

teristics, 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.

(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 electro-cleaners, 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 diecastings prior to cyanide copper flashing or copper plating is discussed.

(489A) S. Spring and L. F. Peale, "On the Mechanism of the Process of Degreasing Metal Surfaces," *Metallüberfläche*, 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," *Metallüberfläche*, 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) 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.

(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.

NEW REFERENCES—1949 and 1950

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.

(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. Composi-

tion 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.

(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 removing 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.

(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.

(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.

(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.

(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.

(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.

(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) 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).

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 10⁶ counts per min. and trial indicated that 25 mg. of the oil (S.A.E. 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 ultraviolet 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 40 C. 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) I. 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. Hy-

¹J. C. Harris, "Metal Cleaning Bibliographical Abstracts," *Am. Soc. Testing Mats.* (1949). (Issued a separate publication *STP No. 90*.)

drofluoric 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 caustic 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 $1\frac{1}{2}$ 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.

(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 B1, 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, and 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.

(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 the 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 crypto-crystalline 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," *Products 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), Quartermaster 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 p.p.m. and type II in water hardness 0 to 120 p.p.m. 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.

(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 electro-cleaning.

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 pre-treatment for electroplating.

(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, reduce corrosion by 99 per cent or more. Combinations of other aralkyl thiocyanates and other quaternary ammonium compounds can be used.

(551) B. F. H. Scheifele, "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.

(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. 217-22, (1949); *Chemical Abstracts*, Vol. 43, p. 8799 (1949).

The results of the friction studies elucidate the mechanism of the formation of lubricating 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," *Metallüberfläche*, 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 amps. 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-pre-cleaned 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.

1950

(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.

(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 soon as possible since it is corrosive in character. This is accomplished by $\frac{1}{2}$ to 2 min. dip in 15 to 20 per cent chromic acid solution.

(568) 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.

(569) "Improved Di-Phase Metal Cleaner," Glyco Products Co., Inc., June 1950.

A polyethylene glycol ricinoleate is used to the extent of about $1\frac{1}{2}$ per cent in trichloroethylene 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.

(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 and 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.

(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 or soil removal, and the effect of surface roughness. Also includes the effect played by oil characteristics.

(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.

(573) L. J. Wieschhaus, "Steel Shot Speeds Blast Cleaning and Shot Peening," *The 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.