phosphate as P_2O_5 , not less than 14 per cent, and total alkalinity calculated as Na_2O not to exceed 33 per cent by weight. Also included are solubility, buffer and pH capacity. Soap shall be synthetic product soluble and stable in the silicate solution as prepared for use, foam power, surface tension, cleaning properties against oil-coated aluminum panel, corrosiveness, stability, rinsing, and coarseness.

(394B) C. Nielsen, "Method of Evaluating Alkali Cleaners," *Organic Finishing*, Vol. 7, No. 8, pp. 9-13 (1946).

Suggests laboratory evaluation test using either the oil present as a soil, or lacking this, SAE No. 50 lubricating oil. A specific method for soiling, by dipping and draining of cold-rolled 20 gage steel panels $2\frac{1}{4}$ by 3 in. is given. The composition to be tested was transferred to one liter beakers and the wash routine expected to be used is followed.

Cleanliness is determined by dip testing of the cleaned panel in a copper sulfate bath consisting of 2 oz copper sulfate and 1 oz of sulfuric acid per gallon.

A rinse test using milk bottles or glass panels is described, with emphasis given on the improved effectiveness with increased water rinse temperature.

(395) F. A. Patty, "Environmental Control of Metal Cleaning Processes," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 33, pp. 808-819, 945-953 (1946).

Control methods and safe concentration limits given for impurities in the air from metal cleaning operations.

(396) W. H. Pfeiffer and V. A. Williamitis, "Obstacle in Cleaning Drawing Compounds from Enameling Iron," *Journal, Am. Ceramic Soc.*, Vol. 30, No. 3, pp. 90-94 (1946).

Drawing compounds probably containing fatty acids or their salts are insoluble in water and alkaline cleaners and are soluble in organic solvents. Laboratory method of reproducing these conditions are described and the utility of precleaning with organic solvent prior to alkaline cleaning is indicated.

(397) S. T. Powell, "Acid Cleaning of Boilers and Auxiliary Equipment," *Transactions, Am. Soc. Mechanical Engrs.*, Vol. 68, pp. 905-917 (1946); *Chemical Abstracts*, Vol. 41, p. 820 (1947).

Discussion of various cleaning agents and inhibitors. The commonly used solution is 4 to 7 per cent hydrochloric acid plus an inhibitor and other reagents. Corrosion minimized by control of temperature of cleaning solution between 140-160 F. Provision for venting of hydrogen evolved, as well as the necessity for using skilled personnel, is stressed.

(397A) Compound, Dishwashing, Quartermaster Corps, Office of Quartermaster General, Tentative Specification 220, July 12, 1946.

Both types I and II are meant for mechanical dishwashing machines, type I above 120 ppm water hardness and type II below 120 ppm. Detail requirements include turbidity, foaming, water softening, corrosion, pH, fineness, rate of solubility, gelation, cleaning efficiency, and relative cost. The cleaning efficiency test is a practical one of observation under closely controlled conditions of operation.

(398) "Laboratory Report of Phosphatizing," Rock Island Arsenal, Office of Publishing Bureau, No. 32864, April, 1946.

Gives complete details for cleaning and phosphating, including testing procedures and examples of imperfect work.

Vapor degreasing is preferred, but in cases where soap-containing rust preventives and greases are used, may have to use alkaline silicate soak baths, since emulsion degreasing is unsuitable.

(399) Rylands Brothers Ltd., Reginald S. Brown, and Arthur Brierley, "Electrochemical Surface Cleaning of Metal Articles," *British Patent No. 576,698*, April 16, 1946; *Chemical Abstracts*, Vol. 42, p. 1832 (1948).

Prior to coating an iron or steel article with zinc, tin, copper, or other non-ferrous metal, the surface is cleaned by vigorously attacking with a strongly oxidizing acid followed by making the article the anode in an electrolytic system in an electrolyte of mineral or organic acids or salts of them.

(400) Arthur P. Schulze, "Preparing Aluminum for Finishing," *Light Metal Age*, Vol. 4, March, 1946, pp. 14-17.

A broad general discussion of various methods of cleaning. Included are sand blasting, solvent degreasing, vapor degreasing, and alkaline cleaning, as well as several methods for specialized purposes.

(401) Arthur P. Schulze, "Degreasing and Deoxidizing Aluminum for Spot Welding," *Light Metal Age*, Vol. 4, No. 9, pp. 11-13 (1946); *Chemical Abstracts*, Vol. 41, p. 7142 (1947).

Thorough surface preparation is required for spot welding. Various surface cleaning techniques including degreasing and deoxi-

dizing, as well as factors governing their effectiveness, are discussed. Chemical deoxidizing using mild acids having a sulfur base is described.

(402) Chester W. Smith, "Acidic-Atmosphere Evaluation of Cleaning on the Corrosion of Steel," Transactions, Electrochemical Soc., Vol. 89, 21-page preprint (1946).

Since cleaning methods produce differences in ease of corrosion of the surface under exposure to normal atmosphere present indoors in industrial plants, the "acidic-atmosphere cell" was devised for reproducing this type of corrosion. The cell, which incorporated significant factors regularly found in plants, such as moisture, acidic gases, oxygen, and temperature variations, was used for evaluating different cleaning materials and methods. Compared abrasive, alkaline compound, volatile or partially volatile solvents, and emulsified solvents. Emulsified solvent cleaning leaves a film of nonvolatile emulsifier which reduces tendency to corrosion.

(402A) H. R. Spence and H. W. Hooker (to Hooker Electrochemical Co.), "Removal of Oxide from Metals," U. S. Patent No. 2,395,694, February 26, 1946; Chemical Abstracts, Vol. 40, p. 2778 (1946).

Oxide removed from iron, nickel, cobalt, and their alloys with each other and with other alloying elements by soaking in a fused caustic soda bath containing 1 to 20 per cent (preferably 5 to 10 per cent) active oxidizing agent at 300-600 C (preferably 500 C) for 1 to 20 min, washing, dipping 15 to 60 sec in dilute non-oxidizing acid such as 1 to 20 per cent hydrochloric acid (preferably at 65-85 C).

(403) S. Spring, H. I. Forman, and L. F. Peale, "Method of Evaluating Metal Cleaners," Industrial and Engineering Chemistry, Analytical Edition, Vol. 18, No. 3, pp. 201-204 (1946). See Reference 325.

Utilized a mechanically and thermostatically controlled method for removal of a high viscosity mineral oil and a sulfurized lard oil, applied in a standard manner to prepared metal sheets. The cleaned panels are evaluated by atomizing water onto the metal surface, sketching the retained droplets on a sheet of paper divided into 100 squares, and the percentage of water retained for both sides is measured on five replicates, and a statistical method for verifying the validity of replicates is used.

(404) Samuel Spring and Louise F. Peale, "Oil Removal by Alkaline Cleaners. Effect of Surface Condition of Metals," Industrial and Engineering Chemistry, Vol. 38, pp. 1063-1066 (1946).

The presence of a film, probably a metal oxide, and the smoothness of the surface of

the metal greatly influence the ease of oil removal from metal surfaces. Mineral oil is removed most readily when the oxide is present, while a fatty oil containing considerable free fatty acid is removed more readily when the oxide film is absent, and this is attributed to soap formation. The surface condition, whether cold-rolled or worked, rather than gross roughness (within a limited range) is more important in determining cleaning performance. Ease of cleaning is reduced as the roughness is increased. The oxide film effect appears to be lost beyond a certain level of considerable roughness.

(405) Boleslaus J. Szatyn (to Solventol Chemical Products, Inc.), "Cleaning Method," U. S. Patent No. 2,399,267, April 30, 1946; Chemical Abstracts, Vol. 41, p. 7671 (1946).

Cleaned parts sprayed with a mixture of emulsified and free solvent may cause the cleaning fluid to become completely emulsified by the effect of soil removed. This can be overcome by maintaining the emulsion at pH 2.5 to 3.5 by the addition of acids or salts such as sulfuric acid, several phosphorous acids, organic acids, and acid salts.

(406) Sydney G. Thornbury (to Turco Products, Inc.), "Composition for and Method of Cleaning and Coating Metal," U. S. Patent No. 2,408,155, Official Gazette, September 24, 1946.

A composition for removal of oil, grease, metal oxide, and the like from, and deposition of a metallic phosphate coating on, the metal being cleaned, comprises a solution consisting of water, phosphoric acid, aromatic petroleum solvent, and a coupling agent comprising by weight 25 to 33 per cent butyl alcohol and 21 to 29 per cent ethyl alcohol.

(407) C. D. Townsend, "Preparing Steel Surfaces for Maximum Paint Adhesion," Products Finishing, Vol. 11, pp. 50-51 (1946).

CrysCoat claimed to have cleaning, wetting, and emulsifying properties is said to contain a phosphate which leaves crystalline nonmetallic coating which absorbs oil as required for satisfactory paint bond.

(408) S. J. Trezac, "Metal Cleaning by Solvent Degreasing," Industrial Finishing, Vol. 20, No. 7, pp. 23-28, 112 (1946); Chemical Abstracts, Vol. 40, p. 4016 (1946).

Discussion of solvent and vapor degreasing.

(409) C. Von Sonnenberg, "A Comparison of Cleaning Processes for Die Castings," Die Castings, Vol. 4, No. 11, pp. 55, 57-58, 60, 62 (1946).

Considers cleaning from the basis of the metals being processed and the soils encountered. Methods are discussed for hot tank cleaning, cold tank cleaning (emulsion), electrocleaning, vapor degreasing and the machines used.

(410) Lionel De Waltoff, "Postwar Metal Cleaning Methods," *Metal Progress*, Vol. 50, No. 5, pp. 1064-1065 (1946).

Improved design and better utilization of equipment were the main developments, the vapor solvent degreasing, emulsion degreasing, and alkaline cleaners still being used for most problems.

(411) Helen E. Wassell (to Carbide and Carbon Chemical Corp.), "Metal Tarnish Remover," U. S. Patent No. 2,393,866, *Official Gazette*, January 29, 1946.

Composition comprising water, abrasive particles, poly-oxethylene diol 15 per cent by weight (molecular weight about 400), a tarnish-removing substance chemically active and used in conjunction with the diol, and a wetting agent.

(412) E. G. West, "Electroplating on Aluminum," *Journal, Electrodepositors' Tech. Soc.*, Vol. 21, pp. 211-226 (1946); *Chemical Abstracts*, Vol. 41, p. 1565 (1947).

Cleaning and surface preparation described.

(413) E. G. West, "Electroplating on Aluminum. Cleaning, Surface Preparation, Coating, and Deposition," *Metal Industry* (London), Vol. 69, pp. 224-226, 264-266, 268 (1946); *Chemical Abstracts*, Vol. 41, p. 34 (1947).

The presence of the normal oxide film on aluminum surfaces is the main difficulty in deposition of other metals. This film, which may be as thick as 10^{-7} mm. reforms as soon as removed. The first necessity was to provide some preplating treatment to first clean the surface completely, then to provide some type of deposit to protect the metal surface, or to form a base for a suitable bond. Because of the position of aluminum in the electrochemical series, formation of immersion deposits readily results.

The process for plating can be divided into three distinct operations: (1) cleaning, (2) preparation of the surface, and (3) deposition of the coating. Exact details for accomplishing the deposition are given.

(413A) Tom Winshurst, "Cleaning and Finishing Aluminum Products," *Industrial Finishing*, Vol. 23, No. 2, pp. 32-34, 46, 48 (1946); *Metallurgical Abstracts*, Vol. 16, Part 7, p. 433 (1949).

Description of conveyorized spray painting arrangement and other treatment procedures are detailed.

(413B) "Cleaning and Acid Pickling: Properties of 'Teepol X,'" *Wire Industry*, Vol. 13, No. 151, p. 382 (1946); *Metallurgical Abstracts*, Vol. 17, Part 1, p. 44 (1949).

Properties and uses of Teepol X, an alkyl sulfate type synthetic detergent, manufactured from petroleum by-products.

(414) R. A. Wyant, D. J. Ashcroft, T. B. Cameron, and K. H. Moore, "Surface Preparation of Aluminum Alloy Sheet for Spot Welding," *Welding Journal* (Suppl.), Vol. 25, February, 1946, pp. 65s-76s.

The main part of the investigation consisted of a series of experiments to determine the effect of precleaning, rinsing, and heat-treating operations on the subsequent surface preparation of aluminum alloys for spot welding.

(415) A. S. Yeliner and B. E. Tsukerman, "Cleaning Valves of Internal-Combustion Engines," U. S. S. R. Patent No. 67,114, September 30, 1946; *Chemical Abstracts*, Vol. 42, p. 5138 (1948).

Deposited lead is removed from valves by treatment in a mixture of alcohol and sodium acetate at a pH about 3.6 in the presence of zinc dust.

(416) C. B. F. Young, "Organic Chemistry," *Products Finishing*, Vol. 10, No. 4, pp. 56, 58, 62, 64 (1946).

General information on cleaning. Considerable discussion of the need for adequate rinsing, and methods for its accomplishment.

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(416A) W. E. Booth (to Imperial Chemical Industries, Ltd.), "Metal Degreasing," *British Patent No. 624,552*, July 2, 1947; *British Abstracts*, Part BI, Section 5, February, 1950, p. 195.

Frothing is stopped in a degreasing process in which an alkaline solution containing a wetting agent is sprayed onto articles by placing a hot horizontal surface such as coiled steam or hot water pipes above the level of the degreasing solution collecting in the sump of the apparatus.

(417) E. Bucknall, Thomas Evans, P. E. White, et al., "Scale Removal," *Journal, Birmingham Metallurgical Soc.*, Vol. 27, pp. 354-377 (1947); *Chemical Abstracts*, Vol. 42, p. 1549 (1948).

Oxide scales of metals formed in manufacture or during heat treatment are discussed, along with methods of scale removal by pickling processes, the sodium hydride process.

(418) Thomas E. Burkhardt (to General Motors Corp.), "Cleaning, Stripping, and Polishing Metal Surfaces," U. S. Patent No.

2,428,141, September 30, 1947; Chemical Abstracts, Vol. 42, p. 2528 (1948).

Anodic treatment of parts to be cleaned in a bath containing from 1 to 12 oz per gal of tetrasodium pyrophosphate. The bath is kept at a temperature of 150 to 210 F. A preferred direct current potential of 7 to 12 v is used. The bath exerts not only a cleaning but also a polishing effect on surfaces of iron, steel, copper and copper alloys, nickel, and aluminum. Certain types of paint or enamel are not affected by the bath, and parts partially coated with such materials may be safely cleaned.

(419) B. B. Button, Jr., "Metal-Cleaning Methods," Southern Power and Industry, Vol. 65, No. 6, pp. 55-57 (1947); Chemical Abstracts, Vol. 41, p. 4664 (1947).

A review of principles, suggesting the use of wetting agents and inhibitors. Temperature and agitation are likewise important factors in cleaning.

(419A) Ciba, Ltd., "Cleaning Preparations for Removing Metal Oxides or Metal Salts from Heavy Metal Surfaces," British Patent No. 622,316, February 5, 1947; British Abstracts, Part BI, Section 5, February, 1950, p. 195.

Iron, copper, silver or brass may be cleaned with an alkaline solution of an aromatic hydroxy compound containing not less than two neighboring hydroxy groups such as pyrocatechol, gallic acid, or tannin, and a reducing agent such as alkali hypophosphite or hydrosulfite.

(419B) "Painting," Corps of Engineers, War Department, Specification No. 1 (Int.), 137 pp., March 12, 1947.

Purpose of the manual is to standardize painting practice and materials for the guidance of the Corps. Gives methods for cleaning of metalwork for painting and has sections on removal of oil and grease, steam cleaning, mechanical methods of removal, sandblasting, flame cleaning, and rust inhibitive wash treatment. Considers these methods in detail as applied to the specific surface and its condition.

(419C) J. B. Delany (to Imperial Chemical Industries, Ltd.), "Tempering and Cleaning of Ferrous Metals," British Patent No. 628,707, November 3, 1947; British Abstracts, B I-5, p. 654 (1950).

Articles tempered in fused caustic soda at greater than 400 C, then cleaned at less than 400 C in caustic soda containing 1 to 20 per cent sodium hydride, sodamide, or sodium cyanide.

(420) J. R. Ewing, "Metal Cleaning—Methods and Results," Steel, Vol. 120, No. 18, pp. 100-101, 140-144 (1947).

Two basic cleaning problems, ordinary and quality, are indicated. The first entails those in which the finish, tolerances, surface condition, and appearance are not controlling factors; while quality cleaning includes those of delicate surfaces and prior to finish or protective coatings.

Two basic cleaning types—removal of oxide films and other stripping action, and cleaning without attack on metal surface.

Straight solvent cleaning is effective for many problems. Emulsion cleaning is useful if the bath is maintained at 180 F or above, but fingerprints covered with oil are not removed and rust spots occur.

Describes multiple-phase system, comprising organic and inorganic solvents for mixture with water to produce a bath with an upper layer of unemulsified solvent and a lower layer of a dispersion or emulsion of organic solvents in water. This system of use in dip cleaning, but best in spray washing processes.

Process utilizes extraction of soil from circulated system giving increased life and larger dirt load before reduction in efficiency of cleaning. Removes soil and protects surface because processes of cleaning by aqueous and nonaqueous media are performed simultaneously.

Protection against corrosion of surface treated with multiphase system is attributed to film of near monomolecular thickness.

(421) J. R. Ewing, "Metal Cleaning—Methods and Results," Metal Finishing, Vol. 45, No. 10, pp. 82-84 (1947).

See Reference 420.

(422) Cleaner, Soap-Alkali, Heavy Duty (for Metal Surfaces), Proposed Federal Specification, February 10, 1947.

Specification is intended to cover mixture of 70 per cent sodium metasilicate pentahydrate, 20 per cent tetrasodium pyrophosphate anhydrous, and 10 per cent sodium resinate for the removal of grease, oil, sludge, and other similar foreign matter from magnesium alloys, brass, bronze, steel, and aluminum alloy surfaces, and fabricated parts.

(423) Stema, Cleaner, Proposed Federal Specification, February 10, 1947.

Nonhygroscopic, granular mixture in powder form of a synthetic detergent and alkaline salts of suitable alkalinity and water softening ability.

For cleaning aluminum, magnesium, and metallic surfaces and machines, for removal of grease and oil from various ferrous and nonferrous metal surfaces.

(424) N. P. Gentieu, "Cleaning and Phosphate-Coating Home Appliances at Hotpoint, Inc.," Products Finishing, Vol. 12, No. 3, pp. 16-18, 20, 22 (1947).

Describes methods, products, and equipment used.

(425) A. G. Gray, "Finishing Clinic," *Products Finishing*, Vol. 12, March, 1947, pp. 58-60, 62.

Electric alkaline cleaning is not entirely satisfactory prior to plating because of overcleaning in some areas while removing heavier grease films from others. Sometimes buffing, particularly in automatic setups, cakes on the compound. Consequently, either solvent or emulsion cleaning as a preliminary step to electrocleaning is desirable.

Selection of alkaline cleaning cycle depends to a considerable extent upon the type of equipment available, but selection of alkali should be from the functional standpoint since it is established that blisters in copper deposits on zinc die castings can result from excessive alkaline cleaning. Many proprietary compounds are available. Non-proprietary compositions are 4 to 6 oz per gal of trisodium phosphate as recommended by the New Jersey Zinc Co., operated as a cathodic electrocleaner at 180 F.

(426) A. G. Gray, "Finishing Clinic," *Products Finishing*, Vol. 12, May, 1947, pp. 58-59, 62.

Before electroplating, the metal surface must be given special treatment after the cleaning operation to prevent surface unevenness and poor plate adherence. If left in natural metal finish, all oil and grease is removed by washing with organic solvents or by alkaline cleaning in $\frac{1}{3}$ oz each of trisodium phosphate and soda ash per gallon. The cleaning procedure is followed by appropriate pickle treatment just prior to performance of plating operation.

Inhibitors are added to alkaline cleaners to prevent excess corrosion and since these adhere to the metal it is advisable to follow the inhibited alkaline bath with a nitric acid wash.

Other factors stressed are a proper wetting agent and an adequately controlled rinse operation.

(427) R. E. Gwyther, "Preparation of Metals for Painting," *A Review, Corrosion*, Vol. 3, No. 4, pp. 201-207 (1947); *Journal, Inst. Metals*, Vol. 15, p. 166 (1947).

Solvent degreasing, alkaline cleaning, mechanical cleaning, pickling, and flame cleaning methods are reviewed, and the pretreatment of iron and steel, zinc, aluminum, and magnesium considered in detail.

(427A) R. Groves, "Cleaning of Metals. I. Choice of Process and Cleaning Agent," *Metallurgia*, Vol. 37, pp. 40-42 (1947); *Chemical Abstracts*, Vol. 42, p. 1548 (1948).

Account of primary points to be considered.

(427B) R. Groves, "Cleaning of Metals. II. Alkali Cleaners," *Metallurgia*, Vol. 37, pp. 100-102 (1947); *Chemical Abstracts*, Vol. 42, p. 1548 (1948).

The most generally used are unsuitable for brass, aluminum, tin, zinc, and copper, but by use of suitable inhibitors they may be adapted to aluminum cleaning. Principal types, applications, and details of operation are discussed.

(428) J. C. Harris, "Fundamental Aspects of Metal Cleaning," *Bulletin, Am. Ceramic Soc.*, Vol. 26, No. 12, pp. 389-392 (1947).

Covers metal surfaces, their chemical reactivity, condition, and surface physical characteristics. The soiling agents, attracting forces, neutralization of the forces, and materials to accomplish are discussed. Methods for soil removal are discussed.

(429) F. P. Heard, "Chemical Finishing of Metals," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 34, pp. 1035-1042 (1947).

Hydrogen embrittlement of steel springs was found to be due more to prior pickling than to phosphating. Springs with a baked synthetic lacquer also showed evidence of hydrogen embrittlement.

(430) Robert S. Herwig, "Effect of Water Conditioning on Metal-Finishing Operations," *Iron Age*, Vol. 159, No. 13, pp. 48-52 (1947); *Chemical Abstracts*, Vol. 41, p. 3032 (1947).

The effect of hard, softened, and demineralized water upon plating and cleaning cycles. The advantages of softening and demineralizing are listed.

(431) William H. Hill (to Koppers Co.), "Cleaning and Pickling of Metals," U. S. Patent No. 2,425,320, August 12, 1947; *Chemical Abstracts*, Vol. 42, p. 99 (1948).

Concerns new pickling inhibitors for use in acid solution prepared by condensation of an aldehyde such as formaldehyde, with an amine thiocyanate. The effectiveness of the inhibitors are established by data on weight loss of open-health and Bessemer plate when pickled at 180 F in 50 per cent sulfuric acid for 10 to 30 min.

(432) Kenneth M. Huston (to Western Electric Co., Inc.), "Electrolytically Cleaning and Plating Conductors Consisting Principally of Copper," U. S. Patent No. 2,422,902, June 24, 1947; *Chemical Abstracts*, Vol. 41, p. 5805 (1947).

The wire to be plated is passed through molten sodium hydroxide and sodium nitrate, then washed and passed through a cleaning bath of fluosillicic acid as the cathode.

(432A) Cleaning and Preparation of Ferrous Metal Surfaces for Organic Protective

Coatings, Joint Army-Navy Specification, JAN-C-490, August 21, 1947.

Consists of two grades, I for production of adherent phosphate deposit on previously cleaned ferrous metal surface, and II of cleaning treatments which leave the metal surface substantially bare. Also of two types, 1, mechanical and 2, hot alkali cleaner (immersion, spray or electrocleaning).

(432B) M. S. Kantrowitz and E. J. Gosnell, "Detergents for the Printer," *Printing Equipment Engineer*, Vol. 74, No. 2, pp. 15-17 (1947); *Chemical Abstracts*, Vol. 41, p. 6739 (1947).

A survey of the use and applications of detergents in the graphic-arts industries. See Reference 600.

(433) L. Karunina, "Washing Media for Aluminum Apparatus," *Myasnaya i Moloch-naya Promyshlennost*, No. 6, pp. 75-76 (1947); *Chemical Abstracts*, Vol. 42, p. 1439 (1948).

The use of sodium silicate as an inhibitor to corrosion of aluminum in the presence of alkali salts.

(434) Richard W. Kingerley, Jr. (to E. I. du Pont de Nemours & Co.), "Electrolytic Cleaning Process," U. S. Patent No. 2,420,602, May 13, 1947; *Chemical Abstracts*, Vol. 41, p. 6164 (1947).

The addition of a substance to mineral oil used in lubricating strip steel from the cold-rolling operation aids materially in the process of cleaning the strips electrolytically.

Film strength of the mineral oil is increased by adding from 0.5 to 2.0 per cent by weight of tritolyol phosphate, and the spreading characteristics of the oil in the presence of water are increased by adding from 0.05 to 0.3 per cent by weight of lorol phosphate and an oil-dispersible wetting agent such as sulfonated castor oil in from 0.2 to 0.5 per cent.

(435) Walter Klabunde (to E. I. du Pont de Nemours & Co.), "Solvent for Degreasing Iron and Aluminum," U. S. Patent No. 2,422,556, June 17, 1947; *Chemical Abstracts*, Vol. 42, p. 98 (1948).

Inhibition of deterioration of trichloroethylene on exposure to air, light, and heat to form hydrogen chloride and resinous substances controlled by the addition of from 0.1 to 1.0 per cent acrylonitrile and an antioxidant such as N-alkyl pyrrole.

(435A) H. Krause, "Cleaning and Polishing Production Goods in Barrels (Tumbling Barrels). II. Ball Burnishing Process," *Metalloberfläche*, Vol. 1, pp. 169-171 (1947); *British Abstracts*, Part BI, Section 4, p. 52 (1949).

The finishing of both hard and soft metal parts by the ball burnishing process is described briefly, with reference to the design and operation of the tumbling barrels, the choice of ball size, etc.

(435B) S. H. Hunt and N. Drey, "Decarbonizing and Degreasing Compositions," *British Patent No. 590,123*, July 9, 1947; *Chemical Abstracts*, Vol. 44, p. 8636 (1950).

Composition for removal of carbonaceous deposits from parts of internal-combustion engines comprises a coal-tar distillate containing phenolic compounds, an emulsifying agent such as an alkali metal salt of naphthenic acid or a soap-forming fatty acid, and an aqueous solution containing an alkali metal silicate.

(436) A. Mankowich, "Testing of Alkaline Metal Cleaners," *Metal Finishing*, Vol. 45, No. 12, pp. 77-78, 88 (1947).

Various methods of evaluating alkaline metal cleaners, and the limitations and advantages of each are discussed.

(437) Rick Mansell, "Survey of the Cleaning Methods Used for Iron and Steel Surfaces," *American Paint Journal*, Vol. 31, No. 49, pp. 54, 56, 60 (1947); *Chemical Abstracts*, Vol. 41, p. 6513 (1947).

A review.

(437A) Ruth D. Marshall and Harold C. Wilson, "Detergents," *British Patent No. 591,035*, August 5, 1947; *Chemical Abstracts*, Vol. 45, p. 886 (1951).

Detergents for cleaning hotel dining ware, including table silver, contain an inert non-alcoholic organic solvent, insoluble in water, such as carbon tetrachloride or odorless kerosene, and a mononuclear alkylaryl sulfonate, the solvent being dispersed in water.

(438) "Degreasing: Applications of a Synthetic Wetting Agent (Teepol X)," *Metal Industry*, Vol. 70, No. 23, p. 425 (1947); *Journal, Inst. Metals*, Vol. 15, p. 208 (1948).

The improvements in aqueous degreasing effected by the use of Teepol X are described.

(439) O. M. Morgan, "A Surface-Active Agent for the Cleaning of Metals," *Monthly Review, Am. Electroplaters' Soc.*, Vol. 34, pp. 430-441 (1947).

The cleaning efficiency of both alkaline and acid cleaners is improved by the addition of a detergent of the alkyl aryl sodium sulfonate type. The method for evaluation of cleaning results is the fluorescence method by ultraviolet radiation.

See Reference 195.

(439A) Compound, Carbon-Removing, *Navy Dept. Specification 51C55b*, October 1, 1947.

Compound intended for use in softening and facilitating removal of carbon, wax, gum, oil, and tar, etc., from engine assemblies. Composition to be a two-phase liquid; an upper layer consisting essentially of water and a lower layer of emulsifying agents and organic solvents. Volume of upper layer not to be more than 20 per cent of total volume of the compound. Other detail requirements listed are flash and pour points, free alkali and acid, specific gravity, emulsification, corrosion, and carbon removal. The carbon removal test is performed with an artificially soiled panel.

(440) Milton E. Parker and Paul W. Bonewitz, "Acid Cleaning of Metal Containers," U. S. Patent No. 2,424,049, July 15, 1947; Chemical Abstracts, Vol. 41, p. 7585 (1947).

Milk cans are cleaned by using a dilute solution of gluconic and/or levulinic acid and, optionally, an alkyl aryl sulfonate detergent, a suitable enzyme such as pepsin, trypsin, or papsin, a water-soluble oil.

See Reference 298.

(440A) S. H. Phillips, "Aircraft Finishing and Related Problems," Organic Finishing, Vol. 8, No. 9, pp. 18-26 (1947).

Either anodizing or chromidizing require a thorough cleaning in a mild alkaline soap, followed by ample rinsing. A final acidified rinse is desirable to free or neutralize the surface of all traces of alkaline film, chiefly silicate before treatment in chromic acid baths. Since many new alloys require artificial aging in an oil bath, the oil must be removed first by solvent cleaning, then by alkaline cleaners.

(441) Edwin P. Plueddemann and Richard Rathman (to Westvaco Chlorine Products Corp.), "Process of Degreasing Aluminum and Magnesium Surfaces," U. S. Patent No. 2,423,343, July 1, 1947; Chemical Abstracts, Vol. 42, p. 98 (1948).

Formamide and its N-substituted derivatives is used to inhibit the corrosion of aluminum and magnesium alloys by chlorinated solvents.

(442) Pierre Prevot, "The Use of Aluminum in the Dairy Industry," Revue de l'aluminium. Vol. 24, pp. 121-128 (1947); Chemical Abstracts, Vol. 41, p. 5996 (1947).

A cleaning solution that does not corrode aluminum has the following composition:

Sodium carbonate . . .	10 g per liter
Sodium silicate . . .	2 g per liter or
Sodium carbonate . .	5 g per liter
Trisodium phosphate.	5 g per liter
Sodium silicate . . .	2 g per liter

(443) "Improved Actusol Degreasing Agent," Products Finishing, Vol. 14, February, 1947, p. 120.

Described as completely odorless and with increased degreasing and emulsifying power.

It is claimed it can safely be used on all metals, plastics, and finishes.

(443A) E. Rabald, "Chemical Cleaning of Kettles, Pipelines, Warm Water Installations, etc.," Metalloberfläche, Vol. 1, pp. 262-263 (1947); Chemical Abstracts, Vol. 43, p. 7399 (1949).

(444) I. Richards, "Preparing Steel for Painting," Organic Finishing, Vol. 8, No. 7, pp. 29-30 (1947); Chemical Abstracts, Vol. 43, p. 544 (1949).

Concerns the acid and flame cleaning processes for preparation of steel for good paint adhesion. The requirements for good adhesion and the need for surfaces free from rust and mill scale are discussed.

(444a) Norizo Sawatsubashi, "Compounds to be Used for Cutting, Corrosion Preventing, and Washing of Metals," Japanese Patent No. 175,393, December 3, 1947; Chemical Abstracts, Vol. 44, p. 6380 (1950).

Cleaner comprises a coconut oil soap containing potassium chromate.

(444A) P. Schane, Jr., "An Evaluation of Steel Cleanliness," Electric Furnace Steel Proceedings, Vol. 5, pp. 3-10 (1947).

Inclusions may be classified as macro-, micro-, and submicroscopic, and these are objectionable because aside from appearance, may be the nucleus for corrosion or a concentration of stresses due to notch effect, the latter causing rejection due to cracks or low strength and ductility. Inclusions may also be classified as exogenous originating from outside sources as from refractories, or endogenous as products of deoxidation or other reactions. There may be many component types, the commonest being oxides, sulfides, silicates, and alumina. A further classification is as to shape.

Methods of testing are macroscopic, microscopic, fracture and magnaflux. Later method uses iron powder and magnetization.

(445) A. P. Schulze, "Preparing Iron and Steel for Bright Zinc Plating," Products Finishing, Vol. 11, No. 4, January, 1947, pp. 46-48, 50, 56, 58.

Absolute necessity for clean surface in bright zinc plating is emphasized.

Methods of cleaning employed listed as still or soak tank, electrocleaning, automatic mechanical washing machines of a variety of types, and combinations of the foregoing. Discusses requirements for cleansing compositions for various types of cleaning processes.

(446) Lyman B. Sperry (to Chrysler Corp.), "Prewelding Cleaning of Aluminum," U. S. Patent No. 2,430,435, November 4, 1947; Chemical Abstracts, Vol. 42, p. 2570 (1948).

Aluminum surfaces to be spot-welded are freed of oxide by use of a solution containing oxalic acid 4 to 8 oz and sodium nitrate 2 to 6 oz per gal of water. A suitable, acid-stable wetting agent may be added. After oxide removal the surfaces are rinsed and dried.

(447) S. Spring and L. F. Peale, "On the Mechanism of Metal Cleaning," *Metal Progress*, Vol. 51, pp. 102-106 (1947).

Believe that evidence is lacking to substantiate the idea that saponification and emulsification are important primary processes in metal cleaning. Their views are said to tend to confirm those as applied to textiles.

Oil removal takes place in the following stages as observed under the microscope: (1) shrinkage of oil film, (2) expulsion (gathering), (3) oil globule formation and (4) removal of oil globule. Viscosity is thus important, and more so than thickness of film. Lard oil has thicker base, indicating stronger bond of attachment than mineral oil.

The authors believe that the following facts tend to refute the idea that cleaning takes place by chemical reaction between fatty oil and cleaner to form soap because: (1) sodium hydroxide is poorer than weaker alkalis, (2) mineral oil (unsaponifiable) requires higher alkali than lard oil for removal, (3) lard oil is adequately removed by addition of surface-active agent in contrast with mineral oil which is not.

The effect of alkaline materials attributed to lowering of interfacial tension, as the more alkaline compounds lower this to a greater extent, as measured by the interfacial tension between mineral oil and aqueous solutions of the agents. Also explains the use of neutral surface-active agents on this basis. This also is explanation of poor action of other weaker alkalis.

Presence or absence of oxide film determines to a considerable extent the ease of oil removal (probably depends upon the bond between oil and metal surface, especially at the globular stage). Removal of mineral oil from unpickled surface is attributed to reduction of attraction by presence of oxide film, hence removed more readily. Pickling reduces oxide and increases bond, hence cleans less readily. By contrast, fatty oil with considerable amounts of free fatty acid gives reverse result and the same mechanism is used to explain.

The practical application of this work is that there is less need to increase alkali than to add surface-active agents to undercut the oil and reduce its attraction for the metal.

(447A) R. Springer, "Degreasing and Cleaning," *Metallüberfläche*, Vol. 1, Part I, pp. 199-206; Part II, 237-239; Part III, pp.

257-258 (1947); *Chemical Abstracts*, Vol. 43, p. 7399 (1949). (Reviews with 176 references.)

(447B) F. P. Spruance and E. Snyder (to American Chemical Paint Co.), "Treating Metal Surfaces," *British Patent No. 629,562*, April 28, 1947; *British Abstracts*, B 1-4, p. 509 (1950).

Iron, zinc, copper, aluminum or their alloy surfaces are degreased and cleaned in water solution (pH 5 to 6) of a primary or secondary alkali or ammonia phosphate. Solution may contain ferric phosphate or aluminum phosphate, a wetting agent, and an oxidizing agent such as alkali nitrite or nitrate.

(448) Esther M. Terry and Morris Kaplan, "Copper-Cleaning Composition," *U. S. Patent No. 2,428,804*, October 14, 1947; *Chemical Abstracts*, Vol. 42, p. 98 (1948).

A homogeneous mixture of an acid, an oxidizing agent, and a brightening agent contains 5 parts by weight sulfuric acid, $4\frac{1}{2}$ parts 30 per cent hydrogen peroxide, 3 parts acetic acid, and $87\frac{1}{2}$ parts by weight water.

(448A) P. M. Van Arsdell, "Health Hazards of Metal-Cleaning Compounds," *Organic Finishing*, Vol. 8, No. 11, pp. 31-41; No. 12, pp. 30-38 (1947); Vol. 9, No. 2, pp. 18-28; No. 3, pp. 38-43; No. 5, pp. 20-25 (1948); *Chemical Abstracts*, Vol. 43, p. 787 (1949).

A thorough discussion of the many health hazards involved from vapors, dusts, and splashes. Largely concerned with the hazards of chlorinated solvent usage.

(448B) H. Vogel, "The Cleaning of Metal Objects of Antiquity, Museum Pieces, and Bronze Monuments," *Metallüberfläche*, Vol. 1, pp. 107-111 (1947); *Chemisches Centralblatt*, 1947, 1, p. 951; *Chemical Abstracts*, Vol. 43, p. 3335 (1949). (Listed without abstract.)

(449) Carl Von Sonnenberg, "Comparison of Cleaning Processes for Die Castings," *Die Casting*, Vol. 4, pp. 55-62 (1947); *Chemical Abstracts*, Vol. 41, p. 4758 (1947).

The final acid or alkaline condition of the metal surfaces can have marked effect upon the tenacity of paint or enamel applied to them. Proper cleaning is followed by a thorough rinse, preferably with an acid rinse to provide a pH of from 6 to 7.

(449A) "Electro-Plating," *U. S. Department of Commerce, Technical Advisory Service*, PB No. 81656, 7 pp., February 18, 1947.

Incident to advice on electroplating includes layouts which show electro-, mechanical, and degreaser cleaning equipment.

(450) Wm. C. Wall and George A. Wilkens (to E. I. du Pont de Nemours & Co.), "Blast

Cleaning," U. S. Patent No. 2,426,072, August 19, 1947; Chemical Abstracts, Vol. 41, p. 7818 (1947).

Carbonized aluminum and magnesium aircraft engine parts are cleaned by blasting them with particles of a synthetic resin such as polymethyl methacrylate, polystyrene, and other resins having an impact strength of less than 0.6 ft-lb per in. and an elongation at break not exceeding 8 per cent. Advantages over cereal grit cleaning are increased cleaning rate, decreased cost, freedom from dust, and easy storage.

(450A) "Cleaning, Preserving, Sealing and Related Materials," War Department Manual TM 9-850, June, 1947.

Indexed 67-page booklet of seven sections and appendix of references. Forty-five cleaning materials are listed, with directions for use.

(450B) E. G. West, "Aluminum in the Dairy Industry," Journal, Soc. Dairy Technology, Vol. 1, pp. 31-34 (1947); British Abstracts, Part BI, Section 6, p. 75 (1949).

The behavior of aluminum and its alloys in contact with cleaning and sterilizing solutions and the range of aluminum base compositions for dairy applications are discussed.

(451) H. S. Whalen, "How to Clean Metals," American Machinist, Vol. 91, No. 23, pp. 109-124 (1947).

Cleaning of steel, particularly referred to, and non-ferrous metals to a limited extent. Cleaning costs are reduced by changing compounds used by including in the materials of previous step, as in drawing or buffing, a material which will aid in its subsequent removal without any effect on the properties of the compound in question.

Subdivides cleaning into four groups: (1) solvents, (2) self-emulsifiable or emulsifiable solvents, (3) alkalies, and (4) acids.

Discusses advantages and disadvantages of each group on the basis of cleaning substances, work to be cleaned, and the operations involved in their usage. Describes types of machines used in cleaning operations. Specifically mentions the advantages of adequate rinsing.

(452) Wayne E. White (to Aluminum Company of America), "Cleaning Aluminum," U. S. Patent No. 2,431,595, November 25, 1947; Chemical Abstracts, Vol. 42, p. 1868 (1948).

Aluminum surfaces cleaned by immersion in molten ammonium fluoride at 300 to 375 F. Oil stains and oxide coatings are removed and surface is brightened in one operation.

1948

(452A) Remover; Paint, Aircraft, Finish, U. S. Air Force Specification, 14119-C, July 1, 1948.

Intended for use in removal of paint finish such as camouflage, from aircraft surfaces. Compound not to contain phenolic or cresylic constituents. Performance tests comprise consistency and flow, evaporation, corrosion, removal power, paint and remover residues, and package stability and service use.

(452B) Compound; Cleaning, Washing Machine (For Aircraft Metal Parts), U. S. Air Force-Navy Aeronautical Specification, AN-C-174, July 6, 1948.

Material is intended for use in industrial washing machines where foaming is objectionable, for cleaning aircraft metal parts. Detailed requirements include corrosion as tested by gas evolution, pH, total alkalinity, solubility, stability, interfacial tension, caking, lather persistence, and cleaning by practical testing.

(452C) Polish; Aluminum, Air Force-Navy Aeronautical Specification, AN-P-88, September 20, 1948.

Material intended for use as a hand polish for removal of tarnish from unpainted aluminum-clad surfaces. Detail requirements cover polishing ability, restoration and retention reflectance, corrosiveness, flammability and flash point, caking, and tarnish removal (latter from an artificially tarnished surface).

(452D) Cleaning Liquid, Mirror, Searchlight, Nonfreezing Type, U. S. Army Specification 4-113, August 6, 1948.

Intended as cleaning liquid for searchlight mirrors, but may be used for cleaning any metal mirrors. Contents per 16-oz bottle should be as follows:

Calcium carbonate	28 g
Rouge, polishing	1.0 g
Black nigrosine, water solution	15 mg
Denatured ethyl alcohol	350 cc
Water	50 cc
Petroleum ether	25 cc

Cleaner will leave no residue on reflector surface which will reduce the reflectance of the surface by more than 2 per cent according to test.

(453) H. L. Alexander, "Cleaning Nonferrous Metals with Sodium Hydride," Wire and Wire Products, Vol. 23, pp. 35-41, 96, 97 (1948); Chemical Abstracts, Vol. 42, p. 1548 (1948).

Present laboratory and commercial experience indicates that further use of the sodium hydride descaling process in the non-ferrous field is practicable in cleaning some metals and alloys.

(453A) G. Black and P. Lewis, "Vapor-Degreasing Equipment (for Metals)," Organic Finishing, Vol. 9, No. 10, pp. 9-11, 16 (1948).

Discussion of types of equipment, heating, design, vapor loss prevention, and handling.

Claim that there is no best equipment, best solvent or best machine, but definitely a best unit for each particular job.

(453b) G. H. Boss, "Etchant for Welds in Aluminum Alloys," *Metal Progress*, Vol. 53, p. 372 (1948); *Chemical Abstracts*, Vol. 44, p. 5302 (1950).

A macro-etchant consisting of a 1:1:1 mixture of hydrochloric, hydrofluoric acids, and water gives good grain contrast on seam welds in aluminum alloys.

(453B) Remover, Paint; Noninflammable, Water Rinsable (for Use in Contact with Synthetic Rubber), Bureau of Aeronautics Specification 52R16 (Aer), April, 1948.

Many detail requirements are given. Performance tests include stripping properties, condition of stripped surface, adhesion, corrosiveness, rinsability, noninflammability, bomb stability, and effect on synthetic rubber.

(453C) Compound, Dishwashing (for Use in Mechanical Dishwashing Machines), Bureau of Ships Specification 51 C49 (Ships), November 1, 1948.

Intended for machine and not for manual use. Requirements include stability, lack of odor, freedom from abrasive, nontoxicity, foaming, water softening, turbidity, pH, and buffer capacity, corrosiveness, and fineness.

(453D) P. H. Cardwell and L. H. Eilers, "Use of Wetting Agents in Connection with Acid Inhibitors," *Industrial and Engineering Chemistry*, Vol. 40, pp. 1951-1956 (1948).

Corrosion rates of certain N-ring types of inhibitors are further lowered by the addition of certain wetting agents. Factors affecting value as inhibitor are cross-sectional area, adsorption and closeness of packing of the molecule. Wetting agents did not prevent pitting but greatly reduced their amount and size.

(453e) Ciba, Ltd., "Removing Heavy-Metal Compounds (from Corroded Metal Surfaces)," Swiss Patent No. 250,383, June 1, 1948; *Chemical Abstracts*, Vol. 43, p. 6149 (1949).

Mixtures containing (1) a water soluble salt of an N-free water soluble acid capable of forming complex heavy metal compounds, e. g., salts of citric, thioglycolic, and tartaric acids and sulfite waste liquor; (2) strong reducing agent whose reducing action is greater than glucose to reduce iron to the ferrous state without hydrogen evolution; and (3) alkaline reacting material. Wetting agent may be used to improve effectiveness. May be used in paste form.

(453E) Ciba, Ltd., "Removal of Metal Compounds from Heavy Metal Surfaces," Swiss Patent No. 252,362, October 16, 1948;

Chemical Abstracts, Vol. 43, p. 7405 (1949).

Heavy metals such as iron, copper, silver or alloys such as brass, are cleaned by alkaline solutions containing 2.5 per cent of aromatic oxides with at least two adjacent hydroxyl groups, such as tannin, pyrocatechol, gallic acid and others, and reduction means such as alkali dithionates. Products can be applied in paste form.

(454) J. T. Clenny (to General Electric Co.), "Cleaning and Electroplating Process," U. S. Patent No. 2,442,195, May 25, 1948; *Chemical Abstracts*, Vol. 42, p. 5780 (1948).

A ferrous metal object is cleaned and copper-plated by alternate operation as anode and cathode in a fused caustic soda bath containing 1 to 10 per cent copper oxide. The surface is then cleaned free of alkali by water and may be finally fluxed and tinned.

(454A) M. B. Diggin and D. G. Foulke, "Surface Treatments for Magnesium," *Metal Finishing Industry Guidebook*, pp. 208-221 (1948).

Magnesium parts to be chemically or electrochemically treated must be chemically clean. Employed are mechanical cleaning which if used must be followed by pickling to etch 0.002 to 0.005 in. of metal from the surface. Either solvent or emulsion degreasing can also be used. Chemical cleaning by highly caustic alkaline cleaners, either soak or electrocleaning, are described. Electrocleaning said to decrease the time and improve the quality of cleaning. Pickling methods such as chromic, sulfuric, or nitrosulfuric methods are described.

(454B) P. F. Dougherty and C. H. Brooks, "Cleaning Tubular Heat Exchangers," *Petroleum Refiner*, Vol. 27, No. 12, pp. 676-678 (1948).

Inhibited acid is best for water side of coolers. Soluble oil is useful where fouling material is completely soluble in oil or can be held in suspension. Use of emulsified oil covered by patent application.

(454C) H. Drever, "Salt Descaling Baths," *Industrial Heating*, Vol. 15, No. 1, pp. 40-52, 166-168 (1948); *Journal, Iron and Steel Inst.* (London), Vol. 159, p. 222 (1948); *British Abstracts*, Part BI, Section 5, p. 377 (1949).

The du Pont and the "Virgo" processes of descaling with sodium hydride baths are described with details of equipment used. The processes differ mainly in the bath temperature used, which are 375 C and 482 C, respectively.

Disadvantages of acid descaling are given, and show that molten salt baths give better removal of oxide scale. Sequence of operations in the descaling of a range of materials given. Sodium hydroxide process differs from the sodium hydride process as the op-

erating temperature of the former is considerably higher. Stresses the importance of frequent removal of sludge accumulating in the bottom of the bath.

(454D) R. Dubrisay and F. Arlet, "Spreading of Oils on Metals," *Comptes rendus*, Vol. 227, pp. 531-533 (1948); *Chemical Abstracts*, Vol. 43, p. 465 (1949).

Shows that the addition of from 1 to 10 per cent oleic acid to hexadecane increases the spreading of the oil only when oil is present. The explanation for the phenomenon is attributed to the fact that copper oleate is formed when the surface is copper, and this reduces the surface tension. Analogous results were obtained with lead, but oleic acid has no effect on nickel. Neither stearic nor palmitic acids changed the amount of spread.

(455) T. C. DuMond, "Metal Cleaning," *Materials and Methods*, Vol. 28, No. 5, pp. 84-94 (1948); *Chemical Abstracts*, Vol. 43, p. 544 (1949).

Common methods for cleaning many ferrous and non-ferrous metals and alloys are described.

(456) A. E. Durkin, "Surface Oxide Removal Important in Final Processing of Aluminum," *Materials and Methods*, Vol. 27, No. 4, pp. 82-85 (1948).

Lack of standardization of oxide removal methods is attributed to differences in the film on the part being processed. Cleaning and oxide removal stressed as being separate operations. In cleaning of buffed metal two operations are necessary: (1) solvent degreasing and (2) inhibited alkali cleaning. In alkaline cleaning the importance of pH is stressed. Can also use emulsion degreasing in combination with inhibited alkaline cleaner. Surface resistance values measured in a standard manner and data presented to show expectation in uniformity of treatment as oxide removers: (1) caustic soda is unsatisfactory, (2) chromium-sulfuric acid has low surface resistance values but critical immersion time, (3) hydrofluoric acid has low surface resistance value but immersion time is prohibitively critical, (4) hydrofluosilicic acid did not produce sufficiently low resistance values. Also evaluated three unnamed compounds.

(457) N. L. Evans (to Imperial Chemical Industries, Ltd.), "Cleaning Metals," U. S. Patent No. 2,442,802, June 8, 1948; *Chemical Abstracts*, Vol. 42, p. 5832 (1948).

Metals and alloys other than zinc and its alloys may be descaled by immersion in a bath of fused salts. The composition of this bath may range from 1 to 10 per cent by weight of an alkali metal cyanide, 0.1 to 2.0 per cent by weight of water, and the remainder principally alkali metal hydroxide. The water causes effervescence to lift the re-

duced oxide from the metal to leave it clean. Acid pickling is unnecessary when using this bath except for alloys high in chromium.

(457A) N. L. Evans, "Sodium Hydride Process of Descaling Metals," *Journal, Electrodepositors' Tech. Soc.*, Vol. 24, pp. 9-13 (1948); *British Abstracts*, Part BI, Section 4, p. 181 (1949).

The process and plant used are described. The advantages claimed are listed.

(457B) N. L. Evans, "Descaling Metals. Advantages of the Sodium Hydride Process," *Metal Industries* (London), Vol. 73, pp. 287-288 (1948); *Chemical Abstracts*, Vol. 43, p. 100 (1949).

A description of the process, procedure, and the various stages involved. Process applicable to any metal which is not attacked by molten caustic soda at a temperature not exceeding 370 C.

(457C) N. L. Evans, "The Sodium Hydride Process and New Method of Descaling Metals: Application to Wire and Strip," *The Wire Industry*, Vol. 15, No. 170, pp. 105-107 (1948); *Metallurgical Abstracts*, Vol. 16, Part 8, p. 518 (1949).

The descaling bath used consists of molten anhydrous caustic soda containing approximately 2 per cent sodium hydride maintained at 350 to 370 C. Plant construction and operation described in some detail. Advantages of process are listed.

(458) U. R. Evans, "Mechanism of the Formation of Films on Metals," *Pittsburgh International Conference on Surface Reactions*, pp. 71-76 (1948); *Chemical Abstracts*, Vol. 42, p. 8040 (1948).

Presents picture of the mechanism of film formation on metals leading to the four equations established by Vernon. Growth of films proceeds in four stages: (1) Attachment of oxygen to the surface by chemisorption with formation of two-dimensional layer of a solid solution. (2) Lateral growth during which the oxide film is in lateral compression. (3) Thickening of film after entire surface is covered. This is believed to result from outward movement of cations and electrons and explains the fact that films with poor electronic or ionic conductivity are protective. (4) Periodic crack-heal growth due to sudden cracking or blistering resulting from internal stress of the existing film.

(459) H. N. Gilbert (to E. I. du Pont de Nemours & Co.), "Metal Cleaning," U. S. Patent No. 2,448,262, August 31, 1948; *Chemical Abstracts*, Vol. 43, p. 509 (1949).

Metal cleaning with sodium hydride 1 to 2 per cent in fused alkali metal hydroxide bath at 300 to 600 C, the bath electrolyzed, using the work as cathode.

(460) C. H. Groom, "Chemical Cleaning in the Refinery," *Petroleum Engineer*, Vol. 19, No. 7, pp. 110-114 (1948).

Gives typical process-side deposits which must be removed in addition to water-side deposits.

(461) R. Groves, "Cleaning of Metals, III, Further Operations," *Metallurgia*, Vol. 37, pp. 147-149 (1948); *Chemical Abstracts*, Vol. 42, p. 2565 (1948).

Discussion of cleaning of buffed and polished parts and for electroplated parts, with particular attention to degreasing solvents and to cleaning by petroleum distillates.

(462) R. Groves, "Cleaning of Metals, IV, Emulsifiable Cleaners," *Metallurgia*, Vol. 37, pp. 217-219 (1948); *Chemical Abstracts*, Vol. 42, p. 3302 (1948).

Emulsifiable cleaners are based on a penetrating and dispersing agent capable of being dissolved in oil. The agent is compounded with paraffin or a safety solvent in the ratio of 1:10. This solution is usually sprayed on the parts to be cleaned, or the parts may be dipped. Cleaning is followed by rinsing in a spray of cold water to remove the dirt-carrying solution which forms an emulsion with the water.

(463) R. Groves, "Cleaning of Metals, V, Mechanical Cleaning Machines," *Metallurgia*, Vol. 37, pp. 267-268 (1948); *Chemical Abstracts*, Vol. 42, p. 4511 (1948).

The simplest forms of apparatus will suffice for many metal parts, but for the majority, machines especially designed for the operations involved are needed to deal with the work economically and efficiently. Various types of mechanical cleaners are described.

(463A) J. W. Hensley, A. O. Long, and J. E. Willard, "Reactions of Ions in Aqueous Solution with Glass and Metal Surfaces," *Journal, Am. Chemical Soc.*, Vol. 70, p. 3146 (1948).

Sorption of radioactive sodium ion to the extent of from 0.2 to 5 monolayers (arbitrarily the number of ions required to cover the macro surface area if each ion covers an area equal to square of its ionic crystal diameter) by cleaned aluminum, steel, silver, and platinum during a few minutes immersion at room temperature.

(463B) T. P. Hoar, "Clean Iron and Steel Surfaces: Some Fundamental Considerations with Particular Reference to Vitreous Enameling," *Sheet Metal Industry*, Vol. 25, pp. 1805-1808, 1826 (1948); *Journal, Iron and Steel Inst. (London)*, Vol. 161, p. 67 (1949); *British Abstracts*, Part BI, Section 5, February, 1950, p. 207.

Functions of various degreasers, pickling, and rinsing processes are explained from a chemical viewpoint and practical operations are discussed.

(463C) G. B. Hogaboom, "Metal Cleaning and a Simple Test for Surface Cleanliness," *Proceedings, Am. Electroplaters' Soc.*, Vol. 35, pp. 215-221 (1948).

A review of metal cleaning problems and the suggestion of a test for cleanliness of steel. The test consists of dipping the article in a solution containing 40 g per liter of copper sulfate and 17 g per liter of sulfuric acid, in which the piece takes a semibright, clear, uniform, adherent copper deposit if the surface is clean.

(464) G. R. Hoover, "Preparation of Metal Surfaces for Organic Coating," *Corrosion*, Vol. 4, No. 8, pp. 399-411 (1948).

Concerns metal preparation for removal of oxide film by pickling and removal of rustproofing compounds, and other compounds accumulated through processing. These soils are best removed by solvent cleaning, sand blasting, alkali and emulsion cleaning. Also a discussion of chemical treatments after cleaning and prior to coating.

(465) J. Hyyppä, "Measurement of Rates of Spread of Solutions of Surface Active Agents," *Analytical Chemistry*, Vol. 20, pp. 1039-1043 (1948).

An instrument is described to measure the rate of spreading of solutions of wetting agents on any standard plane surface. Principle is ejection of a standard amount of solution and simultaneous photographs repeated at 10-sec intervals up to 50 sec. Rate of spread is calculated either from the diameter or area of droplet. Can be applied to metal cleaning and other cleansing operations. Measured the effects produced from several wetting agents on glass and painted surfaces.

(465A) M. Jaffa, "Portable Degreasing Device For Metal Articles," U. S. Patent No. 2,442,272, May 25, 1948; *British Abstracts*, Part BI, Section 4, p. 255 (1949).

An apparatus for use with trichloroethylene provided with means to prevent escape of fumes is described.

(465B) R. F. Kipp, "House Cleaning an Industrial Plant," *Mill and Factory*, Vol. 42, pp. 142-145 (1948).

Rules for keeping clean and selection of cleaning materials for metal processing plants.

(466) W. Klabunde (to E. I. du Pont de Nemours & Co.), "Solvent for Degreasing Iron and Aluminum," U. S. Patent No. 2,435,312, February 3, 1948; *Chemical Abstracts*, Vol. 42, p. 2916 (1948).

Decomposition of trichloroethylene above its boiling point in presence of aluminum or iron is decreased by the addition of diisobutylene as an inhibitor.

(467) W. Klabunde (to E. I. du Pont de Nemours & Co.), "Solvent for Degreasing Iron and Aluminum," U. S. Patent No. 2,436,772, February 24, 1948; Chemical Abstracts, Vol. 42, p. 2916 (1948).

Various organic nitrates and nitrites are used in 0.02 to 1 per cent amounts to stabilize trichloroethylene in contact with aluminum or iron.

(468) W. Klabunde (to E. I. du Pont de Nemours & Co.), "Solvent for Degreasing Iron and Aluminum," U. S. Patent No. 2,440,100, April 20, 1948; Chemical Abstracts, Vol. 42, p. 6144 (1948).

Various thiophene derivatives are useful in stabilizing trichloroethylene in the presence of iron or aluminum.

(468A) J. Koerner, "Surface-Active Agents in Non-Ferrous Metals Technology," The Metal Industry, London, Vol. 73, No. 23, pp. 452-453 (1948); Metallurgical Abstracts, Vol. 16, Part 7, p. 435 (1949).

Discusses theory underlying the action of wetting agents and describes their application in non-ferrous metallurgy.

(468B) B. Kopelman and C. C. Gregg, "Some Wetting Properties of Metal Powders," Am. Soc. Metals, Preprint, No. 40, 11 pp. (1948); Metallurgical Abstracts, Vol. 16, Part 5, pp. 278-279 (1949).

Wetting properties of various metal and metal oxide powders were studied by shaking them with kerosene and water, and water and carbon tetrachloride. Metal powders are not readily wetted by either water or organic liquids and are therefore difficult to disperse in liquid media, the difficulty increasing with the melting point of the metal. Lower melting metals such as aluminum, magnesium, copper and nickel can be made dispersible in organic liquids by the addition of 1 per cent oleic acid. The wetting action in water of the refractory metals such as molybdenum, platinum, tungsten, and tantalum is improved by the addition of commercial wetting agents, and these latter agents also improve the wetting of the lower melting metals by organic liquids. Hydrogen peroxide does not affect the wetting behavior of metal powders. Titanium has wetting properties intermediate between those of the lower melting metals and the refractory metals. The higher oxides of multivalent metals and the oxides of monovalent metals are hydrophilic, but the lower oxides of metals and the metals themselves are not water dispersible.

(468C) P. D. Liddiard, "The Theory and Practice of Metal Degreasing in Aqueous Media," Chemistry & Industry, Vol. 67, No. 28, p. 435 (1948).

A general discussion of cleaning as applied to the metals and the materials to be removed. Discusses the theories of de-

greasing, the use of alkalies, and surface active requirements. Rinsing, contamination from preferentially deposited surface active agent, and hard water difficulties are described. Corrosion and its effect on the cleaning process is discussed. Trends in degreasing practice are toward combinations of aqueous and nonaqueous processes to attain cleanliness for speed of operation. Mention of high speed cleaning of steel strip shows several methods of cleaning applied, followed by adequate rinsing. Aluminum and multiphase alloys still present cleaning problems.

(469) P. D. Liddiard, "Emulsifying Agents for Metal Working. German Practice in Manufacture and Use," Metal Treatment, Vol. 14, pp. 241-242 (1948); Chemical Abstracts, Vol. 42, p. 4506 (1948).

Oil is used as a lubricant for metal working and generally is diluted with paraffin oils or with water. To perform dilution with water, emulsifying agents must be used. Sulfonated agents orient themselves with the SO_3Na radical at the water interface, but the film stability under metal working conditions may result in breaking the emulsion and uneven lubrication. Some of the sulfonic acid groups may cause corrosion of the metal. Describes two emulsifying agents which are said to have properties ideal for metal use.

(469A) A. B. Lloyd, "Cleaning of Steel Castings," Inst. Brit. Foundrymen, Paper 903, 14 pp. (1948); British Abstracts, Part BI, Section 5, p. 141 (1949).

Wet and dry cleaning processes for the removal of adhering molding material were described.

(470) C. M. Loucks and C. H. Groom, "Chemical Cleaning of Heat Exchange Equipment," Paper Trade Journal, Vol. 27, No. 25, December 16, 1948, pp. 26-31.

The use of chemical solvents for removal of offending deposits from heat exchange equipment and restoration of equipment to satisfactory performance. Solvent cleaning depends upon the deposits, the metals in the units being cleaned, solvents available and safe operating practice. Deposits may be inorganic in type resulting from water used and organic from contamination of water or steam with oil or organic matter and slime or algae or mixtures of these. Solvents usually limited to acid, which may be inhibited. Precautions and hazards are outlined.

(470A) A. Mangin, "Chemical Cleansing in the United States," Chimie & Industrie, Vol. 60, pp. 331-335 (1948); Chemical Abstracts, Vol. 43, p. 2917 (1949).

A 1945 report of methods used for iron surface preparation by chemicals.

(471) P. E. Marling (to Monsanto Chemical Co.), "Finish-remover Composition," U. S. Patent No. 2,437,964, March 16, 1948; Chemical Abstracts, Vol. 42, p. 6026 (1948).

Nonvolatile, nonflammable paint and varnish removers are prepared by dissolving 1 to 10 per cent of a thickening agent such as cellulose acetate or nitrate or paraffin wax in diethyl phosphite.

(472) R. McNair, "Cleaning. Preparation of Metals Prior to Electrodeposition," Metal Industries (London), Vol. 73, pp. 206-208, 247-249, 252 (1948); Chemical Abstracts, Vol. 43, p. 94 (1949).

A comprehensive review of cleaners, processes, and cautions in their application.

(472A) "Surface Cleaning in Molten Salt Baths," Metalloberfläche, Vol. 2, No. 3, p. 63 (1948); Metallurgical Abstracts, Vol. 16, Part 7, p. 435 (1949).

Described are the operation and applications of molten caustic baths, working at 360 to 540 C, with or without electrolysis, and molten metallic sodium baths, working at 375 C under atmospheres of hydrogen or cracked ammonia from which all traces of oxygen, carbon monoxide, and carbon dioxide have been removed.

(473) J. B. Mohler, "Economical Rinse Tank Design," Iron Age, Vol. 161, No. 16, pp. 76-77, 140 (1948).

Discussion of design of single and multiple tank systems: Simple running rinse, improved running rinse, surface sweeping type, improved running rinse with bottom drain for precipitate removal, underflow series and double overflow. Gives method for determination and calculation of maximum allowable salt concentration from drag-in as applied to each design.

(474) A. B. Middleton, "Report on Sodium Silicate Cleaners," Die Casting, Vol. 6, No. 1, pp. 65, 66-67 (1948).

Use of sodium silicates in cleaning of zinc and zinc alloy materials prior to copper plating. Review of the work of Hazel and Stericker.

(475) J. A. Monks and J. McMullen, "Molten Salt Descaling by the Efco-Virgo Process," Metallurgia, Vol. 38, pp. 311-313 (1948); Chemical Abstracts, Vol. 43, p. 552 (1949).

The chief feature of the process is the chemical and physical modification of the scale by the action of the molten salts at a temperature of 480 to 540 C. The scale is then removed in the following two stages of the process which consist of a cold water quench followed by a short immersion in warm dilute acid when necessary. The salt used consists of caustic soda containing active ingredients which chemically convert

the refractory oxide to one of a flocculent nature and capable of solution in a weak acid.

(476) J. S. Morris, "Sodium Hydride Descaling of Stainless and Clad Steels," Iron and Steel Engineering, Vol. 25, No. 11, pp. 71-79 (1948); Chemical Abstracts, Vol. 43, p. 551 (1949).

Sodium hydride is produced by the reaction of hydrogen with metallic sodium and these hydrogen bubbles pass up through a bath of fused caustic soda into generator boxes containing sodium and partially submerged beneath the surface of the fused caustic soda. Details of equipment and operation, as well as chemical control, are described. After immersion in the fused bath, maintained at 700 to 725 F for 5 to 20 min, the hot plates are dipped into a water quench tank. The violent reaction created by the formation of steam and the explosive reaction of sodium hydride and water literally blasts the plate clean of its coating of reduced scale. A dip in 10 per cent sulfuric acid, followed by water spray, is required for complete cleanliness following a bright dip.

(476A) Fujitichi Nogaki, "Metal Cutting and Washing Compound," Japanese Patent No. 174,946, June 24, 1948; Chemical Abstracts, Vol. 43, p. 7163 (1949).

The insoluble portion of separated waste liquor from soda pulp is heated with a mixture of lime, ammonium hydroxide, naphthalene, and colloidal clay, and this mixed with the soluble portion of the waste liquor.

(476B) J. F. O'Keefe, "Surface Preparation of Aluminum for Plating," Metal Finishing Industry Guidebook, pp. 201-207 (1948).

Following mechanical finishing it is recommended that solvent vapor degreasing be used followed by alkaline cleaning at pH 9-12. Effectiveness of cleaning checked by water break.

(476C) S. G. Osborne and H. R. Spence, "Molten Salt-bath (Steel) Descaling Process Materially Reduces Production Time," Steel, Vol. 123, No. 24, pp. 106, 109-110, 124, 126, 129-130, 132 (1948); British Abstracts, Part BI, Section 5, p. 485 (1949).

Description of treatment of steel in a molten salt-bath, presumably sodium hydride, is described.

(477) G. H. Orozco (to Gilron Products Co.), "Anodic Degreasing," U. S. Patent No. 2,437,474, March 9, 1948; Chemical Abstracts, Vol. 42, p. 4074 (1948).

A very light but strongly adhering film of calcium and magnesium soaps is formed upon metallic articles which are electrocleaned, and this film is insoluble in water. The tenacity of the film increases with the

pH of the alkaline baths. This film can be prevented by making the articles to be cleaned an anode in a circuit using solutions containing as an example, 8 oz per gal of water of a mixture of sodium acetate 10, caustic soda 16.5, tetrasodium pyrophosphate 28, trisodium phosphate 25, and wetting agent 0.5 per cent. Other salts of potassium and of phosphorus may be used.

(478) S. H. Phillips, "Latest Methods for Cleaning Aluminum Prior to Painting," *Automotive Industries*, Vol. 98, No. 2, pp. 42-43, 45, 54 (1948).

For paint or other finishes to adhere properly the following conditions must prevail: (1) must be free of grease, oil, drawing compounds and shop grime, (2) free of corrosion products, oxide films, grit and metal particles, corrosive salts and welding or annealing scales, (3) free from any chemical or material with alkaline reaction, and (4) free of moisture.

(479) A. H. Pope, "Aluminum-cleaning Methods," *Metal Finishing*, Vol. 46, No. 10, pp. 75-80, 125 (1948).

Lists soils encountered, stressing oxide coatings. Lists the usual types of cleaning baths and specific problems such as cleaning prior to spot welding, electroplating, zinc immersion, oxide coating, burnishing, buffing, bonderizing, porcelain enamel, frosted finish and flux.

(480) R. Pottberg (to Freeport Sulfur Co.), "Cleaning and Coating Metal Articles," U. S. Patent No. 2,441,776, May 18, 1948; *Chemical Abstracts*, Vol. 42, p. 5407 (1948).

Metal articles cleaned of scale, rust, etc., by subjecting them to the reducing action of a metal more electropositive than the metal being treated in a molten salt bath containing the reducing metal. Other metals in addition to iron can be treated, and salts other than caustic soda can be used. The initial fused bath cleaning is due to the action of nascent sodium and of sodium dissolved in caustic soda.

(481) D. Price, "Wetting Agents in Electroplating," *Metal Finishing Handbook*, pp. 385-392 (1948).

Reviews classes, chemical and physical properties of the surface-active chemicals, and relates these to utilization in plating and cleaning.

(482) "Preparation of Aluminum for Plating," *Products Finishing*, Vol. 13, No. 2, November, 1948, pp. 94, 96, 98.

Electroplated aluminum takes better plate when the surface is polished, and several cleaning procedures are outlined to minimize roughening of the surface. Procedure varies according to whether base metal is wrought or cast, and in part upon the com-

position of the aluminum alloy. If much oil or grease is present, a preliminary treatment by vapor or solvent degreasing followed by a mild alkali cleaning is indicated: sodium carbonate 3 per cent, sodium phosphate 3 per cent at a temperature of 140 to 180 F. Parts to receive zincate immersion treatment are given an acid etch, several of which are described. The data is from the Aluminum Company of America.

(483) I. Reich and F. D. Snell, "Diphase Metal Cleaners," *Industrial and Engineering Chemistry*, Vol. 40, No. 7, pp. 1233-1237 (1948).

Action of diphase metal cleaners was evaluated by measurement of interfacial contact angles. Mineral oil and water wet steel equally, while water wets glass preferentially. Oleic acid caused mineral oil to wet steel preferentially while triethanolamine increased wetting of glass by water. Triethanolamine caused both effects simultaneously indicating hydrolysis, with the oleic acid going into the mineral oil and the triethanolamine into the water. Distilled water removed mineral oil under soil from steel. Water would not remove soil to which oleic acid had been added. Neutral soap solutions did not remove oil as a result of hydrolysis, the fatty acids entering soil and preferentially wetting the steel. Addition of alkali to the soap solution repressed hydrolysis and permitted soil removal. Sulfonated and sulfated agents showed less effect of hydrolysis than soaps and nonionic agents improved soil removal at high concentrations. These effects were found with many soils.

(484) I. Reich and F. D. Snell, "Diphase Metal Cleaners. Relation of Emulsion Stability to Cleaning Efficiency," *Industrial and Engineering Chemistry*, Vol. 40, No. 12, pp. 2333-2337 (1948).

Comparison made of diphase or unstable emulsion cleaner type with stable type using metal cleaning and burnt umber tests. The diphase type cleaner proved more effective as a result of a heavy film of solvent with which cleaner coats the metal surfaces and the ability to both wet soil and detach it from the surface and disperse and suspend soil to prevent redeposition.

Diphase cleaner characterized by: (1) simultaneous exposure of metal to both solvent and aqueous phase neither of which must be completely emulsified in the other, (2) solvent phase has oil solubility and preferentially wets metal surfaces, (3) aqueous phase dissolves water soluble soils and preferentially wets mineral oil, (4) solvent phase is of low viscosity, and (5) solvent phase emulsifies either in water or any suitable water solution used for rinsing.

Metal cleaning tests made with mixture of 12 g umber in 11 g oil (49.5 parts mineral

oil, 49.5 parts cottonseed, and 1 part oleic acid). Other soils also were tested.

Explanation of lower cleaning efficiency of stable emulsion cleaners is ascribed to the fact that the solvent is tied up in emulsified droplets and will mix neither with each other or with grease or soil on metal, nor is soap free for the same reason, for full effectiveness.

(485) G. W. Rigby, "Flame Cleaning: A Modern Method of Preparing Steel for Painting," *Gas World*, Vol. 128, No. 3329, Coking Section, pp. 69-80 (1948); *Chemical Abstracts*, Vol. 42, p. 5823 (1948).

The cleaning is done by passing the flame over and close to the surface of the steel at a speed determined by experience. All unbonded mill scale, corrosion products, and occluded moisture are either driven off or so loosened as to be easily removed by wire brushing.

(485A) H. A. Robinson (to Dow Chemical Co.), "Composition for Descaling Ferrous Metal," U. S. Patent No. 2,450,861, October 5, 1948; *Chemical Abstracts*, Vol. 43, p. 3772 (1949).

Tendency of hydrochloric acid solutions to corrode when descaling ferrous metal objects is counteracted by controlling the H-ion attack with organic nitrogen bases, organic sulfur compounds, certain aldehydes or soluble arsenic compounds, as well as simultaneously adding bivalent chromium or trivalent titanium to effect reduction of ferric ions, thus preventing their corrosive attack on the metal being cleaned.

(485B) K. Rose, "Shot Blasting Replaces Pickling on Some Steel Cleaning Applications," *Materials & Methods*, Vol. 28, No. 5, pp. 72-75 (1948); *British Abstracts*, Part BI, Section 5, p. 485 (1949).

The Wheelabrator equipment is used, in which cast iron shot is impelled from a rotating vaned wheel onto the material to be cleaned. Compared with pickling for the removal of scale it has the following advantages: no waste acid disposal problem, less floor space requirements, no hydrogen embrittlement, no carbon smut, and the equipment is more versatile.

(485C) J. W. Ryznar and J. Greene, "A Simple Test Method for Evaluating Corrosion Inhibitors," *Corrosion*, Vol. 4, pp. 505-515 (1948); *Chemical Abstracts*, Vol. 43, p. 97 (1949).

The test was developed to determine whether a substance had inhibiting characteristics, to what extent and in a variety of media and conditions. The main criterion of effectiveness is visual examination of the specimen at the end of the test. A solid cylinder of specified characteristics is pretreated then rotated at constant speed for 24 hr under given conditions.

(485D) L. Sanderson, "Metal Cleaning Processes—I, II," *The Chemical Age*, London, Vol. 58 (1491), p. 205 (1495), p. 331-333 (1948); *Metallurgical Abstracts*, Vol. 16, Part 7, p. 434 (1949).

Factors governing the choice of cleaning methods and materials are discussed. The uses of alkaline solutions are considered.

(486) A. P. Schulze, "Die Castings Must be Clean: I. A Compendium of Cleaning Cycles Proved in Present Day Production Practice," *Products Finishing*, Vol. 12, No. 10, July, 1948, pp. 26, 28, 30, 32, 34, 36, 38, 40, 44, 46.

Need for cleanliness prior to finishing established from various sources. Among factors in the selection of cleaning cycles are: (1) the kind of metal and its surface condition, (2) nature of contaminants to be removed, (3) degree of cleanliness required, (4) type of equipment available, and (5) character of final finish. Cleaning processes may be: (1) solvent cleaning, (2) alkaline cleaning, (3) acid dipping, pickling, or other acid detergent cleaning, and (4) mechanical cleaning. Discussion of vapor and emulsion degreasing and equipment. 18 references.

Part II of above. *Products Finishing*, Vol. 12, No. 11, August, 1948, pp. 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52.

Segregates procedures as: (1) hot still tank cleaning, (2) electrocleaning, and (3) pressure-machine washing. Discussion of various requirements and gives several cleaning cycles under each classification. Stresses need for thorough cleaning and use of acid dip after alkaline cleaning to remove film of alkaline zinc salts which if not removed cause blistering and peeling of electrodeposits. Lists 20 references.

Part III. *Products Finishing*, Vol. 12, No. 12, September, 1948, pp. 40, 42, 44, 46, 48, 50, 52, 54, 58, 60.

Discussion of magnesium, zinc, aluminum according to treatment required on the basis of acid cleaning or dipping to remove any oxide film prior to finishing. Chromatizing films of use in improving paint grippage. 16 references.

(486A) R. R. Sizelove, "Cleaning and Pickling," *Metal Finishing Industry Guidebook*, pp. 43-53 (1948).

Discussion of cleaners used for the electroplating industry which are alkaline soaking cleaners, alkaline electrocleaners, and solvent emulsion cleaners. Discusses the general application of each and gives cleaning cycles for electroplating of steel and steel and copper prior to nickel plating, steel prior to copper, cadmium, zinc, or alkaline tin plating. Also gives cycles for copper and brass prior to nickel. The cleaning of zinc-base die castings prior to cyanide copper flashing or copper plating is discussed.

(487) H. G. Smith, M. L. Hill, and T. L. Cantrell (to Gulf Oil Corp.), "Cleaning and Polishing Composition," U. S. Patent No. 2,442,024, May 25, 1948; Chemical Abstracts, Vol. 42, p. 6146 (1948).

A salt of a higher aliphatic amine with 2-ethylhexyl, 3-methylbutyl orthophosphoric acid is used together with a water-soluble salt to inhibit corrosion of metal cans used to package automobile body cleaners containing a hydrocarbon solvent dispersed in water together with an abrasive cleaner and minor amounts of other ingredients.

(487A) C. T. Snell, "Automobile Radiator Cleaners," Chemical Industries, Vol. 63, pp. 802, 804 (1948); Chemical Abstracts, Vol. 45, p. 5952 (1951).

Most commercial cleaners are strongly sodium carbonate, phosphate, bicarbonate, or sodium oxalate, with the addition of sodium or potassium bichromate as a corrosion inhibitor. Other emulsified compositions are mentioned.

(488) E. Snyder (to American Chemical Paint Co.), "Preparation of Metal Surface for Painting, etc.," Canadian Patent No. 449,226, June 22, 1948; Chemical Abstracts, Vol. 42, p. 6734 (1948).

Iron, zinc, aluminum, or their alloys are treated with a material having an oily substance, principally degreas, mixed with 1 to 15 per cent of orthophosphoric acid. The adhering material remains on the surface until the acid reacts substantially with the metal, and the oily component is removed by washing with an organic solvent before a final coating of paint, varnish, or the like is applied.

(489) S. Spring and L. F. Peale, "Oil Composition in Alkaline Cleaning," Industrial and Engineering Chemistry, Vol. 40, pp. 2099-2102 (1948).

Free fatty acid facilitates soil removal from pickled surfaces but up to 10 per cent free fatty acid reduces ease of removal of sulfurized fatty or fatty oils from unpickled steel. Addition of oil-soluble sodium sulfonate soaps to mineral or lard oils results in improved cleaning, whereas addition to sulfurized oils makes cleaning more difficult. At nearly equivalent viscosities and free fatty acid content ease of removal of oils follows the series: mineral oil > sulfurized mineral oil > lard oil > sulfurized lard oil. Addition of free fatty acid or oil-soluble soap to oils will facilitate cleaning provided these materials do not interfere in the functional application of the oils.

(489A) S. Spring and L. F. Peale, "On the Mechanism of the Process of Degreasing Metal Surfaces," Metalloberfläche, Vol. 2, No. 10, pp. 209-212 (1948); Metallurgical Abstracts, Vol. 16, Part 12, p. 840 (1949).

See Reference 447.

(489B) R. Springer, "Pickling, Etching, Pretreating, Descaling, and Rust Preventives," Metalloberfläche, Vol. 2, I, pp. 123-130, II, pp. 199-203, III, pp. 224-229, IV, pp. 271-275 (1948).

A review with many references for the years 1935 to 1943.

(489C) V. F. Stine, "Blast Cleaning of Metals," Metals Handbook, Am. Soc. Metals, pp. 300-301 (1948).

The centrifugal process for blast cleaning using grit or shot has come into wide use, though many applications remain where the compressed-air method is desirable.

(489D) D. R. Swan, "Advances in Cleaning Compounds," Organic Finishing, Vol. 9, No. 1, pp. 19-25 (1948).

A review of the newly available synthetic agents, starting with Twitchell materials, naphthalene sulfonic acid condensates, other anionic, cationic and nonionic surface active agents.

(489e) U. C. Tainton, by R. Pottberg, administrator of estate (to Freeport Sulfur Co.), "Cleaning and Coating Metal Articles," U. S. Patent No. 2,441,776, May 18, 1948; Chemical Abstracts, Vol. 42, p. 5407 (1948).

Use of molten caustic soda bath and reducing action of metal is more electropositive than the metal being treated. Examples given.

(489E) A. B. Tripler, Jr., "Cleaning and Finishing," The Metals Review, Vol. 21, No. 6, pp. 3, 5, 7 (1948); Metallurgical Abstracts, Vol. 17, Part 2, p. 115 (1949).

A review of developments.

(489F) E. W. Turner, "Solvent Vapor Degreasing," Metal Finishing Industry Guidebook, pp. 53-59 (1948).

Discussion includes solvents, equipment, and degreasing methods.

(490) H. G. Webster (to J. H. Shoemaker), "Metal-cleaning Composition," U. S. Patent No. 2,440,837, May 4, 1948; Chemical Abstracts, Vol. 42, p. 6146 (1948).

The use of dilute aqueous acid solutions to remove oxide films from metal articles previously treated in molten salt baths may be avoided by dipping the metal part in a solution heated to about 220 to 250 F and containing about 8 lb per gal of a composition in parts by weight of caustic soda 70, borax 4, sodium cyanide 18, and for best results sulfur 4 and sodium chloride 4.

(491) J. A. Wettergreen, "Electrochemical Cleaning of Large Steel Casting. An Experiment," American Foundryman, Vol. 13, No. 4, pp. 120-124 (1948); Chemical Abstracts, Vol. 42, p. 5353 (1948).

Use of 30,000 lb of molten caustic soda for removal of fused sand and iron oxides from the interior of the shell of a cast steel turbine with a poured weight of 43,300 lb. Reversed current at 2200 and 4000 amp and 6 v using copper electrodes was used, the polarity at the lower current being positive and for only 3 min. Several hours at the higher current were observed with excellent results.

(491A) K. Wickert, "Effect of Inhibitors in Pickling," *Archiv für Metallkunde*, Vol. 2, 137-139 (1948); *Chemical Abstracts*, Vol. 43, p. 2917 (1949).

Inhibitors reduce metal loss somewhat, but cathodic pickling in acid solution is said to produce lowest metal loss.

(492) C. A. Zapffe, "Electrolytic Descaling," *Metal Progress*, Vol. 53, pp. 833-836 (1948); *Chemical Abstracts*, Vol. 42, p. 5351 (1948).

Additional evidence is offered to support the theory that scale is blasted away from metal such as steel by bubbles of hydrogen issuing from within the metal and under high pressure.

1949

(493) Cleaning Compound, Fingerprint Removing, Metal Surfaces, U. S. Air Force Specification 14156-A, March 4, 1949.

Composition meant for fingerprint removal from metal surfaces prior to preparation for storage or coating with a permanent resin coating. Requirements include easy removal with naphtha, no separation on storage, of given viscosity and flash point. Also included is minimum corrosion, and ability to remove fingerprints and to suppress corrosion from them.

(493A) Compound; Engine Cleaning (Cresol Base) Air Force-Navy Aeronautical Bulletin, ANA Bulletin No. 319a, August 4, 1949.

Contains list of compounds with engineering approval conforming to Air Force-Navy Aeronautical Specification AN-C-163, listing fifteen compounds and eight accredited products containing alternate cresol ingredient. See Reference 635.

(494) Carbon Removal Compound, Orthodichlorobenzene Type (for Engine Parts), U. S. Air Force Specification 20043-A, March 22, 1949.

Intended use in softening and removing carbon deposits and paint from engine parts by immersion in heated solution. Composition is 53 per cent by weight of orthodichlorobenzene, 23 to 25 per cent cresylic acid, 10 to 12 per cent potassium oleate, 5 per cent maximum by volume of water, and 5 per cent maximum of inhibitor and other materials. The general requirements are

odor and toxicity, density, minimum corrosion, undissolved matter, flash point, seal (distinct emulsion formation), laboratory carbon removal, rinsability, practical carbon removal test, and package stability.

(495) Compound, Cleaning, Alkali-Type, U. S. Army Ordnance Department Specification AXS-1849, June 15, 1949.

Product covered is intended for use in the hot soak tank cleaning of ferrous and non-ferrous metal alloy parts. A formula satisfactory for use with ferrous alloys only or for the removal of soil containing considerable calcium soap base grease is comprised of the following in per cent by weight:

Sodium carbonate	32.8
Trisodium phosphate dodecahydrate	47.2
Triton X-100 or Igepal CA-extras High Concentration	5.2
MP-189 or Nacconol NR	14.8

Compound need not conform to any specific chemical composition, the supplier being given wide latitude in selection of raw materials. The compound when used at boiling temperature and a concentration of 7.6 per cent weight to volume shall effectively clean metal surfaces as determined by a performance cleaning test. Maximum pH and corrosiveness specifications are also given.

(495A) Lino Bazzanella, "Degreasing Compound," Swiss Patent No. 262,563, October 1, 1949; *Chemical Abstracts*, Vol. 44, p. 4407 (1950).

Degreasing compound consisting of 5 to 8 parts by volume of a heavy hydrocarbon, 2 to 5 parts of a chlorinated derivative such as trichloroethylene, and 2 drops of a phenol is developed. Said to have the advantage of not leaving white pellicules on the degreased work.

(496) R. Bernstein, "Cleaning Composition," U. S. Patent No. 2,485,554, October 25, 1949.

A metal cleaning solvent-emulsion cleaner is claimed, consisting of the following materials by weight:

	Per Cent
Tall oil	9.5 to 10.5
Pine oil	13.0 to 14.5
Potassium carbonate	1.5 to 2.0
Sodium chromate	0.5 to 1.1
Water	5.0 to 20.0T
Kerosine	Sufficient to make 100

This is used one part by weight with 4 to 6 parts of kerosine, or with 1 to 2 parts of water.

(497) J. L. Bleiweis, "Simplified Methods of Cleaning Metals for Plating," *Materials & Methods*, Vol. 30, No. 3, pp. 74-77 (1949); *British Abstracts*, Part BI, Section 7, February, 1950, p. 224.

Use of chlorinated and petroleum solvents, emulsions, and alkaline cleaners for remov-

ing gross contamination of parts to be plated is described. A caustic alkali and an alkali triphosphate bath, used as such or anodically or cathodically, should be adequate for final cleaning of metals normally encountered. Cleaning cycles for steel, copper-base alloys, zinc die-castings, aluminum, lead alloys, and nickel are given.

(498) Ben Borus (to Shell Development Co.), "Carbon Remover and Metal-surface Cleaning Composition," U. S. Patent No. 2,466,632, April 5, 1949; Chemical Abstracts, Vol. 43, p. 6439 (1949).

A composition for cleaning internal combustion engines, gas turbines, and similar machines consists preferably of 12 to 20 per cent of kerosine or benzene, 4 to 8 per cent of a detergent salt of an amine, ammonia, or alkali metal with a higher fatty acid, terpenic, naphthenic, or sulfonic acid, 20 to 40 per cent of a penetrant especially certain halogenated compounds such as trichloroethylene, orthodichlorobenzene and certain ketones, 8 to 20 per cent of a wetting agent, 12 to 15 per cent water, and 15 to 20 per cent stabilizers such as polyhydric alcohols.

(499) G. H. Boss, "Cleaning Aluminum Sheet Prior to Spot Welding," *Metal Progress*, Vol. 55, pp. 668-763 (1949); British Abstracts, Part BI, Section 6, p. 878 (1949).

Practical methods for degreasing and removal of oxide films are discussed.

(499A) G. H. Botham, "A New Method of Cleaning the Plate-Type Heat Exchanger Used for Milk Pasteurization," *Proceedings, Twelfth International Dairy Congress* (Stockholm), Vol. 3, pp. 302-309 (1949); Chemical Abstracts, Vol. 44, p. 9077 (1950).

Said that the higher sodium phosphates have a sequestering action on the calcium of milk scale and subsequent solution of the casein at the pH used. If wetting agents are added to higher phosphate solutions, no alkali is needed if the runs are short.

(499B) F. P. Bowden and A. C. Moore, "Physical and Chemical Adsorption of Long Chain Compounds on Metals," *Research*, Vol. 2, No. 12, pp. 585-586 (December, 1949).

Method consisted of irradiation of metal foils with slow neutrons, treatment of foils with various long chain chemicals, and desorption with benzene. If no reaction took place with the surface, and physical forces only were involved, the adsorbed film is removed unchanged. However, if chemical change occurred, the film would remove radioactive metal with it.

At temperatures above the melting points of the fatty acids, no lubrication of platinum, gold, or silver took place, but it did occur with zinc, cadmium, iron, and copper because the melting points of the metal soaps are considerably higher than those of the

corresponding acids. Octadecyl alcohol showed no chemical reaction, and adsorption was physical. With stearic acid, neither gold nor platinum showed reaction but other metals involved did, to the order of monolayers. Oxidation of reactive metal surface increases adsorption to several hundred monolayers. Esters of fatty acids react with metals other than gold and platinum, but this is attributed to partial hydrolysis of the ester to provide this effect.

(500) V. Bowes, "Chemical Circulation Methods in Cleaning and Descaling Petroleum Processing Equipment," *Petroleum Refiner*, Vol. 28, No. 10, pp. 121-124 (1949); Chemical Abstracts, Vol. 44, p. 1688 (1950).

The cleaning of refinery process equipment by the circulation of special cleaning solutions of chemicals has many advantages which are listed. Mechanical cleaning methods fall far short in many respects in comparison. The cleaning solution is selected on the basis of the deposits to be removed. Hard water scale is generally removed by acidic cleaners, while deposits in absorber towers and heat exchangers are usually removed by an alkaline cleaner, while solvent-type cleaners are used in some cases.

(500A) Bror Broman, "A New Method for Cleaning Heating Surfaces," *Svensk Papperstidn.*, Vol. 52, pp. 589-591 (1949); Chemical Abstracts, Vol. 44, p. 7203 (1950).

System called Broman Steel Shot Cleaning is described for cleaning secondary and other heating surfaces by means of free-falling granulated pig iron shots of about 5 mm diameter to give more effective removal of deposits and higher heat economy with longer life results.

(501) K. Bruche, "Successful Cleaning of the Water Side of a Double-Sheaf Boiler with Hivolin Mixture (Hydrochloric Acid with an Inhibitor)," *Bergbau und Energiewirt.*, Vol. 2, pp. 170-171 (1949); Chemical Abstracts, Vol. 43, p. 9307 (1949).

Data given to show that use of the acid mixture followed by some mechanical cleaning costs only about 60 per cent as much as complete mechanical cleaning and takes about 32 per cent as much time. Predicted that use of the inhibited acid cleaning at up to 100 C would shorten the time still more.

(501A) K. G. Brummage, "Structure of Stearic Acid Films on Copper," *Nature*, Vol. 164, pp. 244-245 (1949).

See Spink, *Nature*, Vol. 163, p. 441 (1949), Reference 552A. Spink postulated from electron-diffraction evidence that copper stearate was present on a copper surface covered with stearic acid which has been heated. The same pattern was obtained by Brummage from stearic acid and other fatty acids.

(502) Compound, Steam Cleaning, Bureau of Ships Specification 51 C69, April 15, 1949.

The compound is intended for use on aircraft cleaning aluminum, magnesium and other metal surface prior to application of organic or inorganic surface coatings and for surfaces to remain unpainted. Also intended for the removal of grease and oil from various ferrous and non-ferrous surfaces.

Composed of an alkali silicate, phosphate composition containing a synthetic detergent. In addition to composition requirements products must meet foaming, surface tension, corrosion, stability, hard water, and rinsing ability tests.

(502A) "Corrosion, I. Causes and Prevention," Bureau of Ships, Navy Department, Industrial Notes, PB No. 98918, 12 pp. (1949).

Contains much general work on cleaning prior to storage.

(502B) "Corrosion, II. Causes and Prevention," Bureau of Ships, Navy Department, Industrial Notes, PB No. 99188, No. 96, 16 pp., September, 1949.

Contains much general information on aluminum cleaning, also steel, wrought iron, and miscellaneous other metals.

(503) P. H. Cardwell and G. E. Mullin (to Dow Chemical Co.), "Composition for Descaling Ferrous Metal Surfaces," U. S. Patent No. 2,485,528, October 18, 1949.

An improved composition comprising hydrochloric acid for use in removing scale deposits from iron and steel surfaces. An aqueous solution of from 5 to 25 per cent of hydrochloric acid containing as inhibitor from 0.1 to 1 per cent of organic aromatic and heterocyclic nitrogen bases and from about 0.1 to 2 per cent water soluble thiocyanate. Specific examples of organic nitrogen bases are p-toluidine, 2,4,6-collidine, methyl aniline, and the use of ammonium thiocyanate.

(504) E. J. Cartwright, "Cleaning Brass Stampings," Mechanical World and Engineering Record, Vol. 126 (3259), pp. 19-20 (1949); Metallurgical Abstracts, Vol. 17, Part 2, p. 114 (1949).

A short description of chemical and electrolytic methods for removal of scale from brass stampings and sheet pressings.

(504A) R. G. Clendinin, "Cleaning and Rust Prevention," Paper Industry and Works, Vol. 31, pp. 1128-1129 (1949); British Abstracts, B 1-5, p. 206 (1951).

Cleaning and rust prevention of metal articles prior to packaging.

(505) B. V. Deryagin and N. N. Zakhavaya, "The Stability of Thin Lubricant Films Deposited on Solid Surfaces," Kolloidnyi

Zhurnal, Vol. 11, pp. 230-231 (1949); Chemical Abstracts, Vol. 44, p. 828 (1950).

A lubricant deposited on solid surfaces was blown off them so that only a thin wedge remained, and its thickness determined interferometrically. Films containing aluminum oleate or aluminum stearate were more stable on steel than on glass or chromium coating.

(506) "Production Clinic for Finishing Die Castings. The Principles of Detergency as Applied to Metal Cleaning," Die Castings, Vol. 7, No. 3, pp. 41-43 (1949); Metallurgical Abstracts, Vol. 17, Part 2, p. 115 (1949).

The factors affecting detergency are discussed, and a semi-quantitative test method for the evaluation of metal-cleaning compounds is described.

(507) J. G. Donelson and R. A. Neish, "Determination of Cottonseed Oil on Tin Plate," Analytical Chemistry, Vol. 21, No. 9, pp. 1102-1104 (1949).

Majority of tin plate produced by continuous electroplating process lubricated with edible grade cottonseed oil either by spraying with an emulsion or by electrostatic precipitation from an atomized mist. Preferred amount of oil is 0.20 to 0.05 g per base box (total surface area 62,720 sq in). A perfectly oriented oil film is thus equivalent to approximately 5 molecular layers on each surface of plate.

Previous method of determination was by oil extraction, but the present method involves the use of hydrophilic balance modified to permit complete vertical immersion of samples in water filling tray. Oil film transfers to the surface and is measured by usual surface balance technique and is rapid. Chief disadvantage is that it can be used only on fresh plate.

(508) D. L. Doty, "Continuous Strand Cleaning and Coating of High-Carbon Rods and Wires," Wire and Wire Products, Vol. 24, pp. 1034-1038, 1065, 1066, 1067 (1949); Chemical Abstracts, Vol. 44, p. 521 (1950).

Attempt at summarization of the potential advantages and the industry-wide status of continuous strand cleaning and coating of rods and wire in tandem with the patent annealing operation. Results as yet inconclusive, but the process presents definite potentialities with regard to improved quality high-carbon wire and lower costs. Shot blasting and brush cleaning for descaling are worthy of consideration. Descaling in acid solutions and lime shows promise in strand coating. Lime substitutes used singly in strand cleaning require excessive immersion time.

(508A) A. E. Durkin, "Chemical Surface Treatments for Metals," Tool Engineer, Vol. 22, No. 4, pp. 22-25 (1949).

One of first considerations in suitable finishes for steel, magnesium, and aluminum is cleaning, which is subdivided as to emulsions, alkaline, or vapor degreasing. Discusses functions and the equipment used. For emulsion cleaning, the tank should be covered to reduce fire hazard and with suitable sludge remover, rinsing to be accomplished hot, and with agitation or pressure rinse device. Stresses the importance of rinsing with alkaline cleaners and illustrates old and new tank designs, the latter of the weir type.

Vapor degreasing equipment is of standard construction. Rust and scale are removed from low carbon steels with hydrochloric acid or sulfuric acid, while smut is often produced with the latter. With stainless steels, molten type baths are being used increasingly, examples being the sodium hydride, Kolene process, Virgo process, and molten caustic soda. Discusses the advantages of each type.

(508B) "Heatless Degreasing in 10 Seconds by Ultrasonic Waves," *Factory Management and Maintenance*, Vol. 107, No. 11, p. 130 (1949).

Description of demonstration by Massachusetts Labs, Inc., to engineers of the American Steel and Wire Co, and Ferro Enamel Corp., of heavy or light grease removal from steel parts in 10 sec by sound waves at the rate of 33,000 per sec into cleaning solution. Removal of black oxide takes a little longer. Still in the experimental stage development of standardized equipment is planned.

(509) J. F. Farrell, "Pickling versus Grit Blasting for Cleaning," *Metal Finishing*, Vol. 47, No. 2, pp. 69-75 (1949).

Removal of scale and oxides by acid requires careful control to avoid dangers of pitting, hydrogen embrittlement, smut formation, etc. Use of inhibitors and of proper ventilation reduced hazards of pitting, hydrogen embrittlement, and much of health hazard.

Abrasive blast cleaning or grit blasting by centrifugal or airless blasting is described. Advantages are elimination of acid difficulties, no waste disposal, no variation in alloy and the process is continuous. Difficulties are that the equipment is self destructive, requires dust collection equipment. Discusses economies of blast cleaning, effect on finish, abrasives, and typical applications.

(510) F. V. Faulhaber, "Degreasers," *Products Finishing*, Vol. 13, No. 4, pp. 26, 28, 30, 32, 34, 36 (1949).

Summary of types of degreasers, and discussion of design, selection, and installation and operation. Range of degreasing operation includes vapor, vapor-spray-vapor, warm liquid-vapor, boiling liquid-warm liquid-vapor, and variations of these.

(510A) A. J. Finks and N. J. Petito, "Penetration of Sintered Metals by Solutions of Surface-Active Agents," *Analytical Chemistry*, Vol. 21, pp. 1101-1102 (1949).

Technic is described in which was measured the rate of initial seepage and the time for 1 ml of wetting agent solution to pass through sintered stainless steel crucibles. Filters of varying pore size were used to provide better time spread. Data show no direct relationship between seepage rates and surface tension. Suggests use of other sintered metals.

(510B) A. N. Fisker, "Chemical Cleaning of the Pasteurization Plant," *Proceedings, Twelfth Dairy Congress (Stockholm)*, Vol. 3, pp. 319-325 (1949); *Chemical Abstracts*, Vol. 44, p. 6981 (1950).

A dilute solution of nitric acid is circulated for 20 to 30 min at 60 C and then rinsed. This is followed by similar treatment with sodium hydroxide.

(510C) H. A. Fudeman, "Adsorption Phenomena in the Plating Room," *Metal Finishing*, Vol. 47, No. 8, pp. 58-61 (1949).

Some notes on adsorption on metal surfaces in pickling and plating baths and on porosity of electrodeposits are given.

(511) H. Gibbs, "Blastcleaning Stainless Steel Castings," *Metal Finishing*, Vol. 47, No. 12, pp. 68-69 (1949).

Processing at Cooper Alloy Foundry Co. by four types of blasting units:

1. Enclosed cabinet air—precision with small parts
2. Modern tumbling barrel—mass production of small parts
3. Rotating table—flash surface castings where uniformity necessary
4. Sandblast room—using standard air hoses, for large parts.

Sand, steel shot, and stainless steel shot all used depending upon the nature of the part to be blasted.

(512) A. G. Gray, "Recent Developments in Determining Degree of Surface Cleanliness," *Products Finishing*, Vol. 14, No. 2, pp. 69, 72, 74, 76, 78, 80, 82, 84, 86 (1949).

Reviews in detail the Harris, Kamp, Yanko work on radioactive tracer chemicals, reference 517, Morgan's work on fluorescent dyed oil, reference 151, and Spring, Forman and Peale's work on atomized droplets of water in water-break, reference numbers 325² and 403².

(513) E. B. Greenhill, "Adsorption of Long-chain Polar Compounds from Solution on Metal Surfaces," *Transactions, Faraday Soc.*, Vol. 45, pp. 625-631 (1949).

²J. C. Harris, "Metal Cleaning Bibliographical Abstracts," *Am. Soc. Testing Mats.* (1949). (Issued as separate publication STP No. 90.)

Saturation of the surface occurs at very low concentrations with stearic acid, whereas alcohols and esters require much higher concentration. The adsorption process appears to be the same for thoroughly cleaned and reduced powders as for oxide coated powders.

(514) E. B. Greenhill, "Lubrication of Metal Surfaces by Mono- and Multi-molecular Layers," *Transactions, Faraday Soc.*, Vol. 45, pp. 631-635 (1949).

Carefully prepared layers of stearic acid and metallic stearates indicated that breakdown of lubrication occurs at the bulk melting point except with stearic acid on a reactive metal, and here lubrication persists up to a temperature equal to the softening point of the appropriate metal soap.

(515) N. Hackerman and H. R. Schmidt, "The Adsorption of Organic Corrosion Inhibitors on Iron and Steel Surfaces," *Journal of Physical & Colloid Chemistry*, Vol. 53, pp. 629-638 (1949); *Chemical Abstracts*, Vol. 43, p. 6559 (1949).

Films formed by organic corrosion inhibitors on steel and iron surfaces were studied by electron diffraction and by reflection and diffraction patterns. Depending upon the conditions, both oriented and unoriented surface films can be formed. Treatment of naphthenic acid, cyclohexylamine, cyclohexanone, cetyl alcohol, and stearic acid with hydrocarbon solvents show that the intensity of adsorption on the metal surface is a property of the specific substance employed.

(516) E. E. Halls, "Electroplating on Aluminum for Aircraft Components," *Industrial Finishing*, Vol. 2, pp. 30-32, 34-39 (1949); *Chemical Abstracts*, Vol. 43, p. 7833 (1949).

Operations for the preparation of aluminum parts for electrodeposition include the steps of solvent cleaning, alkaline etch, acid pickle, a second acid treatment, zincate treatment, copper plating, silver plating, and drying off with a water rinse at each stage. Details for each of the foregoing processes are given.

(517) J. C. Harris, R. E. Kamp, and W. H. Yanko, "Application of the Radioactive Tracer Technique to Metal Cleaning," *ASTM Bulletin*, No. 158, May, 1949, p. 49 (TP 75).

Radioactive N, N-dibutylstearamide was added to lubricating oil and the mixture added in known amounts to pans. These are assayed before and after washing using a Geiger-Müller tube and counting apparatus. Initial activity was arbitrarily set at 10^5 counts per min. and trial indicated that 25 mg of the soil (SAE No. 60 oil containing 1 per cent radioactive stearamide and 2 per cent of Fluorescent Oil Green H. W.) would cover the pan at the desired level of activity. Gravimetric methods and the use of ultra-

violet light inspection showed total absence of soil, but the radioactive technique indicated soil as still present. The sensitivity of the method on cleaned specimens was 2×10^{-7} g per sq cm. A residual count not removed by one washing, but finally removed in five or more, was attributed to chemisorption.

(518) J. W. Hensley, A. O. Long and J. E. Willard, "Reactions of Ions in Aqueous Solution with Glass and Metal Surfaces," *Industrial and Engineering Chemistry*, Vol. 41, pp. 1415-1421 (1949). See Reference 463A.

Considerable amount of work done on concentration and temperature relations in sorption of sodium ion made valueless by discovery of preferentially sorbed radioactive impurity in the sodium carbonate solution. In general, removal tests on platinum showed appreciable portion of the activity remained after rubbing with filter paper, immersion for 2 hr in fuming nitric acid, and flaming to redness. Abrasive polishing or aqua regia completely removed radioactive material, however.

Removal of sodium ion from cold-rolled steel was 95 per cent accomplished in 10 sec dipping at 40C and 10 per cent sulfuric acid. Immersion in boiling water removed only a negligible portion of the activity and only 10 per cent by rubbing with filter paper. Suggested reason for retention of the sodium ion is the presence of sulfides normally occurring in steel surfaces.

Steel at maximum immersion time and temperature of 90 C picked up 0.54 monolayers of sodium ion, platinum, 0.3, silver, 7.1, and aluminum (2 S), 1.5.

(519) L. C. Hepfer, "Acid Dips in Cleaning Cycles. I. Acid Dips for Low Carbon Steel," *Proceedings, Am. Electroplaters' Soc.*, pp. 127-130 (1949).

The term acid dip generally refers to fairly weak acid solutions used to remove light rust and scale from metals following alkaline cleaning cycles. This is contrasted with strong acid solutions used for pickling purposes. However, in some plating shops this function is combined in the pickle. Most acid dips for low carbon steel are either hydrochloric acid or sulfuric acid or mixtures of the two. Hydrofluoric acid sometimes is added to remove molding sand and nitric acid to sulfuric acid for the removal of tenacious oxides. Acid dips generally used at room temperature and pickles at elevated temperatures. Agitation seldom used with dips, inhibitors not necessary, foaming agents are seldom used. Electropickling offers advantages where large volume of parts of the same surface character are to be processed.

In the discussion, phosphoric acid is mentioned as very effective and as not causing rusting. Smuts are removed by strong caus-

tic and oxidizing agents such as sodium chlorite, or using the work as the anode. If inhibitor is used, care must be taken that the preferentially adsorbed layer is removed before plating. Bibliography of 30 references.

(520) E. R. Holman (to Turco Products, Inc.), "Cleaning Aluminum Preparatory to Spot Welding," U. S. Patent No. 2,477,181, July 26, 1949; Chemical Abstracts, Vol. 43, p. 9022 (1949).

Immersion for $\frac{1}{2}$ to 20 min in a cold bath containing 5 per cent orthophosphoric, phosphorous, or pyrophosphoric acid or similar acid of phosphorous, enough non-halogen mineral acid such as sulfuric, to reduce the pH below 3 and preferably to 0.5 to 1 initially, and 0.01 to 2 per cent of a catalytic agent such as sodium fluoride or similar halide.

(521) M. Jaffa (to Optimus Equipment Co.), "Degreasing Tank with Means to Speed the Flow of Cleansing Vapors from the Heating to the Condensation Zone and Control the Level of the Liquid Pool," U. S. Patent No. 2,469,040, May 3, 1949; Chemical Abstracts, Vol. 43, p. 6966 (1949).

Device is used for degreasing metal objects and is adapted for use with either gaseous or liquid cleaner, which may include inhibitors.

(523) G. W. Jernstedt (to Westinghouse Elec. Corp.) "Cleaning and Activating Compositions and Use Thereof in Producing Protective Phosphate Coatings on Metal Surfaces," U. S. Patent No. 2,490,062, December 6, 1949.

An activating composition is prepared by dissolving from 0.005 to 20 per cent by weight in water of soluble salts of titanium, zirconium, lead and tin and the balance of disodium orthophosphate. These salts are dried. From 0.1 to 2 per cent by weight of the disodium orthophosphate and a concentration of from 0.001 to 0.1 per cent of the metal radical of the water soluble compound to provide a pH of from 10 to 12.5, the balance being water. Soda ash may be the alkaline cleaning compound, but others may be used.

(524) D. H. Krouse, "Pickling Acid Measurement and Control," Blast Furnace and Steel Plant, Vol. 37, pp. 961-964 (1949); Chemical Abstracts, Vol. 43, p. 7399 (1949).

Flowmeters, valves, and other controlling instruments used in the regulation of large-scale pickling systems are discussed.

(525) C. B. Leape, "An Electrolytic Wire Cleaner," Organic Finishing, Vol. 10, No. 11, pp. 12-13 (1949).

The wire is carried through a specially devised apparatus into a cleaner solution of an alkali containing a wetting agent, while a

current is passed through the bath, the wire acting as a negatively charged electrode. This removes a thin film of copper and leaves the wire hot enough to dry it before entering the enamel.

(526) G. Leffingwell, "Soap in Metal Treatments," Products Finishing, Vol. 14, No. 1, pp. 24, 26, 28, 30 (1949).

Review of soap functions in metal cleaning and utilization as a constituent of cleaning compositions.

(527) G. Leffingwell, "Synthetic Surface-Active Agents in Metal Finishing," Metal Finishing, Vol. 47, No. 4, pp. 68-70 (1949).

Describes fluorescent soil method for cleaner evaluation. Specific uses of certain common types of agents are described.

(528) M. A. Lesser, "Radiator Cleaners," Soap and Sanitary Chemicals, Vol. 25, No. 5, pp. 40-43, 147 (1949).

Discusses requirements for such cleaners. Types of cleaners are illustrated and of alkaline, acid, and combination cleaner types.

(529) H. D. McAfee, "Inhibited Acid Cleans Heating Coils," Chemical Engineering, Vol. 56, No. 3, pp. 141-142 (1949); Chemical Abstracts, Vol. 43, p. 4905 (1949).

A solution of 14 per cent of technical grade hydrochloric acid, 83 per cent water, and 3 per cent aniline for inhibitor is used to clean scale from copper coils with steel head and spacers.

(530) C. W. MacMullen and C. G. Ozar, "Sodium Silicates in Metal Cleaning," Metal Finishing, Vol. 47, No. 4, pp. 52-54 (1949).

A discussion of the role of silicates in cleaning. Films of silicates formed have been identified as Fe_2O_3 and Fe_3O_4 as anodic, and a combination of ferrous-ferric oxide and hydrated silicon dioxide as a cathodic film. Both films being readily acid soluble said to represent no plating problem.

Advantages of silicates in zinc cleaning and in rinsing were reviewed. Rinsing said to be problem of dilution and silicates said to possess excellent stability toward dilution in preventing redeposition of soil.

(531) R. A. Machlowitz, "Evaluation of Polishes for Use on Aluminum Aircraft Surfaces," ASTM Bulletin, No. 156, January, 1949, p. 46 (TP8).

Tests include corrosiveness, abrasive number, coarse particle determination. Performance properties determined by artificial tarnishing, prepolishing, restoration of reflectance and retention of reflectance, rate of tarnish removal test.

(531A) A. Mankowich, "Some Notes on Synthetic Detergents," Metal Finishing, Vol. 47, No. 11, p. 48 (1949).

The types of surface active agents are discussed.

(532) Rick Mansell, "Removing Mill Scale from Steel," *Organic Finishing*, Vol. 10, No. 8, pp. 8, 20-21 (1949).

Discusses removal by pickling, mechanical methods, sand blasting, and flame cleaning. Advantages and disadvantages for each type and the condition of the work after treatment are discussed.

(533) B. H. Marks, "Liquid Blasting Cleans and Finishes Metallic and Non-Metallic Surfaces," *Materials & Methods*, Vol. 29, No. 4, pp. 64-67 (1949); *British Abstracts*, Part BI, Section 4, p. 929 (1949).

A suspension of abrasive particles in water is pumped through a nozzle into which air at 90 psi is forced. Treatment carried out in a closed cabinet with observation window and handling sleeves. Burr and scale from metals and plastics can be removed by choice of conditions and abrasive.

(534) "Methods and Types of Cleaners for Various Metals," *Materials & Methods*, Vol. 29, pp. 89-91 (1949).

General list of types of cleaners and their application to some of the most common metals.

(535) J. E. O. Mayne and M. J. Pryor, "The Mechanism of Inhibition of Corrosion of Iron by Chromic Acid and Potassium Chromate," *Journal, Chemical Soc.*, pp. 1831-1835 (1949); *Chemical Abstracts*, Vol. 43, p. 9015 (1949).

As a result of examination by electron-diffraction method of thin films of oxide formed on iron both in the air and from chromate-passivated films, concluded that inhibition must be considered as a heterogeneous reaction between ions in solution and the iron surface.

(536) R. C. Merrill, "Industrial Applications of the Sodium Silicates," *Industrial and Engineering Chemistry*, Vol. 41, No. 2, pp. 337-345 (1949).

Protective action of silica or silicate ions is apparently due to invisible film of silica or metal silicate. Free-rinsing properties are useful. Shows rates of soil removal from Dow metal by alkaline solutions at constant sodium oxide content, soils being stearic acid, paraffin, and red oxide buffing compound. Comparison made of caustic soda, trisodium phosphate, and 3:2 and 1:1 ratio silicates, the latter showing the most effective rate of removal.

(537) W. R. Meyer and S. H. Brown, "Cleaning, Etching, Chemical Polishing and Brightening of Aluminum," *Proceedings, Am. Electroplaters' Soc.*, pp. 163-191 (1949).

Because of the chemical reactivity of aluminum, removal of heavy oil, grease, and buffing compounds and solid dirt is generally accomplished with organic cleaning agents. This is followed as required by alkaline cleaners to remove any remaining light films.

Reviews vapor degreasing, solvent wash, emulsion-solvent cleaners, emulsion cleaners and oil-solvent type acid cleaners usually made with phosphoric acid and grease-dislodging agent such as alcohol, ketone, or a surface active material. Latter type usually used cold, but some used warm, mixed with water and most effective prior to organic finishing and when brushed or swabbed on the surface.

Reviews alkaline cleaners which are subdivided as nonetching and etching types. Mentions use of wetting agents but indicates they cause roughening of etched surface and also reduce rate of attack. Discusses additives which affect rate of reaction with caustic soda on aluminum and acid treatments.

Smut removal usually occurs after alkaline etching, and two acids are generally used: nitric acid to dissolve all elements present in metal smuts and hydrofluoric acid to remove silicon smuts. Best results are obtained with the mixed acids which represent a container problem. Another acid used for smut removal is chromic, but this is not suitable against silicon and is best used on work prior to painting or organic finishing.

(538) Donald L. Miles (to American Chemical Paint Co.), "Cleaning Bath for Zinc and Zinc-base Alloys Prior to Electroplating," U. S. Patent No. 2,461,228, February 8, 1949; *Chemical Abstracts*, Vol. 43, p. 3299 (1949).

Die castings are cleaned and lightly etched by the use of a bath consisting essentially of mineral spirits, phosphoric acid, cyclic coal-tar bases, sulfuric acid, thiourea, wetting agents, and water.

(538A) Compound, Carbon Removing, Military Specification MIL-C-881 (Ships), October 1, 1949.

Intended for use in softening and facilitating removal of carbon, wax, gum, oil, and tar from engine assemblies. Requirements include composition as single phase liquid composition comprising organic solvents, emulsifying agents and corrosion inhibitors, separation into layers with water, and emulsification. Carbon removal is compared with type composition to give good removal as illustrated.

(539) "Vapor Degreasing Manual," Optimum Equipment Co., 24 pp. (1949).

Discusses design of vapor, vapor-spray, and liquid-liquid-vapor units and auxiliary equipment. Concerns installation, operation, cleaning, maintenance, and recovery of solvents.

(540) R. E. Paret, "How to Clean Stainless Steel Textile Equipment," *Textile Industries*, Vol. 113, No. 9, pp. 96-97 (1949).

Cleaning usually accomplished with borax, soda ash, or sodium perborate. Only mild abrasives such as whiting, grade FFF pumice, magnesium oxide, and fine scouring powders. Coarser materials may roughen polished surfaces. Metal scrapers and brushes are not recommended but stainless steel wool is satisfactory. For heating coils and heat exchange tubing a 10 to 20 per cent solution of nitric acid is normally used, but not in contact with common steel, brass, or copper. Heat tints from excessive exposure are removed by a commercial stainless steel polish.

(541) L. A. Pavlish, "Drawing Compounds and Other Variables in the Rinsing of Metal Cleaners," *The Enamelist*, Vol. 26, Summer, 1949, pp. 3-7; *Plating*, Vol. 37, No. 5, p. 508 (1950).

In porcelain enameling, rinsing between the cleaning of steel and immersion in sulfuric acid pickle has been given little consideration. A modification of the regular pickling procedure was used to determine the effects of various rinsing variables: addition of drawing compound to cleaner, carryover of cleaner to rinse, flanged parts, transfer time between cleaner and rinse, and temperature of rinse. The results of these tests are illustrated.

(542) "Vapour Blasting: Its Many Uses Increase Almost Daily," *Products Finishing*, London, Vol. 2, No. 1, pp. 14-19, 61 (1949); *Metallurgical Abstracts*, Vol. 16, Part 8, p. 519 (1949).

A blast of water and fine abrasive mixture is directed against the surface to be treated by means of compressed air. The abrasive media include a specially selected cryptocrystalline chalcedonic silica, pumice, kieselguhr, or even ground husks of cereals, walnut shells, or other organic solids. Advantages and uses of process discussed at length. Cleaning of aluminum and magnesium alloy sand castings, the preparation of aluminum for anodizing, the surface finishing of the molds for zinc alloy die-castings, and the finishing of automotive and aero-engine parts for improved lubrication and burr removal.

(543) "Degreasing: A Safe Process," *Products Finishing*, London, Vol. 2, No. 1, pp. 80-81 (1949); *Metallurgical Abstracts*, Vol. 16, Part 8, p. 517 (1949).

Brief description of the "Graking" immersion at 170 F (77 C) cleaning process for ferrous and non-ferrous metals. Is claimed to have a number of advantages over trichloroethylene vapor degreasing.

(544) "Metal Cleaning with Acid," *Prod-*

ucts Finishing, London, Vol. 2, No. 4, pp. 16-18 (1949); *Metallurgical Abstracts*, Vol. 61, p. 840 (1949).

A survey giving recommended solution compositions for pickling aluminum bronzes, nickel silver, and cupro-nickels.

(545) Compound Dishwashing (For use in Mechanical Dishwashing Machines), Quarter-master Corps Tentative Specification OQMG 220A, April 18, 1949.

Material is intended for use in dishwashing machines and not for manual cleaning. Type I for water in hardness greater than 120 ppm and type II in water hardness 0 to 120 ppm. Composition of type I: Moisture 25 per cent maximum, alkalinity as Na_2O 30-48 per cent, phosphate as P_2O_5 18 per cent minimum, silicate as SiO_2 8 per cent minimum, carbonate as CO_2 20 per cent maximum, insoluble matter 1 per cent maximum, other constituents 3 per cent maximum.

Other requirements are pH and buffering capacity, foaming, water softening capacity, turbidity, corrosion, fineness, and stability.

(545A) H. Raether, "Detection of Surface Films by Means of Electron Interferences," *Zeitschrift Naturforschung*, Vol. 4a, pp. 582-587 (1949); *Chemical Abstracts*, Vol. 44, 4302 (1950).

Theory indicates that crystalline films 5 to 10 Å thickness should be recognizable on smooth surfaces but not on rough ones. Electrolytically polished aluminum surfaces become covered with an oxide layer so thin, 30 to 60 Å, that interferences are noticeable after a month of exposure to the atmosphere.

(546) Arthur A. Reid (to Reid Engineering Co.), "Preparing Aluminum for Spot Welding," U. S. Patent No. 2,465,750, March 29, 1949; *Chemical Abstracts*, Vol. 43, p. 4212 (1949).

Aluminum articles are freed from oxide and protected from oxide formation before welding by dipping them for 20 min into a solution of phosphoric acid 33, nitric acid 33, ammonium hydroxide 32, and a wetting agent, such as Aerosol, Nacconol NR, Terigitol 1 per cent held at room temperature and rinsing in water. The method reduces surface resistance from 39-60 microhms to 10 microhms.

(547) "Finishes for Aluminum," Reynolds Metals Co., Inc. (1949).

Contains section on cleaning treatments. These include directions for solvent, solvent-tank, solvent-vapor, alkaline, phosphoric acid, and mixed acid cleaning. Precleaning for resistance welding requires mechanical, acid, or alkaline removal of oxide film. Alternate cleaning methods are listed and are high temperature (oven at 425 F) and electrocleaning.

Four tables of typical cleaning practices are given, listing the methods of cleaning and a large number of proprietary compounds suitable for the purpose.

(548) Edward Rosen, "Finishing Monel Metal," *Metal Finishing*, Vol. 47, No. 4, pp. 60-65 (1949); *Metallurgical Abstracts*, Vol. 17, Part 1, p. 43 (1949).

The possible sources of soil and contamination on monel metal articles are considered and many methods for removing them are described in detail.

(549) E. Rosen, "Blast Cleaning with Suspended-Abrasive Media," *Metal Finishing*, Vol. 47, No. 10, pp. 76-78, 80 (1949).

A wide range of matte and satin finishes are produced by aqueous solutions of suspended abrasive media. Cites experience and refinements, including corrosion inhibition, abrasive media and equipment. Advantages cited are:

1. Smooth surface with nondirectional finish,
2. Minute etching causes surface to hold and distribute lubricant evenly,
3. Peening action has the effect of cold working,
4. Will treat surface when tolerances are as low as 0.001 in. and reach crevices in intricate parts,
5. Economical and rapid, and
6. Simple control and operation.

Process is finding application as surface pretreatment for electroplating.

(549A) Carlo Rossi (to Ciba, Ltd.), "Removing Corrosion Products from Surfaces Containing Heavy Metals," U. S. Patent No. 2,472,684, June 7, 1949; *Chemical Abstracts*, Vol. 43, p. 6149 (1949).

Rust removed by alkaline water solutions containing 2 to 5 per cent ortho-dihydroxy aromatic compounds such as pyrocatechol and gallic acid together with a reducing agent such as sodium hydrosulfite or hydrazine sulfate. Mentions the use of wetting agent and of thickeners to convert to paste form.

(549B) Carlo Rossi (to Ciba, Ltd.), "Cleaning Baths for Oxides and Corrosion Products from Metals," U. S. Patent No. 2,488,832, November 22, 1949; *Chemical Abstracts*, Vol. 44, p. 8311 (1950).

See Swiss Patent No. 250,383, Reference 453e.

(550) J. T. Rucker (to Hooker Electrochemical Co.), "Corrosion Retarder," U. S. Patent No. 2,459,119, January 11, 1949; *Chemical Abstracts*, Vol. 43, p. 3772 (1949).

A eutectic mixture of lauryl pyridinium chloride and benzyl thiocyanate is added in 0.02 to 0.1 per cent amounts to dilute aqueous acid solutions as 15 per cent sulfuric

acid and reduces corrosion by 99 per cent or more. Combinations of other aralkyl thiocyanates and other quaternary ammonium compounds can be used.

(551) B. F. H. Schelfele, "Rust Removers and Rust Inhibitors," *Farbe und Lack*, Vol. 55, pp. 13-14, 47-48 (1949); *Chemical Abstracts*, Vol. 43, p. 4995 (1949).

Rust is removed by 8 to 10 per cent inhibited hydrochloric or sulfuric acids, by 15 per cent phosphoric acid at 70 C, followed by 2 to 3 per cent phosphoric acid at 90 C, by 5 to 10 per cent caustic soda or alkaline salts, wetting agents and other additives. Rust is prevented by subsequent treatment with oily or greasy compositions and other materials or treatments.

(552) Sherwin Williams Co., 13 pp. (1949).

Pamphlet concerning the preparation of metal surfaces by cleaning of foreign substances and a means for improving adhesion and durability by etching, deposition of other substances, or otherwise changing the surface character of the metal. This is more important with newer fast-drying resins than with slow-drying type paints which exhibit some compatibility with oily soils.

Outlines methods and reasons for the use of solvent cleaning (a) by wiping, (b) solvent-jet, and (c) vapor degreasing. Lists alkaline cleaning, emulsion cleaners, acid cleaners, burn off, flame cleaning, mechanical cleaning, and blasting. Gives for each one the essentials, reasons, and precautions for effective use.

Also includes data on precleaning, rust proofing. Chemical treatments are described, including crystalline phosphates and amorphous phosphates.

(552A) J. A. Spink, "Structure of Molecular Films of Stearic Acid on Copper," *Nature*, Vol. 163, p. 441 (1949).

Electron diffraction pattern produced evidence of the existence of crystallites of copper stearate on a copper surface after heating of the stearic acid on it.

See Reference 501A.

(553) M. E. Straumanis and N. Brakss, "The Rate of Solution of Super-Pure Aluminum and Its Binary Alloys in Bases. I.—(In Sodium Hydroxide Solutions)," *Metall*, Vol. 3, 3-4, pp. 41-47 (1949); *Metallurgical Abstracts*, Vol. 17, Part 3, p. 175 (1949).

Review and theory of solution process.

(554) D. Tabor and E. D. Tingle, "Surface Attack of Metals by Fatty Acids, and the Formation of Lubricating Layers," *Research (London)*, Supplement, *Surface Chemistry*, pp. 217-222 (1949); *Chemical Abstracts*, Vol. 43, p. 8799 (1949).

The results of the friction studies elucidate the mechanism of the formation of lu-

bricating soap films by chemical reaction between fatty acids and metals. Friction experiments on surfaces from which the oxide film has been removed indicate that this reaction does not occur directly with the metal, even in the case of electronegative metals. The reaction does not take place in the presence of oxide films but in the absence of water. Adequate soap formation requires the presence of water during the formation of the oxide film. The most likely explanation is that water forms a hydroxide or some other compound which is readily penetrated and attacked by the acid.

(555) F. Todt, "Electrochemical Behavior and Rate of Formation of Oxide Films on Metal Surfaces, Especially Iron," *Metaloberfläche*, Vol. 3, pp. 170-173 (1949); *Chemical Abstracts*, Vol. 44, p. 2869 (1950).

Metals covered with a thin oxide layer form a galvanic element with cadmium in a strong salt solution until the oxide is reduced. The total number of coulombs produced is an indication of the amount of oxide present. Exposure of iron for 5 min in air gives an oxide film of about 200 Å. The local couple formed between iron and its oxide film usually produces current in the order of magnitude of 10^{-4} coulombs per sq cm.

(556) B. Tremain, "Cleaning Composition for Rust Stained Lacquered Surfaces," U. S. Patent No. 2,462,341, February 22, 1949; *Official Gazette of the U. S. Patent Office*, Vol. 619, No. 4, p. 1037 (1949).

From 10 to 50 parts by weight of oxalic acid and from 90 to 50 parts by weight of a partially sulfonated saturated aliphatic hydrocarbon.

(557) I. I. Vainshenker and Z. I. Granik, "Chemical Control in Finishing the Surface of Steel Wire," *Zavodskaya Laboratoriya*, Vol. 15, pp. 1006-1007 (1949); *Chemical Abstracts*, Vol. 44, p. 974 (1950).

The use of titration methods for sulfuric acid concentration, and the determination of ferrous sulfate by the use of permanganate titration and copper by iodometric method. Calcium precipitated as calcium carbonate is determined by titration with 0.5 N hydrochloric acid to the disappearance of the phenolphthalein color.

(558) H. G. Webster (to J. H. Shoemaker), "Salt-bath Cleaning Castings Prior to Hot-dip Coating with Lead," U. S. Patent No. 2,458,660, January 11, 1949; *Chemical Abstracts*, Vol. 43, p. 2154 (1949).

Superior adhesion and freedom from pinholing is claimed through cleaning and etching of objects to be coated in molten salt bath, rinsed in water, and the smut removed by a dip in dilute acid.

(559) H. G. Webster and C. L. Falter (to

J. H. Shoemaker), "Salt-bath Cleaning of Metals to Replace Pickling," U. S. Patent No. 2,458,661, January 11, 1949; *Chemical Abstracts*, Vol. 43, p. 2154 (1949).

See Reference 558. Process of 2,458,660 is advocated in place of pickling because of increased speed, freedom from hydrogen embrittlement, and no spent liquor.

(560) H. G. Webster, "Molten Salt Baths," U. S. Patent No. 2,458,663, January 11, 1949; *Chemical Abstracts*, Vol. 43, p. 3769 (1949).

Cleaning of ferrous parts accomplished by bubbling steam through molten baths of caustic soda, sodium nitrate, and sodium chloride or caustic soda, sodium chloride, and sodium aluminate.

(561) Hugh G. Webster (to J. H. Shoemaker), "Electrolytic Cleaning of Metal," U. S. Patent No. 2,468,006, April 19, 1949; *Chemical Abstracts*, Vol. 43, p. 5680 (1949).

Electrolytic cell containing a fused salt containing sodium hydroxide or potassium hydroxide 75 to 90, sodium chloride 10, sodium fluoride 4, and sodium aluminate 1 per cent at 450 to 480 C at a current density of 50 amp per sq ft. Slow alternating or successively reversed direct current is used at 4 to 6 v.

(562) K. Wellinger, "Erosion of Metals by Sandblasting," *Zeitschrift für Metallkunde*, Vol. 40, pp. 361-364 (1949); *Chemical Abstracts*, Vol. 44, p. 1388 (1950).

Data are given for sandblasting five steels of varying hardnesses, with four kinds of sand to show the effects of frictional quality of sand impact angle, type of nozzle, and air pressure.

(563) R. M. Wick, "Acid Dips in Cleaning Cycles. II. Acid Dips for High Carbon Steel," *Proceedings, Am. Electroplaters' Soc.*, pp. 132-137 (1949).

The two factors in addition to requirement for low carbon steel are tendency toward embrittlement and requirement for adhesion of electroplate. This is avoided by preventing overhardening. Preferred degreasing is by anodic alkaline baths; cathodic introduces some risk of hydrogen embrittlement. Best plating results obtained with anodic sulfuric acid treatment.

(564) L. J. Wieschhaus, "Cleaning (Steel) Forgings," *Metal Progress*, Vol. 56, pp. 496-497 (1949); *British Abstracts*, Part BI, Section 5, p. 343 (1950).

Airless blasting method cheaper than pickling, tumbling, and sand blasting for miscellaneous forgings.

(565) E. R. Yarham, "Aluminum. Its Surface Preparation and Finishing. I," *Products Finishing*, Vol. 13, No. 12, pp. 38-40, 42, 44, 46, 48, 50, 52 (1949).

Removal of lubricants, oils, soap emulsions and drawing compounds, and general dust and dirt accomplished by hand cleaning, immersion, or vapor cleaning depending upon work and subsequent processes. Discusses alkaline process by immersion or organic solvent-precleaned parts for a few minutes at 176-203 F in a solution of:

Washing soda 0.8 to 2.4 oz per gal
Trisodium phosphate 0.8 oz per gal

or a solution of:

Washing soda 1.6 to 6.4 oz per gal
Sodium silicate 0.8 to 1.6 oz per gal

For removal of soap-base compounds suggests immersion at 100-110 F in a solution of:

Sodium carbonate 3 oz per gal
Sodium bicarbonate 6 oz per gal

Smut removed by dip in 30 to 50 per cent nitric acid and 10 per cent hydrofluoric acid, the time of dip depending upon the part.

(566) A. J. Zino, Jr., "How to Clean Hydraulic Systems," *American Machinist*, Vol. 93, No. 14, pp. 99-100 (1949).

Stresses necessity for absolute cleanliness of system before hydraulic oil change. Cleanliness during assembly and prior to initial use also discussed. Operating machines are cleaned because moisture in the system can reduce life expectancy of fluid and working surfaces. Consists of removal of dirt, grease, cutting oils, and coolants, and sludging of pumps and valves with fluid with low resistance to oxidation. Sludge and gum solvents used for cleanup and also correction of oxidation and rust inhibition. Where this method is inadequate, flushing and finally dismantling is resorted to. Tubing can be cleaned with hot strong caustic solutions.

1950

(567) J. Albin, "Fast Methods for Cleaning Bearings," *Metal Finishing Manual*, Iron Age, p. 103 (1950); *Iron Age*, Vol. 163, No. 21, p. 73 (1949).

Use of high pressure sprays using spray guns known commonly as engine cleaner siphon guns or Varsol spray guns. For cleaning bearings in quantity, a depot from a 55-gal drum is illustrated and is used for cleaning pieces held on a perforated holding grid. Jet is mounted on a spindle to revolve and clean evenly, generally accomplished in 10 min.

(568) "Tentative Recommended Practice for the Preparation of and Plating on Stainless Steel," ASTM Committee B-8, 16 pp., November 1, 1950.

Preparation comprising removal of scale, removal of oil, grease, or foreign material, and activation.

Precleaning includes the removal of lubricants and finishing compounds by spray cleaning in a power washer using alkali or emulsion-type cleaner. Soak cleaner and vapor degreaser may also be used, as well as preferred anodic electrocleaning. Scale removal is accomplished by blasting, shot peening, tumbling, pickling, molten salt treatment (U. S. Patent No. 2,377,876, Reference 568, or U. S. Patent Reissue No. 22,887, Reference 568, originally U. S. Patent No. 2,395,694), or wire brushing.

(569) Tentative Recommended Practice for the Preparation of Zinc Base Die Castings for Platings," ASTM Committee B-8, 1950.

Steps involved in preparation consist of polishing parting lines, polishing other surfaces where needed, buffing, precleaning, rinsing, alkaline cleaning, rinsing, acid dipping, rinsing, copper striking. Precleaning recommended, depending upon soil, by solvent cleaning, emulsion cleaning, soak and spray cleaners, or electrolytic cleaning with recommendations for each type. Acid dip is necessary after alkaline cleaning. Failure to achieve proper cleaning cycle will result in separation of the plate, usually in the form of blisters. Under and over cleaning result in specific peculiarities of blister.

(570) G. L. J. Bailey and H. C. Watkins, "Surface Tensions in the System Solid Copper-Molten Lead," *Proceedings, Physical Society (London)*, Vol. 63B, pp. 350-358 (1950); *Chemical Abstracts*, Vol. 44, p. 7657 (1950).

Method described for the determination of surface tension of surfaces occurring in the copper or copper-lead with hydrogen or argon. The failure of lead to spread readily on copper appears to be a feature of the lead-copper system and is not due to contamination of the surface. The results demonstrate the strongly marked reduction in the surface tension of a solid metal surface that may be brought about by the adsorption upon it of atoms of another metal.

(571) Joseph J. Bayer, "Cleaning Copper-Containing Metal Articles," U. S. Patent No. 2,522,496, September 19, 1950; *Chemical Abstracts*, Vol. 45, p. 108 (1951).

Copper containing materials such as brass cleaned by heating to 900 F, then quenched in a solution consisting of 1 lb zinc chloride-ammonium chloride (93:7 parts by wt) in 1 gal water, to remove oxide films.

(572) J. J. Bikerman, "Surface Roughness and Contact Angle," *Journal, Physical and Colloid Chemistry*, Vol. 54, pp. 653-658 (1950).

The contact angles formed by air, water droplets, and stainless steel plates of six commercial standard finishes were determined by measuring the diameters of the bases of drops of various sizes. The angles were almost identical for the coarsest to the finest heights of elevation as determined by a tracer instrument. Spreading of droplets on grooved surfaces seems to show that contact angles depend on the type of surface roughness rather than on its degree.

See Reference 667.

(573) J. J. Bikerman, "Sliding Drops from Surfaces of Different Roughnesses," *Journal, Colloid Science*, Vol. 5, No. 4, pp. 349-359 (1950).

Values are given for sliding without acceleration water drops upon stainless steel, polished, and pickled steel. Roughness of surface markedly affected results, these being accounted for by surface tension effects. Plates chosen for test were of varying roughness on which were tested rolling balls, contact angles, and sliding of water drops.

(574) (Formerly 566) J. L. Bleiweis, "Processing Cycles for Chromium Plating," *Products Finishing*, Vol. 14, No. 8, pp. 38, 40, 42, 44 (1950).

Provides processing cycles for ferrous metals, copper alloys, zinc die castings, lead base alloys, aluminum alloys, magnesium alloys, and buffed nickel plate. Ferrous metals and copper alloys use cathodic and reverse electrocleaning; zinc die castings, aluminum alloys, and magnesium alloys require schedules of vapor degreasing and alkaline soak cleaning. Complete cycles following the cleaning operations are described.

(575) E. R. Boller, L. D. Eubank, and C. A. Littler (to E. I. du Pont de Nemours & Co.), "Process of Cleaning and Coating Ferrous Metal," U. S. Patent No. 2,515,488, July 18, 1950; *Chemical Abstracts*, Vol. 44, p. 8311 (1950).

A zinc-aluminum alloy coating is produced by passing a ferrous article thru a molten zinc chloride flux supported on a mass of molten zinc and, while still hot, thru a molten zinc-aluminum alloy containing less than 0.05 per cent by weight of iron with 0.2 to 1.5 per cent aluminum. Flux may contain ammonium chloride, zinc ammonium chloride, etc.

(576) Ben Borus and G. A. Martin (to Shell Development Co.), "Carbon Remover and Metal Surface Cleaning Composition," U. S. Patent No. 2,509,197, May 30, 1950.

Active ingredients comprise a hydrocarbon base admixed with specific types of detergent, wetting and coupling agents, a penetrant, and water. An example follows:

	Per Cent
Kerosene	20
Ethylene diamine oleate	4.4
o-Dichlorobenzene	40
Ethylene glycol monobutyl ether	15
Ethylene diamine	5.6
Water	15

Propylene diamine oleate and propylene diamine may be used.

(577) V. E. Bowes, "Chemical Cleaning," *Petroleum Engineer*, Vol. 22, No. 5, pp. C-20, C-22, C-24, C-25 (1950).

Methods developed in general use classified as: (1) cleaning one or a bank of heat exchangers by chemical cleaning material; (2) same as (1), but in a bank and not into tower; (3) cleaning pulled tube bundles by immersion in a tank of specialized cleaning material. Discusses need for regular cleaning, make-up of deposits to be removed, and cleaning materials for these. Cleaning materials are discussed in general and illustrations of proprietary compounds listed.

(578) A. Bregman, "Metal Cleaning," *Metal Progress*, Vol. 57, pp. 75-78 (1950); *British Abstracts*, B I-4, p. 643 (1950).

Discusses factors influencing selection of suitable metal cleaners and general types of cleaning methods.

(579) "Cleaning Metal Surfaces, III," *Bureau of Ships, Navy Department, Industrial Notes*, 10 pp., March 31, 1950.

Description of improved techniques for smaller shops with a variety of cleaning problems. Steam cleaning preferred for articles too large for immersion cleaning. Seed blasting is recommended for removal of oxide or carbon deposits where sand or grit blasting are harmful. Gas flame cleaning is useful before painting, and improvements in cleaning equipment are noted. Cleaning of stainless steel suggested by solvent cleaning, acid treatment, scale removal in sodium hydride, and pickling. Lead surface cleaning suggested by mechanical methods. Nickel and nickel alloy surface cleaning similar to stainless steel. Cleaning before zinc coating or galvanizing is accomplished by pickling or fluxing. Cleaning of surfaces to be tinned accomplished by the usual cleaning methods followed by pickling. Methods are given for cleaning of aluminum work pieces before spot welding. Solvent cleaning is generally recommended for preserving and packaging of metal articles. Importance of cleaning before use of dies stressed. Other subjects discussed are conditioning for nickel plating, hard facing, liquid baths, cleaning bolts, cooling systems, hydraulic systems, zinc or zinc alloy work pieces. A separate section is given on economics in cleaning. Bibliography contains 17 references, 13 specifications.

(580) T. E. Burkhardt (to General Motors Corp.), "Rust Removing," U. S. Patent No. 2,531,320, November 21, 1950; Chemical Abstracts, Vol. 45, p. 1493 (1951).

Oxidized or scaly metal surfaces are cleaned and polished by immersing the metal electrolytically in an aqueous solution containing 10 oz tetrasodium pyrophosphate per gallon water with sufficient acid to reduce the pH to 9.7. A potential of 7 to 12 v is applied.

(581) P. A. Cartwright, "Metal Finishing Handbook," Blackie and Son, Ltd., London and Glasgow, 216 pp. (1950); Science Progress, Vol. 38, No. 152, pp. 780-891 (1950).

Methods for cleaning which do not mention the use of phosphates, metasilicate, and emulsion type cleaners.

(582) "Electrolytic Descaling," Chemical Age, Vol. 63, p. 21 (1950); British Abstracts, B 1-7, p. 931 (1950).

Discussion of the advantages of tin salt as an inhibitor in the descaling bath, a unique feature in the Bullard-Dunn electrolytic descaling and tin plating process.

(583) T. F. Clark and E. C. Lathrop, "Soft Grits Provide Low Cost Method for Blast Cleaning Metals," Materials and Methods, Vol. 31, No. 5, pp. 67-69 (1950).

Agricultural residues such as corn cobs, rice, and nut shells can be used for conventional blasting equipment for degreasing, removing welding scale, and cleaning metals prior to plating.

(584) (Formerly 567) G. C. Close, "Magnesium Processing and Finishing," Products Finishing, Vol. 14, No. 7, pp. 32-34, 36, 38, 40 (1950).

Preparation of magnesium for further processing requires adequate cleaning. Stresses the difference in chemical characteristics and in attack by cleaning agents between aluminum and magnesium. Hydrofluoric acid in 10 per cent amounts has no effect on magnesium but aluminum is attacked violently. Nitric acid does not attack aluminum but severely etches magnesium. Graphite used as a lubricant in hot forming and drawing must be removed as soon as possible, since it is corrosive in character. This is accomplished by 1/2 to 2 min dip in 15 to 20 per cent chromic acid solution.

(585) P. Corash, "Milk Plant Equipment and Sanitation," Modern Sanitation, Vol. 2, No. 11, pp. 28-30, 58 (1950).

Suggests the use of ultraviolet light in the inspection of metal equipment to show evidence of milk stone or other residue.

(586) Werner David (to Shell Development Co.), "Composition for Removing Fingerprint Deposits from Non-Absorbent Sur-

faces," U. S. Patent No. 2,517,636, August 8, 1950; Chemical Abstracts, Vol. 45, p. 1492 (1951).

Composition prepared by mixing a clear soluble oil with critical amounts of a water-insoluble volatile degreasing agent and water in such proportions as to form a stable uniphase system. Example contains benzene 20, water 23, spindle oil 33, sodium naphtha sulfonate 18, and 3 per cent each of diacetone alcohol and sulfated fish oil.

(587) J. G. Donelson, "Measuring Minute Surface Film," Modern Packaging, Vol. 23, No. 7, pp. 125-126 (1950).

In tinplate production, an oil film is applied to promote ease of lifting in lithographic printing and deposit of lacquers; it also acts as a lubricant and retards tarnish. Edible cottonseed oil generally applied to electrolytic tinplate and palm oil to hot dipped plate.

Describes technic of measurement of oil on plate by dipping of plate in calibrated hydrophil-balance equipment. Amount of oil on electrolytic tinplate generally is very close to 0.0000015 g per cm. Method applicable to production control. See Reference 507.

(588) Alfred Douty and Eugene Snyder (to American Chemical Paint Co.), "Preparing Iron and Aluminum Surfaces to Receive Organic Coatings and Solution Therefor," U. S. Patent No. 2,516,685, July 25, 1950; Chemical Abstracts, Vol. 45, p. 1946 (1951).

After a primary cleaning treatment, articles of iron or aluminum and their alloys are rinsed in a dilute, acidic solution of 0.01 to 0.1 per cent of either chromic or phosphoric acid or their mixtures and from 0.001 to 2.00 per cent of a nonionic, surface active agent capable of reducing the surface tension of the solution to 50 dynes per cm or less. This acidic rinse improves the adhesion and durability of organic finishing coatings.

(589) Du Bois Co., "An Introduction to Electrolytic Cleaning," 6 pp. (1950).

Discusses the fundamentals of electrolytic cleaning. Direct current cleaning with work as the cathode is faster but has the possible disadvantages of smut formation and hydrogen embrittlement. While reverse current cleaning is slower, the disadvantages of direct cleaning are eliminated. Cleaning equipment and effect on operation are discussed. Considered in choice of electrolytic cleaners are high electrolytic conductivity for profuse gassing, good wetting, excellent emulsification and suspending ability, lime control and deflocculation, proper foam control, and long solution life. Recommendations for effective operation are given. Typical direct or reverse current cleaning cycle is given as:

1. Electrolytic cleaning
2. Water rinse at 100 to 120 F
3. Hydrochloric acid treatment at room temperature in 25 to 50 per cent concentration by volume
4. Cold water rinse
5. Plate

The above is for single-tank setup and in absence of heavy soil or smut, but where these are present the above cycle acts as a preclean, followed by a second cleaning cycle:

5. Electrolytic cleaner
6. Water rinse at 100 to 120 F
7. Sulfuric acid 5 to 10 per cent by volume or 1 : 5 hydrochloric acid at room temperature
8. Cold water rinse
9. Plate

In automatic systems the following cycle is suggested:

1. Electrolytic cleaning by direct current
2. Same with reverse current
3. Water rinse at 100 to 120 F
4. Hydrochloric acid at 25 to 50 per cent by volume at room temperature
5. Cold water rinse
6. Plate

(590) Eric Eichwald (to Arrow Laboratories, Inc.), "Detergent Composition," U. S. Patent No. 2,503,381, April 11, 1950; Chemical Abstracts, Vol. 44, p. 8685 (1950).

Composition for cleaning automobile radiators comprised of trisodium phosphate 38 to 46, soda ash 1 to 3, sodium sesquicarbonate 1 to 3, borax 1 to 3, sodium or potassium citrate 0.25 to 7.0, potassium tartrate 0.25 to 8, and sodium tartrate 0.25 to 9.

(591) "Degreasing (of Metals) with Emulsifiable Solvent Cleaners," Electroplating, Vol. 3, pp. 215-216 (1950); British Abstracts, B I-4, p. 643 (1950).

Discussion of cleaning of steel and brass parts in barrel process, cleaning for still vat plating, and emulsion cleaning in spray-wash machine. Two types of immersion-emulsion cleaners are described.

(592) E. Engle, "Metal Finishes and Finishing Processes," Metal Finishing Manual, Iron Age, pp. 1-10 (1950).

Cleaning classified as mechanical, physical, and chemical. Mechanical cleaning of surface signified absence of oils, grease, solids, and products of oxidation, but not necessarily products of all chemical reactions. Chemical cleanliness of surfaces means absence of any foreign matter. Cleaning procedures under these three classifications given. Tables are given summarizing comparisons of pickling, degreasing and cleaning procedures, acid pickling and bright dip treatments, electrolytic pick-

ling, removal of cutting and drawing oils, factors in alkaline metal cleaning, typical immersion cleaning solutions by metals cleaned, typical electrolytic metal cleaning procedures.

(593) E. Engle, "Polishing and Cleaning Metals Prior to Finishing," Tool Engineer, Vol. 24, No. 3, pp. 43-47 (1950).

Stresses effect of adhesive forces (attraction between unlike materials) and cohesive forces and the effects each plays in cleaning practice. Adhesive bond can be chemical and, to this end, reactive materials should be removed as soon as possible to prevent chemical reaction with metal surface. Describes methods for removal of soil, special cleaning applications as for aluminum alloys containing silicon which cause smut, removed by hydrofluoric acid-nitric acid solutions. and general aluminum etching.

Cleaning methods described for brass, copper alloy, magnesium alloy, monel, and nickel (in sodium cyanide or by cathodic cleaning in strong sulfuric or hydrochloric acid). Describes steel preparation for lacquering and plating. Suggests laboratory test method for determining effectiveness of cleaning solutions, using copper sulfate-sulfuric acid dip for determining cleanliness.

(594) "Sequestering Agent for Alkaline Cleaners," Enley Products, Inc., New York, N. Y., Metal Finishing, Vol. 48, No. 11, p. 84 (1950).

Added in 1/2 oz per gal. of solution and said to have the following properties:

1. Dissolves metal soaps.
2. Prevents contamination of metal surfaces by soap or rosin acids.
3. Stabilizes metasilicate baths against colloidal precipitation after prolonged heating.
4. Prevents precipitation of calcium phosphates, silicates, or carbonates.
5. Deionizes heavy metal and alkaline earth ions. Soluble complexes formed with other metals.
6. High alkali and temperature stability.
7. Non-volatile and stable.

(595) (Formerly 588) R. O. Fehr, "Ultrasonics," Products Finishing, Vol. 14, No. 7, p. 94 (1950).

Ultrasonics can be used to clean small metal parts of grease and grime in 10 sec. Special needs of ultrasonic generators are a large supply of electric current at frequencies hundreds of times higher than the usual 60 cycle current. Cleaning tanks along production lines for processing of small parts is envisioned.

(596) J. E. Fritts, "Molten Caustic Bath Provides Rapid, Efficient Method of Cleaning Steel Parts for Painting," Products Finishing, Vol. 15, No. 3, pp. 10-11, 13-18 (1950).

Describes prepaint cleaning cycle for steel parts which involved the use of molten caustic soda in which paint from reject parts may also be stripped. Comprises automatic conveyorized cleaning cycle containing a molten caustic soda bath with necessary rinses and phosphoric acid dip. Function of cleaning cycle is to remove non-pigmented drawing compound used in forming operations and to produce on the clean surface a thin, inert, phosphate film which promotes paint adherence and resists corrosion. Molten caustic soda bath is Ajax Hultgren type. Parts on rack are immersed automatically in molten caustic soda at 720 to 780 F in a 50-sec cycle. This is followed by a quench in water at 150 to 180 F. Next portion of the cleaning operation is immersion in proprietary cleaning solution at 180 F, followed by water rinse. The phosphoric acid tank is operated at 10 to 13 per cent strength at 160 F for 50 sec followed by an acid rinse, hot water rinse, and dryer.

Cleaner and acid tanks are of weir type and water sprays at solution surface to maintain clean liquid surface. Phosphoric acid, acid rinse, and final rinse tanks are air-agitated. Process restricted to steel parts of shape to permit draining of caustic quickly and completely.

(597) G. E. Gardam, "A Simple Instrument for Measuring 'Surface Truth' of Metal Surfaces and the Amount of Polishing Required," *Journal, Electrodepositors' Technical Soc.*, Vol. 28, No. 4, pp. 1-8 (1950).

Describes a simple lamp and transparent striped screen before which the articles to be examined are placed. Roughness or lack of polish are easily observed at 45 deg angle by eye or a record made photographically.

(598) Alexander Gilbert, "Dye Penetrant for Surface Flaws," *Iron Age*, Vol. 166, No. 20, pp. 91-92 (1950); *Chemical Abstracts*, Vol. 45, p. 512 (1951).

A dye penetrant method of inspection for surface cracks and discontinuities is described. After cleaning, the dye penetrant is applied as a solution of high capillarity and low surface tension. No special equipment is needed, and the solution can be applied by spraying, dipping, or brushing. The second step is to wash off the excess penetrant. The third step is to apply the developer in the same manner as the penetrant. This provides a smooth white background to give a good contrast, and the cracks show up as vivid red marks on a white surface. Internal flaws or porosity cannot be detected unless the cavity extends to the surface.

(599) (Formerly 569) "Improved Di-Phase Metal Cleaner," Glyco Products Co., Inc., June, 1950.

A polyethylene glycol ricinoleate is used to the extent of about 1/2 per cent in tri-

chloroethylene to which is added mineral spirits. This is added to a water layer which remains on top of the chlorinated solvent, and phosphates are frequently added to the water to help remove soluble dirt from the metals. Bath operated at room temperature with a minimum of agitation, avoiding difficulties with toxic fumes, fire hazard, loss of solvent, and change in composition of the two phases.

(600) "Detergents for the Printer," Government Printing Office, Printing Industry of America, Inc., Bulletin M-1, 5 pp. (1950).

Problem is removal of ink or grease from the printing surface, an indispensable operation. The removal of wax from electrotypeshell, cleaning press rollers, ink containers, slug-casting-machine matrices, and numbering heads accomplished by volatile solvents, alkaline cleaning agents, or surface active agents.

Solvents listed are gasoline, benzol, ink solvent (50 per cent benzol and 50 per cent acetone), kerosene, dry cleaners' solvent, and isopropyl alcohol. Table given listing their drying rates, solvent power on dried inks, and flammability. Also listed are the maximum safe concentrations in air. Alkaline cleaning agents listed are caustic soda, trisodium phosphate mixture, sodium metasilicate, and sesquisilicate.

Wetting agents used in as little as 0.1 per cent solution.

(601) A. G. Gray, "Metal Cleaner Efficiency," *Products Finishing*, Vol. 15, No. 2, pp. 80, 82, 84, 86, 88 (1950).

Cleaning in the plating room was discussed by E. C. Rinker, indicating that trouble was due to acceptance of everything, regardless of condition. Lack of proper equipment was said to be another contributory factor. Example cited was lack of proper rinse tanks following cleaning. Gives sketch of one type of electrolytic cleaning tank recommended. Emphasized necessity for immediate rinsing.

W. R. Meyer suggested first test of cleaning solution be its ability to remove unsaponifiable materials from a 2 x 3 in. panel treated with No. 50 engine oil under conditions specified. Recommends 10 amp per sq ft as preferred current density for electrolytic cleaners, since low current density areas are hardest to clean. Water break test suggested followed by a 30-sec dip in 10 per cent sulfuric acid bath for oxide removal, followed by bright nickel plating. Presence of solid dirt said to be noticeable by making "criss-cross" on panel with a piece of clean rubber. If no "criss-cross" is evident, this was cited as evidence that surface is definitely free from loose dirt.

Reviews G. B. Hogaboom's paper on copper dip method, Reference 463C, Spring's spray pattern method, Reference 403, and Morgan and Lankler's fluorescent dye method, Reference 196.

(602) C. H. Groom, "Chemical Cleaning of Process Side Equipment," *Petroleum Engineer*, Vol. 22, No. 5, pp. C-48, C-50, C-52 (1950).

Process side deposits dissolved by compositions such as inorganic, organic, and mixtures of both. Typical process side deposit analysis for desalted, Illinois crude oil was organic matter soluble in carbon tetrachloride 31 per cent but insoluble in carbon tetrachloride 8 per cent.

(603) N. Hackerman and E. E. Glenn, Jr., "Orientation of a Polyfunctional Organic Molecule at a Steel Surface," *Journal, Physical and Colloid Chemistry*, Vol. 54, pp. 497-505 (1950).

Electron-diffraction patterns of SAE 1020 and evaporated iron surfaces after adsorption and desorption of alkylpyrrolidinedione showed firm adsorption in an oriented two-dimensional layer. Irreversible adsorption took place from solutions of the agent from Skellysolve B.

(604) A. J. Halloway, "Emulsion and Alkaline Cleaning," *Finish*, Vol. 7, No. 1, pp. 53-54, 76 (1950); *Chemical Abstracts*, Vol. 44, p. 8141 (1950).

Discussion of the use of alkaline cleaners for vegetable oil removal and emulsion type cleaners to remove mineral oils.

(605) Wm. D. Harkins and E. H. Loeser, "Surfaces of Solids. XIX. Molecular Interaction between Metals and Hydrocarbons," *Journal, Chemical Physics*, Vol. 18, pp. 556-560 (1950).

The energy of interaction between a hydrocarbon and a metal increases rapidly in the order copper, silver, lead, and iron. For the oxide-coated metals, the values are only slightly higher. Recommends that the use of adhesion tension should be abandoned because it is in error.

(606) J. C. Harris, R. E. Kamp, and W. H. Yanko, "Improved Radioactive-Tracer Carrier for Metal Cleaning Studies," *ASTM Bulletin*, No. 170, pp. 82-83 (1950). See Reference 517.

Carbon-14 tagged n-undecane was used because of the potentially lesser adsorption than N, N-di-n-butyl stearamide. Higher alkyl carbon length of tracer is indicated, but the method differentiates successfully between types of cleaning compounds.

(607) J. C. Harris and R. E. Kamp, "Development of Metal Cleaners Using Radioisotopic Evaluation Methods," *Metal Finishing*, Vol. 48, No. 11, pp. 75-78 (1950).

Radioisotopic method of References 517 and 606 were used. It was determined that 2.5 per cent Sterox CD combined with 97.5 per cent sodium metasilicate at least as satisfactorily in cleaning as a 5 per cent alkylbenzene sulfonate and 95 per cent metasilicate. In the alkylbenzene sulfonate compositions, the meta- and ortho-silicates proves most effective, a second or lower level was attained with soda ash, trisodium phosphate, and tetrasodium pyrophosphate, while a third level contained modified soda and caustic soda.

(608) J. C. Harris, R. E. Kamp, and W. H. Yanko, "Detection of Soil Removal in Metal Cleaning by the Radioactive Tracer Technique," *Journal, Electrochemical Soc.*, Vol. 97, No. 12, pp. 430-432 (1950).

Quantitative sensitivity of water break, fluorescent dye, and copper plate methods ascertained using the radioisotopic method. See Reference 517. Comparative sensitivity:

Radioisotopic method	110
Water break	11
Copper plate	4
Fluorescent dye	1

Following are apparent limits of sensitivity of methods in grams of soil per square centimeter:

Fluorescent dye method	2.3×10^{-5} to 5.7×10^{-6}
Copper plate	6.4 to 2.0×10^{-5}
Water break	2.4×10^{-6} to 4.4×10^{-7}
Radioisotopic method	1.7×10^{-7} to 0

(609) J. C. Harris, "Improved Finish Through Better Surface Cleaning," *Canadian Metals*, Vol. 13, No. 12, pp. 41-42, 44-45 (1950).

Review of the causes for poor cleaning and poor subsequent processing.

(610) J. C. Harris and R. E. Kamp, "Development of Metal Cleaners Using Radioisotopic Evaluation Methods," *Metal Finishing*, Vol. 48, No. 11, pp. 75-78 (1950).

Used method described in Reference 606 except that n-undecane was used as the radioisotopic tracer compound in place of N,N-di-n-butyl stearamide.

Shows that Santomerse No. 1 in 5 per cent amounts combined with 95 per cent alkaline salt is effective cleaner, but that the decreasing order of effectiveness of alkaline salts is meta- and ortho-silicates, trisodium phosphate, tetrasodium phosphate, modified soda, soda ash, and caustic soda. More effective cleaning is shown at reduced solution concentration levels with combinations of Sterox CD-metasilicate, Sterox SK-metasilicate, or Sterox MXP.

(611) R. H. Hertzog (to John A. Roebbling's Sons Co., Trenton, N. J.), "Sulfuric Acid Cleaning and Coating of Rod and Wire in a Straight-Line Operation," *Wire and Wire Products*, Vol. 25, pp. 1047-1048, 1079, 1080,

1081, 1082 (1950); Chemical Abstracts, Vol. 45, p. 1001 (1951).

Four types of coating are applied depending upon mill requirements, and each is discussed briefly: (1) sull and borax, (2) borax, (3) lime, and (4) copper.

(612) (Formerly 570) Hooker Electrochemical Co., "Cleaning Process," Chemical and Engineering News, Vol. 28, No. 1, p. 60 (1950).

Describes a fused alkali descaling bath, the product trade-named Virgo Salt, which converts scale or rust to an acid soluble oxide. Used for cleaning of steel and other metals. The fusion bath is generally followed with a water quench and a short acid dip. Applicable to any metal not attacked by molten caustic soda at 930 F or whose physical properties are not adversely affected by such temperatures.

(613) R. Justh, "Alkaline Degreasing in Metal Finishing," Metalloberfläche, Vol. 4, pp. A72-76 (1950); Chemical Abstracts, Vol. 44, p. 9907 (1950).

A review.

(614) A. E. Kadell, "Tinplate Cleaning and Annealing Cycle May be Cut to Less than Two Days," Steel, Vol. 127, No. 4, p. 72 (1950); British Abstracts, B I-5, p. 95 (1951).

Process using continuous cleaning and annealing plant successfully reduced time cycle.

(615) G. V. Karpenko, "Effect of Surface-Active Substances on the Fatigue of Steel," Doklady Akademii Nauk S. S. S. R., Vol. 73, pp. 1225-1228 (1950); Chemical Abstracts, Vol. 45, p. 1482 (1951).

Curve of fatigue strength of a perlite-ferrite steel indicates that surface-active substances can lower the strength appreciably, indicating that penetration of the substance into the micro-cracks proceeds with a finite velocity, and that at too large a number of cycles per minute, the micro-cracks are dried open too short a time for the substance to penetrate.

(616) Robert G. King (to Robert J. King Co., Inc.), "Liquid Cleaner for Metal," U. S. Patent No. 2,528,230, October 31, 1950; Chemical Abstracts, Vol. 45, 1794 (1951).

Cleaner consists of a liquid alkylated benzene in which the benzene radical has one or more hydrocarbon substituents, a soap, and an alcohol of 4 to 7 carbon atoms. A rust inhibitor is usually included. Potash soaps of naphthenic acids gave products superior to those with fatty acid soaps. Suitable relative proportions are: 55 to 80 parts of the alkylated benzene, 6 to 12 parts soap (anhydrous), 20 to 30 parts of the alcohol, not more than 1 part of water, and about 1 to 6 parts of rust inhibitor.

(617) L. E. Kuentzel and A. W. Liger, "Modern Paint Removers," Metal Finishing Manual, Iron Age, pp. 106-111 (1950).

Paint removers act on paint films in at least four different ways: (1) paint binder may dissolve and form solution with solvent, (2) solvent may react chemically with paint film and destroy it, (3) physical penetration of paint film may destroy adhesive and cohesive properties of film, (4) solvent may penetrate film by way of scratches and along broken edges, destroying adhesion of film. Comparison given of eight chlorinated hydrocarbon solvents in standard laboratory paint remover formulation.

(618) L. E. Kuentzel (to Wyandotte Chemicals Corp.), "Paint Remover," U. S. Patent No. 2,507,984, May 16, 1950; Chemical Abstracts, Vol. 44, p. 9593 (1950).

The paint-removing power of methane dichloride is improved tremendously by simultaneous addition of water and formic, acetic, and other organic acids, or the same quantity of phenol. These compounds may be made more effective by adding a wetting agent and more convenient for use by adding thickening agents.

(619) L. E. Kuentzel (to Wyandotte Chemicals Corp.), "Paint Remover," U. S. Patent No. 2,507,985, May 16, 1950; Chemical Abstracts, Vol. 44, p. 9593 (1950).

Other chlorinated solvents are benefited through the use of water and the organic acids listed in U. S. Patent No. 2,507,984, Reference 618.

(620) J. B. Kushner, "Drag-Out Losses in Wire Plating, Parts II, III," Wire and Wire Products, Vol. 25, pp. 646-648, 695, 697 (August, 1950); Plating, Vol. 38, No. 4, p. 384 (1951).

Recommendations given for reduction in losses and use of recovery rinse tanks. Mathematical analysis of process given, showing application of equations to practical problems.

(621) A. W. Larchar (to E. I. du Pont de Nemours and Co.), "Metal Degreasing Composition," U. S. Patent No. 2,517,894, August 8, 1950.

Consists of trichloroethylene and from 0.02 to 0.25 per cent of cyclohexane.

(622) A. W. Larchar (to E. I. du Pont de Nemours and Co.), "Stabilized Chlorohydrocarbon Cleaning Composition," U. S. Patent No. 2,517,895, August 8, 1950.

Consists of an aliphatic chlorohydrocarbon solvent and from 0.02 to 1 per cent of a saturated aliphatic 1,3-diketone.

(623) A. I. Levin and A. V. Ponomosov, "Hydrophobization of Metal Powders as a Means of Their Protection Against Corro-

sion," Doklady Akademii Nauk S. S. S. R., Vol. 72, pp. 1075-1078 (1950); Chemical Abstracts, Vol. 44, p. 8846 (1950).

Electrolytically produced copper powder is effectively protected by washing with solutions of hydrophobic substances, followed by rinsing with water and drying at 110 to 120 C under reduced pressure. Powders treated with solutions of soda soap filled with ceresin or treated with thiocresol in caustic soda were unwettable in water in 10 per cent sulfuric acid or in 10 per cent sodium hydroxide.

(624) H. B. Linford and E. B. Saubestre, "Cleaning and Preparation of Metals for Electroplating. I. Critical Review of the Literature," Plating, Vol. 37, No. 12, pp. 1265-1269 (1950); Vol. 38, No. 1, pp. 60-65 (1951); No. 2, pp. 158-166 (1951).

Extensive review covering the need for cleaning, types of soil (organic or inorganic), methods of cleaning which are arbitrarily classified. Degreasing is differentiated from descaling. Gives extensive, representative, non-electrolytic, industrial cleaner formulas for brass, steel, and aluminum. Formulations given for electrolytic, alkaline, cleaning solutions for cathodic or anodic brass and anodic steel. Describes the character of bath constituents and principles of detergency and other physico-chemical factors. Discusses solvent cleaners, solvent-emulsion cleaners, alkaline copper cyanide cleaners, and descalers.

Descalers are subdivided as to abrasive, acid pickling, cyanide, fused salt, and reducing atmosphere media.

Standards of cleanliness are discussed according to the nature of adhesion, origin and effect of films, effect of surface condition of the metal on degreasing. Also discussed in detail are tests for cleanliness such as water break, spray pattern, gravimetric, residue pattern, fluorescent dye, radioactive tracer, ferricyanide paper, and copper deposition on iron.

(625) H. Linkletter and W. Van Kirk (to Ultra Chemical Works, Inc.), "Dry Electrolyte for Cleaning Silverware," U. S. Patent No. 2,513,187, June 27, 1950; Chemical Abstracts, Vol. 44, p. 7167 (1950).

Prepared from calcium hydroxide 53, sodium bicarbonate 45, and the sodium salt of sulfonated mineral oil 2 per cent by weight.

(626) L. P. Litchfield, "Safe Operation of Solvent Degreasers," Metal Finishing Manual, Iron Age, pp. 112-116 (1950).

Discussion of installation, operation, solvent recovery, cleaning out of degreaser, and solvent conservation.

(627) A. Mankowich, "Alkaline Metal Cleaning Compound Specifications," Plating, Vol. 37, No. 8, pp. 843-844 (1950).

Types of specifications are listed with examples. They are exemplified by composition, composition properties, and laboratory performance. Discusses requirements of laboratory performance specifications and indicates its main advantages are that there are no restrictions on the use of suitable raw materials and that changes in formulation are quickly made.

(628) J. F. Mason, "Finishes for Aluminum," Metal Finishing Manual, Iron Age, pp. 92-98 (1950).

Indicates the cleaning steps necessary before each of the many finishing treatments given aluminum.

(629) John W. McCutcheon, "Synthetic Detergents," MacNair-Dorland Co., New York, pp. 279, 295, 328 (1950).

Suggests use of wetting agent under strongly acid-strongly oxidizing conditions to improve wetting and degreasing. Notes that these are stringent conditions of usage, eliminating many surface active agents. Gives examples of aluminum cleaning compositions:

	Parts
1. Sodium sesquicarbonate	35
Trisodium phosphate	50
Sodium metasilicate	10
Nekal BX	5
	Per Cent
2. Soda ash	20
Trisodium phosphate, anhydrous	20
Sodium metasilicate	20
Alkylaryl sulfonate	1
Water	39

For iron cleaning prior to galvanizing:

	Per Cent
Soda ash	66.6
Trisodium phosphate	30.0
Alkylaryl sulfonate, 100 per cent	1.7
Water and salts	Balance

(630) P. W. McDaniel, "Health Hazards in Metal Degreasing," Metal Progress, Vol. 58, pp. 77-78, 102, 104, 106, 108, 109, 111 (July, 1950); Plating, Vol. 38, No. 4, p. 382 (1951).

Survey of health hazards in alkaline, acid, and solvent cleaning.

(631) J. S. McFarlane and D. Tabor, "Adhesion of Solids and the Effect of Surface Films," Proceedings, Royal Society (London), Vol. A202, pp. 224-243 (1950); Chemical Abstracts, Vol. 45, p. 6007 (1951).

Experiments show that with clean, hard surfaces in dry air, the adhesion is negligibly small. The absence of adhesion between clean, hard surfaces is not due to the non-formation of metallic junctions.

(632) Compound: Electrolyte and Cleaner (for Can Reconditioning), Military Specification MIL-C-1839, January 31, 1950.

See Quartermaster Corps Specification JCQD No. 1038, October 3, 1945, Reference 344A.

Compound intended for electrolyte and for cleaning of tinned cans designed to maintain uniform electrolytic conductance, provide for removal of organic matter, and be free rinsing. Shall be mixture of sodium carbonate, sodium metasilicate, and sodium phosphate. Requirements include pH, electrical resistivity, solubility, and cleaning when used in reconditioning machine.

(633) Compound: Cleaner and Brightener, Nonflammable (for Use on Aluminum Surfaces), Military Specification MIL-C-5410A, October 10, 1950.

In standard or concentrate form it is comprised of nonflammable phosphoric acid base, clear liquid, is free from sediment or abrasive, completely emulsifiable, non-toxic, non-corrosive, with surface tension not more than 30 dynes per cm at 25 C, and lack of attack on acrylic base plastic.

Cleaning accomplished according to arbitrary test. A circular panel 6 in. in diam is precleaned with acetone to the absence of fluorescence under ultraviolet light. To the place in a 4 1/2 in. diam. area, 1.5 g of 1120 oil is brushed on. Three milliliters of the cleaning compound are applied with a typewriter brush, using a circular motion. The panel is rinsed in a stream of cold tap water. The second and third applications are applied, and the panel again observed for fluorescence in comparison with the results obtained with a control formula of the following composition by weight:

	Per Cent
Orthophosphoric acid 85 per cent reagent grade	3.0
Citric acid (cp)	4.0
Synthetic soap (Spec. C-120, sea water soluble) ..	2.0
Methylethyl ketone	3.0
Distilled water	88.0

(634) Compound: Cleaning, Washing Machine (for Aircraft Metal Parts), Military Specification MIL-C-5543, January 9, 1950.

Supersedes Air Force-Navy Aeronautical Specification AN-C-174. See Reference 452B.

(635) Compound: Engine Cleaning (Cresol Base), Military Specification MIL-C-5546A, August 21, 1950.

See Air Force-Navy Aeronautical Specification AN-C-163 which it supersedes. Also see Reference 493A.

Material intended for use in softening carbon deposits on engine parts by spray application and for removing paint and carbon from engine parts by immersion in heated solution. Composition by weight of water: 8 per cent maximum water, soap 30 per cent maximum, and cresols 62 per cent minimum, the soap to be 85 per cent minimum fatty acids and 15 per cent maximum of alkali as potassium oxide.

Physical and chemical requirements include solubility in water and kerosene, performance in aqueous solution, lack of cor-

rosiveness, adequate stripping and rinsing properties, oil removing properties, and carbon removal.

(636) Cleaning Compound: Baking Pans (Tinned and Black Iron Pans Only), Military Specification MIL-C-10325 (QMC), May 29, 1950.

Two types of cleaning compounds to be used either in tank or hand cleaning and not suitable for cleaning aluminum pans. Cleaning ability tested upon burned-out surfaces (in need of cleaning) in which 98 per cent of carbonaceous deposit shall be removed and shall have no visible corrosion of metal surface.

(637) Compound: Metal Conditioner and Rust Remover (Phosphoric Acid Type), Military Specification MIL-C-10578 (Ord.), October 3, 1950.

Two types, either wash-off or wipe-off. Requirements include the absence of inhibiting agents, specified acid content, and the presence of grease solvent.

Grease removal test comprises application of grease to panel in standard manner, immersion for 30 min, followed by rinsing. Water break method is used to determine the cleanliness in comparison with type control formulas containing, in addition to phosphoric acid, Triton N-100, butyl cello-solve, and water.

(638) Trichloroethylene: Stabilized Degreasing, Military Specification MIL-T-7003, September 5, 1950.

Supersedes Specification AN-T-37a, otherwise is the same. See Reference 315a.

(639) J. B. Mohler, "Economical Rinse Tank Design," Metal Finishing Manual, Iron Age, pp. 154-156 (1950).

Illustration and discussion of the factors in the design of rinse tanks.

(640) Cleaning Compound: Grease, Solvent-Emulsion, Navy Department 51C65, May 24, 1950.

According to U. S. Patent No. 2,485,544, it is intended for use as a concentrated material which on dilution with kerosene, Diesel fuel oil or similar distillate, or with water removes oil, grease and other surface contaminant from metal parts.

Comprised of maximum and minimum amounts of water, hydrocarbon volatile with steam, hydrocarbons absorbed by fuming sulfuric acid, potash soap, and sodium chromate. Requirements include emulsion stability and corrosion maxima.

(641) M. J. Newing, "The Surface Properties of Polar Silicones," Transactions, Faraday Soc., Vol. 46, Part 9, pp. 755-762 (1950).

Concerns the surface properties of some organo-silicon compounds with reference to

orientation on a water surface and efficiency as boundary lubricants. At low pressure, all silicone molecules lie flat on the water surface while at 8 to 10 dynes per cm^{-1} siloxane chain lifts out of the water. With hydroxy compounds the molecule is anchored by the hydroxy group. Close packing of the molecule does not occur even under pressure of 25 dynes per cm^{-1} because of small lateral adhesion. Silicones are less effectively adsorbed on metal surfaces than polar hydrocarbons in reducing metallic contact, when used as steel lubricants. Preliminary investigation of these films on copper showed no boundary lubrication.

(642) A. C. Pabst and E. S. Salmon (to Socony-Vacuum Oil Co.), "Metal Cleaning Composition," U. S. Patent No. 2,524,825, October 10, 1950.

Composition for removal of rust and grease, etc., from water-cooling systems of internal combustion systems. Claimed is an oil-in-water emulsion comprised of a dispersed phase of a mixture of kerosene and *o*-dichlorobenzene, a continuous phase of an aqueous hydrochloric acid solution, and about 0.1 to 5 per cent by weight of the emulsion of 1-hydroxyethyl 2-heptadecenyl glyoxalidine as an emulsifier, the concentrations of hydrochloric acid in the emulsion amounting to at least 10 g per l.

(643) A. C. Pabst and E. S. Salmon (to Socony-Vacuum Oil Co.), "Metal Cleaning Composition," U. S. Patent No. 2,525,078, October 10, 1950.

Relates the use of a composition for rust and scale removal from systems such as those of internal combustion engines. Types of cleaning compositions for this purpose are classified as (1) slow acting water solutions of alkaline salt, (2) alkaline emulsions of hydrocarbons and other organic solvents which do not effectively remove scale, and (3) aqueous solutions of acid or acid salts which are very corrosive and have little effect on grease or oil deposits. Claim a cleaning composition in the form of an oil-in-water type emulsion comprised of a dispersed phase of kerosene, continuous phase of an aqueous solution of hydrochloric acid 10 to 30 per cent by weight, and 0.1 to 5 per cent by weight of the emulsion of an emulsifying agent consisting of a mixture of polyethylene glycol monoisooctyl phenyl ether and 1-hydroxyethyl 2-heptadecenyl glyoxalidine.

(644) M. E. Parker and G. H. Benham, "Dairy Utensil and Equipment Cleaners. A Comparative Study," *Modern Sanitation*, Vol. 2, No. 11, pp. 49-51 (1950).

Eleven brands of proprietary cleaning compositions were analyzed, ten of them being synthetic detergents combined with polyphosphates and ordinary alkaline builders.

Comparison is made of their resistance to water hardness and of their emulsive capacity.

(645) M. E. Parker and G. H. Benham, "Dairy Utensil and Equipment Cleaners. A Comparative Study. Part II," *Modern Sanitation*, Vol. 2, No. 12, pp. 44, 46-48 (1950).

Brand comparison given for carbon suspending property, comparative protein peptization action, and comparative cleaning of tinned iron and stainless steel. The metals were soiled by dipping them in whole milk and drying them overnight horizontally. The cleaning was accomplished in a bottle containing the metal plate, and cleanliness was ascertained by reflectance, using the Schaar Glossmeter (model 660) after three or more successive soiling, washings, and rinsings.

(646) L. Pessel (to Radio Corp. of America), "Process of Cleaning and Tinning Conductors," U. S. Patent No. 2,505,627, April 25, 1950; *Chemical Abstracts*, Vol. 44, p. 5792 (1950).

To tin electrical conductors coated with polyvinyl acetal or formal, the coated wire is "solubilized" by short dipping in a hot polyhydroxy compound such as pyrogallol, after which treatment the polymer is soluble in acetone, alcohol, or similar solvent. The solubilizing agent can also replace the soldering flux.

(647) W. Reeder and J. J. Russ (to Campbell Taggart Research Corp.), "Cleaning Preparation for Removing Silicone Resins from Baking Pans and Similar Articles," U. S. Patent No. 2,525,079, October 10, 1950; *Chemical Abstracts*, Vol. 45, p. 1794 (1951).

Multiple silicone coatings can be effectively removed without damaging tin or tin oxide surfaces by cleaning with an aqueous solution of a mixture of sodium metasilicate 35 to 55 per cent, sodium carbonate 22 to 42 per cent, and borax 18 to 28 per cent.

(648) J. T. Richards, "Beryllium Copper," *Materials and Methods*, Vol. 31, No. 4, pp. 75-90 (1950).

Includes section on mechanical and chemical cleaning. Beryllium copper products are treated in the same manner as copper alloys. Sand blasting, which precludes necessity for pickling, can be used to provide clean, uniform, dull, rough finish. Solvent cleaning is used for removal of sulfurized, lard cutting oils. Stains and tar-nish can be removed by immersion for 20 to 30 min in cold 10 per cent sodium cyanide solution, or in dilute 5 to 10 per cent by volume of sulfuric or hydrochloric cold acid solutions. Rinsing is imperative after such treatment. Alkaline cleaning and proprietary cleaners may be used.

Pickling with 20 to 30 per cent by volume of sulfuric acid can loosen dark scale, fol-

lowed by nitric acid dip for removal of all traces of black and red oxides. Acid stains are minimized by thorough rinsing and drying.

(649) R. J. Rodger, "Metal Degreasing Using Trichloroethylene," *Proceedings, Queensland Sugar Cane Tech., 16th Conference*, pp. 37-44; *Journal, Int. Sugar*, Vol. 52, p. 158 (1950); *British Abstracts*, B I-4, p. 87 (1951).

Small trichloroethylene degreasing plants used in Queensland to degrease sugar machinery in place by distillation of solvent on equipment in situ.

(650) M. Rubinstein, "Additive Compounds in Electroplating Baths. III," *Metal Finishing*, Vol. 48, No. 11, pp. 68-74 (1950).

Discusses the mechanics of operation of wetting agents, the addition of salts and sequestering agents. Discusses cohesion and adhesion in the mechanics of wetting as applied to metals, and surface and interfacial tension in their effect. The structure of wetting agents and their effect upon plating is outlined. Their function in cleaning baths is described, including their use to decrease dragout, and they are further classified.

(651) A. L. Scaffo, "The Aviation Market for Cleaning Compounds," *Aviation Week*, 24 pp. mimeographed market survey, December, 1950.

Subdivided according to the market, description of cleaning compounds, where used, who makes them, and who buys them. The market consists of airframe and power plant manufacturers, maintenance and overhaul companies, trunk-line users, and the largest user, military aviation. The latter has an estimated \$400 million for aircraft and power plant overhaul in 1950.

Listed are 20 types of cleaning or sanitizing compounds consisting of chlorinated solvents, several types of carbon removers, quaternary ammonium deodorants, solvent emulsion cleaners, potassium oleate, brightener, metal polishes, alkaline cleaner, acid brighteners, oil tank cleaners, paint stripper, and exhaust and carbon track removers.

Shows point-by-point breakdown of usage in the maintenance and overhaul operations.

Lists 40 manufacturers and military, maintenance, and overhaul bases, scheduled air carriers, aircraft manufacturers, and rotary wing aircraft and component manufacturers.

(652) G. Schmerling, "Emulsion Cleaning of Metals," *Journal, Electrodepositors' Technical Soc.*, Vol. 26, No. 12, pp. 1-8 (1950).

Discusses principles of emulsion cleaning on the basis of contact angles and effect of surface active agents on them. Specifica-

tions for emulsion cleaners were outlined as speed and efficiency of cleaning, absence of corrosion, stability on standing, absence of attack on resin-coated jigs, absence of fire hazard, absence of fumes, and availability of raw materials.

Evaluation work carried out with the following soils by dipping plates in them and air-drying for 24 hr: 10 per cent solution of stearine in naphtha, 5 per cent petroleum jelly, 5 per cent lubricating grease in white spirit, and 10 per cent lanolin in a mixture of equal volumes of solvent naphtha and white spirit.

Test pieces were degreased by two-state method by immersion for 3 min and rinsing fully submerged in cold running water and drying. Promising mixtures were further tested by a 2 min immersion in hot alkaline cleaner of 3 oz per gal each of sodium metasilicate and trisodium phosphate, dipping in 10 per cent sulfuric acid, and nickel plating. Strip giving continuous coating with good adhesion and without peeling or bending was considered to have passed the test.

Example of actual composition used was:

	Per Cent
Pine oil	62
Oleic acid	10.8
Triethanolamine	7.2
Ethylene glycol monobutyl ether	20

This was diluted before use with an equal volume of a 50-50 mixture of white spirits and solvent naphtha. In two-stage process of emulsion cleaning, the parts are dipped in mixed non-aqueous liquid 2 to 3 min, then vigorously water-rinsed. In single-stage process, parts are dipped or sprayed with emulsion of non-aqueous cleaner and water, generally used hot and of either stable or unstable types. This latter is generally less economical than two-stage process.

(653) G. Schultze, "Cleaning of Metal Surfaces," *Werkstoffe u. Korrosion*, Vol. 1, pp. 26-33 (1950); *Chemical Abstracts*, Vol. 44, p. 4402 (1950).

The different methods for cleaning metal surfaces are outlined, and the advantages of chemical use with inhibitors are pointed out.

(654) C. M. Shaw (to California Research Corp.), "Detergent Concentrate," U. S. Patent No. 2,531,166, November 21, 1950.

Composition for cleaning heavily soiled and greasy surfaces such as rear engine, Diesel-powered buses comprising, for example, alkylbenzene sulfonate (60 per cent active) 28 per cent by weight, mahogany soap 4 per cent, isopropanol 4 per cent, and liquid aromatic hydrocarbon 64 per cent, as a stable suspension.

(655) W. H. Shearon, Jr., "Aviation Chemicals," *Chemical and Engineering News*, Vol. 28, No. 46, pp. 3964-3965 (November 13, 1950).

Review of chemicals used in airplane maintenance. Estimated that the annual maintenance cost for a DC-6 is approximately \$1225 and for a DC-3, \$950. Much of the discussion concerns metal cleaning of fuselages, wing surfaces, and engine parts. Solvent emulsions used for "skin" cleaning are applied by spray or by hand and are comprised of soaps, emulsifiers, and water, and diluted for use with kerosene or cresols. Criteria for selection of cleaners are: (1) effect on metal to be cleaned, (2) wetting out effect, (3) efficiency in removal of oxidation products, (4) effect on hot skin. Exhaust panels are subjected to heavy oxidation and staining. Protective coatings have not proved satisfactory, and cleaning by application of paint strippers is used, usually containing chlorinated hydrocarbons and/or phenols.

Cleaner stains themselves are important, and it is suspected that these are caused by petroleum base solvents or by excessive use of tall oil soaps in cleaners, not to mention enhancement of such stain production by hot sun or windy days when insufficient rinsing is applied immediately.

Effect of cleaners on methacrylate window surfaces is an important precaution in use.

Emulsion cleaning produces clean skin, but solvent-containing waxes with abrasives must be used for brightening and protection. Phosphoric acid brighteners are also used. Maintenance schedule calls for weekly emulsion cleaning, mechanical polishing every 1 or 2 mo, and mechanical buffing every 4 to 5 mo.

Engine cleaning is initiated with steam jet or blowers, cleaning with an alkaline compound, tank cleaning of engines and engine parts. Involves use of materials containing phenols, cresols, soaps, ortho-dichlorobenzene, inhibitors, and buffers. Cold tank cleaning involves two-layer type, the upper layer acting as a sealer to prevent the escape of solvent of vapors and to minimize dragout.

Cleaning and stripping of integral fuel tanks is accomplished by steam cleaning, solvent treatment to remove gums, carbon, and oil, and testing for leaks with soapless, neutral, bubble fluid. Fuel tank stripping compounds must permit easy resealing.

Removal of carbon from aluminum pistons accomplished with a blast of crushed walnut shells.

(656) H. Clark Smith, Jr., "Molten Salt Descaling," *Wire and Wire Products*, Vol. 25, pp. 1050-1051, 1085, 1086, 1087-1089 (1950); *Chemical Abstracts*, Vol. 45, p. 1001 (1951).

A study of operations indicated some of the difficulties were traceable to annealing furnace atmospheres and insufficient control of acid concentrations. Discussion of the process and the type of scale formed and means for full removal.

(657) P. I. Smith, "Detergents for Printers Type," *Soap*, Vol. 26, No. 12, pp. 44-45, 81 (1950).

Cites advantages of removal of abrasive grit and dried ink from type and engravings. Usual materials for removal have been solvents such as gasoline, benzol and acetone, and kerosene. Also used were strong aqueous solutions of soap and strong lyes. Requirements for effective agents are: (1) they will dissolve easily in hard water to give clear, neutral solutions capable of reducing surface and interfacial tension; (2) they will be at best only tinted; (3) they must not hydrolyze and must be stable over wide pH range; (4) they should be effective at low concentration; (5) they should be non-flammable, non-toxic, and have low volatility; (6) they should leave type and engravings with a scum-free, polished surface.

Teepol, Shell Chemical, Ltd., find application in England. Effective used in 4 oz, 2 lb of soda ash per gal of water. Rinsing is important to remove detergent from type faces to prevent smudging.

(658) (Formerly 571) S. Spring, "Laboratory Investigations on Metal Cleaning," *Metal Finishing*, Vol. 48, No. 3, pp. 67-72, 74 (1950).

A discussion of the process of oil removal as illustrated by photographs of the action occurring when alkaline silicate and surface active agent cleaners are used. The discussion includes tables showing the oxide effect on steel of soil removal, and the effect of surface roughness. Also includes the effect played by oil characteristics.

(659) H. A. Strow, "Surface Active Agents and Related Chemicals in Metal Processing," *Proceedings, Chemical Specialties Manufacturers' Assn.*, *Soap*, December, 1950, pp. 135-139.

Mentions the use of soaps, alkylaryl sulfonates, alcohol sulfates, and nonionic agents. Mentions the possible applications of the latter. No apparent advantage in the use of the cationic types is indicated.

Visual examination is satisfactory, because an absolute figure system was found to vary so widely.

Synergistic action of mixtures of surface active agents and builders is said to be important.

In the evaluation of cleaning, five soils are used: (1) dirty SAE 20-30 motor oil, (2) 600-W or steam cylinder engine oil, (3) RD-561-BSA of Socony-Vacuum, a low aromatic with high boiling point, (4) Band-392, a Colonial Beacon rustproofing oil, (5) a calcium soap drawing compound used on stainless steel. These are applied to panels in a hydraulic press, aged 24 hr, and then washed in liter beakers at alkali concentrations of 50 g per l.

(660) R. C. Tarring, "Surface Active

Agents in the Improvement of the Cleaning of Metals," *Journal, Electrodepositors' Technical Soc.*, Vol. 26, No. 13, pp. 1-8 (1950).

Discusses theory of surface active agents, their functions, and the kinds of hydrophilic and hydrophobic groupings, and describes three types of agents. Recommends use of these in alkaline cleaning compositions to ensure penetration of corners and pores and to promote contact between the cleaning solution and the metal surface.

Utility of surface active agents in the removal of unsaponifiable oils is important; these are used on 0.1 to 0.5 per cent amounts on the solution basis. Foaming is controlled by reducing the concentration of the agent.

Suggests the use of surface active agents in pickling to increase the speed of pickling and to reduce the acid spray about the pickling tanks. Another advantage of their use is reduction in drag-out loss through ready drainage.

(661) A. Teplitz, "Electrolytic Apparatus for Cleaning Strip," U. S. Patent No. 2,535,966, December 6, 1950; *Plating*, Vol. 38, No. 4, p. 390 (1951).

Description of apparatus recommended.

(662) (Formerly 572) R. H. Tiers, "Development of Alkaline Cleaners," *Metal Finishing*, Vol. 48, No. 4, pp. 49-53 (1950).

A review of metal cleaning to date. Lists properties of alkaline cleaners in order of importance as:

1. Dissolving power and high alkalinity
2. Dispersing power for solids
3. Emulsifying power for liquids
4. Free rinsing
5. Low surface tension or wetting ability for soil and metal
6. Stability
7. Conductivity (for electrolytic cleaners)
8. Low concentration for use
9. Economy
10. Freedom from hazards of toxicity and flame

Includes a general discussion of testing methods and describes a "swirl method" for controlled cleaning operations, wherein a gravimetric method is used for determination of soil removal. Stresses need for satisfactory method for cleaning evaluation.

(663) R. H. Tiers, "Swirl Method for the Evaluation of Metal Cleaners," *Metal Finishing*, Vol. 48, No. 9, pp. 56-60 (1950).

Discusses methods of evaluation and soils used for laboratory evaluation. Describes two soils of very adherent nature which were used, and their application. The method of cleaning comprises a 3-l beaker fitted with a baffle. Soiled panels of cold-rolled steel were attached to a shaft rotated by a small

motor in the bath. The efficiency is determined gravimetrically. Shows data typical of cleaning operation and indicates that certain conditions of operation influence the efficiency of the cleaner, and these are set for any given comparison of cleaners.

(664) E. D. Tingle, "Importance of Surface Oxide Films in the Friction and Lubrication of Metals. II. Formation of Lubricating Films on Metal Surfaces," *Transactions, Faraday Soc.*, Vol. 46, pp. 99-102 (1950); *British Abstracts*, B I-5, p. 719 (1950).

Effective lubrication depends on a surface film of oxide or hydroxide and fatty acids chemically attached to such surfaces.

(665) C. A. Tyler, "Detergents for Mechanical Dishwashing," *Soap*, Vol. 26, No. 12, pp. 37-39, 90 (1950).

Discussion of formulations in which are used at the maximum 5 per cent amounts of Nacconol or Santomorse, because of their tendency to foam.

(666) D. W. Vance (to Kelite Products Co., Inc.), "Aqueous Compositions for Treating Iron and Steel," U. S. Patent No. 2,493,327, January 1, 1950; *British Abstracts*, B I-5, p. 209 (1951).

Rust removed from iron and steel prior to painting and for storage protection by immersion for 2 to 5 min in an aqueous solution containing 10 to 25 per cent of a mixture of phosphoric acid 73.7 per cent, formic acid 6 per cent, zinc 0.25 per cent, water 10.1 per cent, wetting agent 0.5 per cent, and 2-butoxyethanol 9.45 per cent.

(667) R. N. Wenzel, "Surface Roughness and Contact Angle," *Journal, Physical and Colloid Chem.*, Vol. 53, pp. 1466-1467 (1950).

Refers to Bikerman's work on stainless steel and contact angle as affected by roughness elevation where "roughness area ratio" can be precisely defined. Hence Bikerman's work is not in contradiction to accepted theory.

See Reference 572.

(668) (Formerly 573) L. J. Wieschhaus, "Steel Shot Speeds Blast Cleaning and Shot Peening," *Iron Age*, Vol. 165, No. 5, pp. 82-85 (1950); *Chemical Abstracts*, Vol. 44, p. 2432 (1950).

Less wear on equipment is caused by cast steel shot, it lasts longer, and eliminates the pickle rinse normally used when chilled iron or malleabilized iron abrasives are used.

1951

(669) "Tentative Recommended Practice for the Preparation of and Plating on Aluminum Alloys," *ASTM Committee B-8*, 21 pp., February, 1951.

Cleaning and conditioning treatments consist of removal of oil or grease by vapor degreasing or solvent cleaning, mild etching type alkaline cleaner of 23 g per l each of soda ash and trisodium phosphate, at 140 to 180 F for 1 to 3 min.

Removal of oxide film by acid etch, double zinc immersion treatment, the first zinc layer removed in a dip of 50 per cent by weight of nitric acid, some casting alloys in solutions containing three parts (by volume) of concentrated nitric acid plus one part (volume) of 48 per cent hydrofluoric acid. Summarizes cleaning and conditioning treatments for wrought alloy, wrought and castings, and casting alloys (high silicon).

(670) "Preparation of and Plating on Aluminum Alloys," ASTM Committee B-8, Preprint of 1951 Annual Report, pp. 10-19.

A guide to electroplating with chromium, nickel, copper, brass, silver, gold, or modifications of these as applied to aluminum alloys.

Consider effect of aluminum microstructure and oxide film upon plating characteristics. Cleaning removed oil or grease by vapor degreasing or solvent degreasing, but ordinarily mild etching type of alkaline cleaner is recommended. Example of such cleaner is 3 oz per gal each of sodium carbonate and trisodium phosphate, this solution to be used at 140 to 180 F for 1 to 3 min. Subsequent treatment must accomplish removal of original oxide film and any micro constituents which might interfere with subsequent plating solutions.

Conditioning treatments for wrought alloys consist of hot sulfuric acid dip under specified conditions. Another treatment comprises hot zinc-immersion and removal of the first zinc layer with 50 per cent nitric acid solution. For high silicon alloys, a dip in three parts (volume) of nitric acid plus one part (volume) of hydrofluoric acid (48 per cent).

(671) F. P. Bowden and A. C. Moore, "Physical and Chemical Adsorption of Long Chain Compounds on Radioactive Metals," *Transactions, Faraday Soc.*, Vol. 47, Part 8, pp. 900-908 (1951).

Radioactive foils of gold, platinum, zinc, cadmium, and copper were treated with benzene solutions of stearic acid, octadecyl alcohol, and ethyl stearate. Sensitivity indicated as 3.3×10^{-7} g of gold for an area of 1 sq cm and a monolayer of aurous stearate over the whole area. No chemical reaction occurred with gold or platinum toward stearic, and only reactive metals showed attack. Physical adsorption of octadecyl alcohol occurred with reactive metals, while ethyl stearate adsorption may involve chemical reaction.

(672) "Cleaning Tandem," *Chemical Week*, Vol. 68, June 30, 1951, p. 25.

Use of solvent cleaner for electric motors expanded to other usages. Carbon removal from Diesel engines accomplished by emulsion of coupled solvents soluble either in water or hydrocarbons. Solvents indicated as chlorinated products for solvent power with minimized toxicity and hydrocarbons with retarded flammability.

(673) G. C. Close, "Fitting Metal Cleaners to the Job," *Modern Machine Shop*, Vol. 23, No. 8, pp. 182-184, 185, 186, 188, 190, 192, 194, 196, 198, 200 (1951).

Practical usage indicates "best" cleaner is the cheapest to provide a clean surface in reasonably short time and at low unit cost. Cleaning based upon type of soil to be removed. These types are described. Indicates that laboratory tests of cleaners should be checked by practical evaluation.

Free rinsing necessary and materials said to detract are rosin or resinate, meta-, sesqui-, or orthosilicates, high titer soaps, and bentonite.

(674) W. Davis (to Shell Development Co.), "Fingerprint Removing Solution," U. S. Patent No. 2,517,636; *Metal Finishing*, Vol. 49, No. 1, p. 76 (1951).

45 to 70 per cent by weight of clear soluble oil, 10 to 37.5 per cent by weight of water, 15 to 50 per cent by weight of substantially volatile, liquid, organic compound selected from the group consisting of benzene, trichloroethylene, and carbon tetrachloride. Specific formulation of 55 spindle oil, 30 sodium naphthalene sulfonate, 5 sulfated fish oil, 5 water, 5 diacetone alcohol.

(675) Bert Doggett, "Metal Cleaner Decreases Paint Failures," *Products Finishing*, Vol. 15, No. 9, pp. 90-91 (1951).

Use of a proprietary phosphatizing cleaner resulted in reduction in paint failures on a popular home ironer. Cleaner used in three-stage washer, followed by chromic-phosphoric acid rinse.

(676) T. C. DuMond, "Cleaning and Finishing Stainless Steels," *Materials and Methods*, Vol. 33, No. 4, pp. 94-104 (1951).

Comprehensive survey covering cleaning, pickling and descaling, grinding, polishing and buffing, electropolishing, plating, coloring, and etching.

Nearly all stainless steel products require some type of cleaning, from wiping with solvent saturated cloth to chemical and vapor degreasing baths. Physical cleaning involved descaling and pickling. Mill finishes are listed and described. Removal of greasy materials accomplished with ordinary solvents, machine or tank usage depending upon size of piece and quantity to be cleaned. If degreasing machines or tanks are used, carbon tetrachloride or trichloroethylene are suitable, followed by water

washing and dipping in hot 10 to 20 per cent (volume) nitric acid. Heavy, tightly adhering grease removed by paste of soda ash on soft cloth. Care in selection for forming lubricants is indicated to provide easily emulsified type.

(677) A. G. Gray, "A Practical Method for Plating on Magnesium," *Products Finishing*, Vol. 15, No. 4, pp. 36-38, 42, 46, 48, 50, 52, 54, 58, 60, 62, 64 (1951).

In a new method developed by Dow Chemical Co. for plating on magnesium, surface conditioning is used. Removal of grease buffing compounds and similar oily matter is accomplished in solvent rinsing, vapor degreasing, or solvent emulsion cleaning. Heavy duty alkaline cleaners are also used. Satisfactory cleaner recommended comprises soda ash 3 oz per gal with 2 oz per gal of caustic soda, operated at 180 to 212 F for 3 to 10 min. For simple immersion, 0.1 oz per gal of soap is sometimes added. Without soap, the composition may be used as an electrolytic cleaner, the parts made cathode at a current density of 10 to 40 amp per sq ft at 6 v.

(678) A. G. Gray, "Fundamentals of Electrocleaning," *Products Finishing*, Vol. 15 No. 6, pp. 54, 56, 58, 60, 62, 66, 68, 72 (1951).

Review of lectures by G. A. Lux and W. R. Meyer. A clean surface is defined as one on which interfering films are no thicker than the order of magnitude of the atomic spacing of the base metal and the deposited metal.

Discussion of types of electrocleaners and their properties. Silicates of proper type are excellent inhibiting materials. Buffering action and tolerance for chromic acid contaminants are necessities. Proper choice of cleaner, preferably anodic, will prevent passivation and poor adherence of electrodeposits. Proper operation of bath and temperature control are important.

(679) J. Haas, "Electroplating Stainless Steels," *Metal Finishing*, Vol. 49, No. 6, pp. 50-54 (1951).

Precleaned with trichloroethylene or any other satisfactory method followed by electrocleaning at 6 v at 180 to 190 F. The following cycle was used: direct for 30 sec, reverse for 30 sec, and direct for 30 sec. This was followed by a water rinse and acid dip and rinse, before initiation of electroplating operation.

(679A) Nathaniel Hall and G. B. Hoga-boom, Jr., "Pickling and Acid Dipping," *Metal Finishing Guidebook*, pp. 207-214 (1951).

General discussion and special pickling formulations are given for sheet and cast aluminum, cadmium, copper and alloys, iron and steel, magnesium and alloys, nickel and

alloys, silver, stainless steel, zinc and its alloys. Proportions of acids required are given. Treatment prior to pickling also indicated.

(680) J. Fred Hazel and Wm. Stericker, "Removal of Stearic Acid from Surfaces by Alkaline Detergents," *Industrial and Engineering Chemistry*, Vol. 43, pp. 919-925 (1951).

Removal of stearic acid of a purified grade or of a regular commercial grade investigated from zinc, aluminum, steel, and glass. For cleaning purposes caustic soda, trisodium phosphate, sodium carbonate, and sodium silicates were investigated.

Results indicate that the purified grade was removed more easily from metals other than zinc, while removal of the regular grade was easier in all cases. Intermediate concentrations of alkali were generally more effective than high concentrations, since salting out of the sodium soaps formed was avoided. Removal of the acids was favored by higher temperatures.

(681) J. F. Hazel and W. Stericker, "Effects of Alkaline Detergents on a Magnesium Die Casting Alloy," *Journal, Electrochemical Soc.*, Vol. 98, pp. 273-276 (1951).

Test panels of a magnesium die casting alloy were immersed in baths of alkaline electrolytes at 90 C. The metal was not attacked by sodium hydroxide, sodium orthophosphate, and the more alkaline silicates, except when it was the anode. Magnesium ion sequesters, tetrasodium pyrophosphate, Calgon, and Quadrafos caused marked weight losses. Pyrophosphate alone caused darkening, but mixed with metasilicate corrosive attack was eliminated.

(682) R. Justh, "Alkaline Degreasing Practice," *Metallüberfläche*, Vol. 4, No. 5, pp. A72-A76 (1951); *Metal Finishing*, Vol. 49, No. 4, pp. 70-71 (1951).

Effective degreasing improved by addition of colloidal agents to stabilize dispersion and emulsion. Experiments described to show that mechanical effect can destroy emulsion to give soil redeposition. Use of soap in electrolytic degreasing baths may cause scarcely visible film of insoluble soaps, not removed by acids which cause plating difficulties. Mentioned as additives to electrolytic cleaning baths are sulfated fatty alcohols, Igepons, Mersoles, and Mersolates. Latter said to have high cleaning and foaming powers.

(683) A. J. Liebman, "Importance of Surface Preparation for the Protection of Metals," *Paint and Varnish Production*, Vol. 41, No. 3, pp. 18-22, 37 (1951).

Since paint is held to metal surface by molecular attraction or mechanical anchor,

the strength of bond involves closeness of contact, surface area, and stress conditions. Mechanical anchors produced by chemicals, electrochemical etch, three types of blasting, chemical pretreatment, grinding, surface corrosion, or roller roughening. Chemical pretreatment involves surface cleaning with the solvents, alkalies, and emulsions, followed by surface reaction or surface conversion treatment.

Discusses various types of blast cleaning.

(684) H. B. Linford and E. B. Saubestre, "Cleaning and Preparation of Metals for Electroplating. II. Soiling and Cleaning Procedures," *Plating*, Vol. 38, No. 4, pp. 367-375 (1951).

Contents include review of soiling and cleaning procedures, presentation of data, equipment, procedure, evaluation of soiling technics, and six appendices.

Soiling of a pointed, paddle-shaped panel accomplished by a dipping and draining technique. A typical steel cleaning detergent formula was used in the work, comprised of the following in per cent by weight:

Sodium orthosilicate	85
Soda ash	10
Nacconol NR	5
at a concentration of 6 oz per gal (45 g per l)	

Cleaning method chosen was a soak bath.

Presentation of data included standard deviation, "t" test for comparison of two sets of data, and limit of confidence test (L). Complete table given covering all variables tested and showing all statistical data.

Variables investigated were mineral oil, effect of different methods of preparation of panels, effects of impurities, effect of time and temperature, lard oil, effect of different methods of preparation for lard oil, impurities, and time-temperature.

Using preferred method, contamination of baths does not affect lard soiling characteristics until immiscibility occurs between the various solutions. With mineral oil contamination (by solvents), there is a decreased amount of oil present, so solutions must be renewed frequently. Presence of water or alcohol on panel reduced test reproducibility markedly. Changes in temperature or time of draining also affect soiling conditions. Appendices include steel specifications, oil specifications, laboratory procedures, statistical criteria, laboratory data, and nomenclature.

(685) H. B. Linford and E. B. Saubestre, "Cleaning and Preparation of Metals for Electroplating. III. Degreasing Evaluation Tests: The Atomizer Test," *Plating*, Vol. 38, No. 8, pp. 847-855 (1951).

Presents theory of wetting of surfaces and application to water break. Presents much statistical data on sensitivity of wettability tests, the size of atomized droplets, and reproducibility of the atomizer test.

(686) H. B. Linford and E. B. Saubestre, "Cleaning and Preparation of Metals for Electroplating. IV. Degreasing Evaluation Tests: Sequential Testing," *Plating*, Vol. 38, No. 11, pp. 1157-1161 (1951).

Performance evaluation of tests used to determine cleanliness. Complete list of tests and references given. Typed as wettability by water-break, spray-pattern, or atomizer; tracer by fluorescent-dye or radioisotopic; chemical by copper-replacement or potassium ferricyanide paper; miscellaneous by gravimetric or residue pattern. Qualitative tests are cloth-wipe, solvent residue, or carbonaceous residue tests. Quantitative tests were compared by sequential testing, since some of the tests are destructive and interfere with further testing. Results of each test are recorded as "Cleaning Index" and these then compared. Advantages said to be determination of relative sensitivity and determination of whether different tests measure same type of contaminant.

Sequential series of tests set up for test and description of the conditions used in making them on a time schedule to overcome aging effects.

(687) John A. Lotz (to The Union Switch & Signal Co.), "Removing Scale from Steel," U. S. Patent No. 2,559,445, July 3, 1951; *Chemical Abstracts*, Vol. 45, p. 8434 (1951).

Annealing scale or oxide film may be removed from certain types of alloy steels of low-silicon content without pitting by a pickling solution containing equivalent amounts by volume of phosphoric and one or more of the halogen acids, preferably at 180 to 190 F. Bath can be used as an electrolytic bath. Preferred aqueous solutions are 10 per cent by volume hydrochloric acid with 5 per cent phosphoric, or 20 per cent by volume of hydrochloric acid.

(688) A. L. McClellan and N. Hackerman, "The Sorption of Gases on Metals at Room Temperature," *Journal, Physical and Colloid Chem.*, Vol. 55, pp. 374-382 (1951).

Sorption of oxygen, nitrous oxide, nitric oxide, and chlorine were measured at low pressures on reduced and unreduced metals. Sorption decreased in the order of steel, stainless steel, and chromium powder. Reduction increased the sorption of oxygen and chlorine on steel. The gas pick-up was apparently due largely to chemical reaction and was equivalent to 2 to 62 layers of adsorbate, and no physical adsorption was detected.

(689) L. R. McCoy (to Wyandotte Chemicals Corp.), "Nonferrous Metal Burnishing Composition and Burnishing Process," U. S. Patent No. 2,540,003, January 30, 1951.

Method comprises ball-burnishing in an aqueous solution containing a wetting agent of the sodium salt of sulfonated glycerol

higher fatty acid monoester, or the sodium salt of sulfated lauryl alcohol and ethylene diamine.

(690) J. W. Menter and D. Tabor, "Orientation of Fatty Acid and Soap Films on Metal Surfaces," *Proceedings, Royal Soc., London*, Vol. 204, No. 1079, pp. 514-524 (1951).

Electron-diffraction and reflexion methods were used. At room temperature the first layer was generally oriented with the hydrocarbon chains normal to the surface. At higher temperatures, layer lines became less distinct, and at a characteristic temperature only pattern of the substrate was observed.

(691) "Rinsability and Buffering Action of Alkaline Cleaners," *Metal Finishing*, Vol. 49, No. 6, pp. 62-63 (1951).

Proposed ASTM methods are fully described. Rinsing method comprises pre-cleaning, followed by drying. Test consists of dipping, drying, rinsing under controlled conditions, and drying at 45 deg angle. Retention of cleaner observed by eye and by treating surface with a drop of alcohol and noting the deposition of a ring.

Method for determination of buffering action utilizes standard test for pH determination and titration of 1 oz per gal concentrations of cleaner solution with hydrochloric acid. Buffer index of three levels: (1) milliliters of 0.5N acid to reduce initial pH to 12.0, (2) pH from 12 to 11, (3) pH from 11 to 10.

(692) "pH and Buffering," *Metal Finishing*, Vol. 49, No. 6, p. 80 (1951).

Table of pH values for 13 acids, 11 bases, and a table of buffer mixtures for pH values of 2 to 11.5.

(693) Compound: Cleaner (for Oil Coolers), *Military Specification MIL-C-6864A*, May 21, 1951.

Detailed requirements include flash point, pH, volatility, solubility in water and in organic solvents, corrosion resistance. Performance specification requires cleaning of test panel soiled with SAE 50 oil and lamp-black in standard manner and comparatively with a control cleaning formula comprised of the following in per cent by weight:

Neutral coal tar oil	43.9
Potassium hydroxide, cp	2.8
Oleic acid, USP	13.6
Triethanolamine	8.0
Petroleum sulfonate	7.5 (Petrionate)
Diethyleneglycol mono-	
butyl ether	13.3
Distilled water	10.5
Ethyl silicate, tech.	0.3
Sodium chromate, cp	0.1

(694) Cleaning Compound: Baking Pans, *Military Specification MIL-C-16045 (Ships)*, March 15, 1951.

A material consisting of a mixture of sodium carbonate, sodium metasilicate, and

sodium chromate in free-flowing form without abrasives or inert fillers. Included is a performance corrosion test.

(695) Compound: Steam Cleaning, *Military Specification MIL-C-16161 (Ships)*, June 1, 1951. Supersedes Bureau of Ships Specification 51C69; see Reference 502.

Compound to be a nonhygroscopic, granular mixture in powder form of synthetic detergent and alkaline salts of suitable alkalinity and softening ability. Compositional requirements are maximum of 20 per cent moisture, maximum total alkalinity of 33 per cent, silicates (as SiO_2) 8 to 12 per cent, minimum phosphorous as P_2O_5 not less than 14 per cent. Other requirements include foaming, surface tension, corrosiveness, water hardness stability, and rinsing properties.

(696) J. H. Noble, R. L. Pottberg, and U. C. Tainton (to Freeport Sulphur Co.), "Cleaning Stainless Steels," U. S. Patent No. 2,538,702, January 16, 1951; *Chemical Abstracts*, Vol. 45, p. 2846 (1951).

Hot-rolled stainless steels of the 18 Cr-8 Ni type are immersed in fused caustic soda containing 5 per cent sodium nitrate, rinsed in water, placed in 10 per cent hydrochloric acid at 180 F for 1 min, and then in 15 per cent nitric acid at 180 F for 15 sec. Oxidizing sodium nitrate converts chromium scale in soluble state and can be replaced with sodium peroxide with good effect.

(697) "How to Clean Metals in Aircraft Production," *Oakite Products, Inc.*, 47 pp. (1951).

Generally concerned with application of proprietary materials. Section on equipment for cleaning of general interest. Discussed are tanks for cleaning, rinse tanks or sprays, metal washing machines. These sections contain suggestions on construction, materials of construction, and means for control and improved operation.

(698) J. A. Odier (to Compagnie de produits chimiques et electrometallurgiques Alais, Froges and Camargue), "Electrolytic Cleaning and Oxidation Cell for Endless Strip or Wire," U. S. Patent No. 2,541,275, February 13, 1951; *Chemical Abstracts*, Vol. 45, p. 3262 (1951).

A three-compartment unit in which the arrangement of electrodes and current shortens the time of oxidation but also subjects the wire to cathodic cleaning prior to oxidation.

(699) L. Piatta, "Effect of Wetting Agents on (Steel) Corrosion," *Chimia*, Vol. 5, pp. 8-11 (1951); *British Abstracts*, B I-5, p. 502 (1951).

Corrosion of steel in tap water and in 0.4 per cent solution of Teepol studied gravi-

metrically and photometrically. Rate of corrosion greater with Teepol and is mainly due to rapid detachment of corrosion products in the presence of wetting agent. Pitting is much less marked in the presence of Teepol than in water alone.

(700) "Soak Cleaning Before Alkaline Electrocleaning," *Plating*, Vol. 38, No. 4, pp. 377-378 (1951).

Reviews the five mechanisms of soil removal from metal surfaces. The functions of the cleaner constituents listed: caustic soda for saponification, soda ash to maintain the alkaline reserve and keep the compound dry and free-flowing, silicates to act as deflocculants and dispersing agents and to provide alkali for saponification and soil removal, polyphosphates to remove water hardness and peptize and remove certain soils, trisodium phosphate to maintain the alkaline reserve, wetting agents and soaps to reduce surface tension and interfacial tension, and to emulsify and remove and disperse soils.

When smut appears, soak cleaning generally is followed by electrocleaning.

Table given showing superiority of balanced cleaner in removing wide range of soils.

(701) T. E. Purcell and S. F. Whirl, "Phosphoric Acid-Cleaning of Boilers," *Transactions, Am. Soc. Mechanical Engrs.*, Vol. 73, pp. 135-139 (1951); *Chemical Abstracts*, Vol. 45, p. 3103 (1951).

A procedure is given for the phosphoric acid cleaning of a new boiler, which when put into operation was free from oxide and corrosion, whereas a similar boiler treated with hydrochloric acid and inhibited proved much less satisfactory. Advantages of phosphoric acid solutions indicated as stability at atmospheric pressure boiling, freedom from corrosive fumes, negligible attack on the metal, and freedom of the treated surfaces from rusting.

(702) W. A. Raymond, "Metal Finishing Progress in 1950," *Metal Finishing*, Vol. 49, No. 1, pp. 48-54 (1951).

Review covering subjects of blast cleaning, descaling, deburring, pickling, and alkaline and emulsion cleaning.

(703) J. V. Sanders, and D. Tabor, "Thin Films of Aliphatic Esters and Alcohols on Metals," *Proceedings, Royal Soc., London*, Vol. 204, No. 1079, pp. 525-533 (1951).

Electron-diffraction study supplemented by transmission and reflexion methods. On metal surfaces, first molecular layer generally oriented with the hydrocarbon chains normal to the surface. Orientation lost at temperatures close to film melting point.

(704) G. Schmerling, "'Emulsion' Cleaning of Metals," *Journal, Electrodepositors'*

Technical Soc., Vol. 26, Preprint, 8 pp. (1950); *British Abstracts*, B I-4, p. 87 (1951).

Discussed are principles of emulsion cleaning and requirements of a suitable commercial mixture of pine oil 62, oleic acid 10.8, triethanolamine 7.2, and ethylene glycol monobutyl ether 20, diluted with an equal volume 1:1 with white spirit-solvent naphtha mixture. Advantages, characteristics, and applications of emulsion cleaning in two-stage and single-stage methods discussed.

(705) D. F. Seymour, "Preparing Zinc-Base and Aluminum-Base Die Castings for Finishing," *Materials and Methods*, Vol. 33, No. 3, pp. 68-69 (1951).

Difficulty with zinc-base alloys is the reactivity of the metals and the variation in porosity which results in thin, comparatively dense skin and very porous core. With aluminum-base castings smut (from silicon) and thin oxide coating are main difficulties.

Preparing aluminum-base castings consists of soak or spray cleaning, pickling in nitric-hydrofluoric acid, rinsing, and phosphatization or treatment with sodium zincate. Zinc-base treatment consists of regular cleaning, followed by acid etch and phosphatization. For parts to be electroplated, steps are electrocleaning, acid dipping, and electroplating.

(706) M. T. Simnad and R. C. Ruder, "The Mechanism of Exchange Between Radioactive Ions in Solution and Metal Surfaces," *Journal, Electrochemical Soc.*, Vol. 98, No. 8, pp. 301-306 (1951).

Study made with radioactive cobalt ions in solution. Acquired activity of metals of different treatments were measured by means of the autoradiograph. Local cell action, due to differences in potential or metal surfaces, is the factor governing radioactivity acquired by metals.

(707) "Industrial Cleaning Agents," *Soaps, Perfumery, and Cosmetics*, Vol. 24, No. 3, pp. 238-244 (1951); *Soap*, Vol. 27, No. 6, p. 83 (1951).

In the formulation of metal cleaners, alkaline materials remove scale and are corrosion inhibitors while, in the dairy industry, they dissolve proteinaceous material. Advantages to the use of synthetic detergents is their resistance to hard water and their compatibility with strong acids and alkalis.

Alkylaryl sulfonates useful in pickling and some petroleum sulfonates may also be used advantageously. Modern methods favor use of a composition containing from 2 to 10 per cent active detergent.

Emulsion cleaners based upon chlorinated or petroleum solvents advantageously adjusted to a specific gravity of unity for greatest stability. Anionic detergents when used in emulsion cleaners should be salt free.

(708) H. R. Spence and H. W. Hooker (to Hooker Electrochemical Co.), "Electrolytic Process for Removing Oxide from the Surface of Metals," U. S. Patent No. 2,538,055, January 16, 1951.

This method comprises immersing the surface in a fused anhydrous bath of a caustic alkali containing an alkali metal or alkaline earth chlorate, nitrate, dichromate, manganate, or permanganate, simultaneously passing electric current from the anode through the fused bath, and then subjecting the unreduced oxide to a dilute, inorganic acid.

(709) S. Spring, "Chemical Surface Preparation. Metal Cleaning," Metal Finishing Guidebook, pp. 182-198 (1951).

Thorough discussion of cleaning principles. Soils typed as oily, semi-solid, or soils containing solids. Standards of cleanliness dependent upon subsequent processing. Cleaner types given and economics of cleaning method selection indicates that alkaline cleaning is cheapest. Electrocleaning fairly common to electroplaters industry. Soils moderately difficult to remove utilize emulsion and diphasic cleaners. Solvent degreasing hazards are indicated. Alkaline cleaners remove soil by detergent action rather than by solvency. Discussion of soaps, surface active agents. Thorough discussion of alkaline cleaners, giving original pH and buffer index. Hard water generally requires selection of a wetting agent and polyphosphates to overcome difficulties.

Emulsion and diphasic cleaners composed of soap such as triethanolamine-fatty acid, coupling agent, and organic solvent. No convenient methods except performance checks to control concentration of emulsion cleaners. Emulsifiable solvents are used generally in concentrated form for removal of heavy films of oils, waxes, and buffing compounds, dried-on pigmented compounds, and rust preventives. Chlorinated solvents could be used by immersion, but lack ability of the emulsifiable solvents to permit easy rinsing of contamination.

(710) C. D. Tuttle (General Motors Corp.), "Cleaning Process Especially Adapted to Remove Buffing Dirt and/or Drawing Compounds from Metal Preparatory to Plating Operations," U. S. Patent No. 2,561,158, Official Gazette, Vol. 648, No. 3, July 17, 1951.

Comprises solvent-emulsion cleaner with oil-soluble upper layer and oil-in-water emulsion under layer. Parts are immersed in lower layer, withdrawn, and sprayed with an intimate mechanical mixture of two solutions, the first of which consists essentially of aqueous solution of alkali metal silicate, and the second largely of mineral spirits,

plus a smaller proportion of chlorinated solvent. Thereafter the parts are subjected to hot chlorinated solvent.

(711) D. W. Vance, "Metal Cleaning," Metal Finishing, Vol. 49, No. 1, pp. 55-57, 73 (1951).

A general review article covering theory and action of many cleaning systems and agents.

(712) G. W. Walter, "Solvent Vapor Degreasing," Metal Finishing Guidebook, pp. 198-207 (1951).

Factors influencing choice of vapor degreasing are rapid, easy, and complete removal of oily contamination by chlorinated solvents, non-flammability, equipment requiring minimum of floor space, heat and cooling water, work coming from the degreaser warm, dry, and ready for subsequent treatment. Stabilized trichloroethylene most commonly used because of low specific heat, comparatively high vapor weight, and ease of stabilization with organic bases. Perchloroethylene used to limited extent, particularly when large amount of moisture is present in the cleaning system.

Discussion of design of equipment for vapor immersion and spray and stabilization of solvent. Gives field test for solvent, recommendations for solvent conservation, and maintenance of equipment and recovery of solvent.

(713) H. G. Webster (to J. H. Shoemaker), "Composition and Process for Electrolytic Cleaning of Metals," U. S. Patent No. 2,547,510, April 3, 1951; Official Gazette.

Composition comprises caustic alkali, sodium chloride, sodium aluminate, and alkali cyanide.

(714) Carl A. Zapffe and M. Eleanor Haslem, "Surface-Active Agents and Pickling Brittleness," Wire and Wire Products, Vol. 26, pp. 127-133 (1951); Chemical Abstracts, Vol. 45, p. 3314 (1951).

Measurements of bendability using a specially designed wire-bend test showed that the agents used alone or with inhibitors in a 10 per cent sulfuric acid bath on steel or stainless steel varied in effect. All anionic reagents were without effect on embrittlement for either the steel or stainless, while nonionic reagents characteristically improve bendability.

(715) R. O. Zerbe (to Monsanto Chemical Co.), "Cleaning of Metallic Surfaces," U. S. Patent No. 2,544,001, March 6, 1951.

Hydroxy polyether derivatives of mercaptothiazolines are used as inhibitors in pickling of steel.