

# TESTING FORUM

## Terminology for Grouting from ASTM D 653-88, Standard Terminology Relating to Soil, Rock, and Contained Fluids

Subcommittee D18.16 on Grouting, under the leadership of Reuben H. Karol, and Subcommittee D18.93 on Terminology Relating to Soil, Rock, and Contained Fluids, under the leadership of A. Ivan Johnson, have established a list of grouting terminology which has been included in ASTM D 653-88, Standard Terminology Relating to Soil, Rock, and Contained Fluids. As a means of letting the geotechnical community know the terminology included, the list of grouting terms is provided below.

**absorption**—the assimilation of fluids into interstices.

**accelerator**—a material that increases the rate at which chemical reactions would otherwise occur.

**activator**—a material that causes a catalyst to begin its function.

**additive**—any material other than the basic components of a grout system.

**adhesion**—shearing resistance between soil and another material under zero externally applied pressure.

	Symbol	Unit
Unit Adhesion	$c_u$	FL <sup>-2</sup>
Total Adhesion	$C_a$	F or FL <sup>-1</sup>

**adhesion**—shearing resistance between two unlike materials under zero externally applied pressure.

**admixture**—a material other than water, aggregates, or cementitious material, used as a grout ingredient for cement-based grouts.

**adsorption**—the attachment of water molecules or ions to the surfaces of soil particles.

**advancing slope grouting**—a method of grouting by which the front of a mass of grout is caused to move horizontally by use of a suitable grout injection sequence.

**aggregate**—as a grouting material, relatively inert granular mineral material, such as sand, gravel, slag, crushed stone, etc. "Fine aggregate" is material that will pass a No. 4 (6.4-mm) screen.

"Coarse aggregate" is material that will not pass a No. 4 (6.4-mm) screen. Aggregate is mixed with a cementing agent (such as Portland cement and water) to form a grout material.

**agitator tank**—a tank, usually vertical and with open top, with rotation paddles used to prevent segregation of grout after mixing.

**alkali aggregate reaction**—a chemical reaction between Na<sub>2</sub>O and K<sub>2</sub>O in the cement and certain silicate minerals in the cement and certain silicate minerals in the aggregate, which causes expansion resulting in weakening and cracking of portland cement grout. See **reactive aggregate**.

**alluvium**—soil, the constituents of which have been transported in suspension by flowing water and subsequently deposited by sedimentation.

**angular aggregate**—aggregate, the particles of which possess well-

defined edges formed at the intersection of roughly planar faces.

**aquiclude**—a relatively impervious formation capable of absorbing water slowly but will not transmit it fast enough to furnish an appreciable supply for a well or spring.

**aquifer**—a water-bearing formation that provides a ground water reservoir.

**aquitard**—a confining bed that retards but does not prevent the flow of water to or from an adjacent aquifer; a leaky confining bed.

**area grouting**—grouting a shallow zone in a particular area utilizing holes arranged in a pattern or grid.

*Discussion*—This type of grouting is sometimes referred to as blanket or consolidation grouting.

**backpack grouting**—the filling with grout of the annular space between a permanent tunnel lining and the surrounding formation.

*Discussion*—Same as crown grouting and backfill grouting.

**base**—in grouting, main component in a grout system.

**base exchange**—the physicochemical process whereby one species of ions adsorbed on soil particles is replaced by another species.

**batch**—in grouting, quantity of grout mixed at one time.

**batch method**—in grouting, a quantity of grout materials are mixed or catalyzed at one time prior to injection.

**batch mixer**—in grouting, a machine that mixes batches of grout, in contrast to a continuous mixer.

**binder**—anything that causes cohesion in loosely assembled substances, such as clay or cement.

**blaine fineness**—the fineness of powdered materials, such as cement and pozzolans, expressed as surface area usually in square centimetres per gram.

**blanket grouting**—a method in which relatively closely spaced shallow holes are drilled and grouted on a grid pattern over an area, for the purpose of making the upper portions of the bedrock stronger and less pervious.

**bleeding**—in grouting, the autogeneous flow of mixing water within, or its emergence from, newly placed grout caused by the settlement of the solid materials within the mass.

**bleeding rate**—in grouting, the rate at which water is released from grout by bleeding.

**bond strength**—in grouting, resistance to separation of set grout from other materials with which it is in contact; a collective expression for all forces such as adhesion, friction, and longitudinal shear.

**catalyst**—a material that causes chemical reactions to begin.

**catalyst system**—those materials that, in combination, cause chemical reactions to begin; catalyst systems normally consist of an initiator (catalyst) and an activator.

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**cation**—an ion that moves, or would move toward a cathode; thus nearly always synonymous with positive ion.

**cement factor**—quantity of cement contained in a unit volume of concrete or grout, expressed as weight, or volume (specify which).

**cement grout**—a grout in which the primary cementing agent is portland cement.

**cementitious factor**—quantity of cement and other cementitious materials contained in a unit volume of concrete or grout, expressed as weight or volume (specify which).

**chemical grout**—any grouting material characterized by being a true solution; no particles in suspension. See also **particulate grout**.

**chemical grout system**—any mixture of materials used for grouting purposes in which all elements of the system are true solutions (no particles in suspension).

**circuit grouting**—a grouting method by which grout is circulated through a pipe extending to the bottom of the hole and back up the hole via the annular space outside the pipe. Then the excess grout is diverted back over a screen to the agitator tank by means of a packing gland at the top of the hole. The method is used where holes tend to cave and sloughing material might otherwise clog openings to be grouted.

**closure**—*in grouting*, closure refers to achieving the desired reduction in grout take by splitting the hole spacing. If closure is being achieved, there will be a progressive decrease in grout take as primary, secondary, tertiary, and quaternary holes are grouted.

**coefficient of permeability (permeability),  $k$  ( $LT^{-1}$ )**—the rate of discharge of water under laminar flow conditions through a unit cross-sectional area of a porous medium under a unit hydraulic gradient and standard temperature conditions (usually 20°C).

**coefficient of transmissibility**—the rate of flow of water in gallons per day through a vertical strip of the aquifer 1 ft (0.3 m) wide, under a unit hydraulic gradient.

**cohesion,  $c$  ( $FL^{-2}$ )**—the portion of the shear strength of a soil indicated by the term  $c$ , in Coulomb's equation,  $s = c + p \tan \phi$ .

*apparent cohesion*—cohesion in granular soils due to capillary forces.

**collar**—*in grouting*, the surface opening of a borehole.

**colloidal grout**—*in grouting*, a grout in which the dispersed solid particles remain in suspension (colloids).

**colloidal mixer**—*in grouting*, a mixer designed to produce colloidal grout.

**colloidal particles**—particles that are so small that the surface activity has an appreciable influence on the properties of the aggregate.

**communication**—*in grouting*, subsurface movement of grout from an injection hole to another hole or opening.

**consistency**—the relative ease with which a soil can be deformed.

**consolidation grouting**—injection of a fluid grout, usually sand and portland cement, into a compressible soil mass in order to displace it and form a lenticular grout structure for support.

*Discussion*—In rock, grouting is performed for the purpose of strengthening the rock mass by filling open fractures and thus eliminating a source of settlement.

*contact grouting*—see **backpack grouting**.

**contact pressure,  $p$  ( $FL^{-2}$ )**—the unit of pressure that acts at the surface of contact between a structure and the underlying soil or rock mass.

**continuous mixer**—a mixer into which the ingredients of the mixture are fed without stopping, and from which the mixed product is discharged in a continuous stream.

**core**—a cylindrical sample of hardened grout, concrete, rock, or grouted deposits, usually obtained by means of a core drill.

**core recovery**—ratio of the length of core recovered to the length of hole drilled, usually expressed as a percentage.

**cover**—*in grouting*, the thickness of rock and soil material overlying the stage of the hole being grouted.

**creep**—slow movement of rock debris or soil usually imperceptible except to observations of long duration. Time-dependent strain or deformation, for example, continuing strain with sustained stress.

**cure**—*in grouting*, the change in properties of a grout with time.

**cure time**—*in grouting*, the interval between combining all grout ingredients or the formation of a gel and substantial development of its potential properties.

**curtain grouting**—injection of grout into a sub-surface formation in such a way as to create a barrier of grouted material transverse to the direction of the anticipated water flow.

**deformability**—*in grouting*, a measure of the elasticity of the grout to distort in the interstitial spaces as the sediments move.

**differential settlement**—settlement that varies in rate or amount, or both, from place to place across a structure.

**dilatancy**—property of volume increase under loading. (ISRM)

**direct shear test**—a shear test in which soil or rock under an applied normal load is stressed to failure by moving one section of the sample or sample container (shear box) relative to the other section.

**displacement grouting**—injection of grout into a formation in such a manner as to move the formation; it may be controlled or uncontrolled. See also **penetration grouting**.

**drain**—a means for intercepting, conveying, and removing water.

**drainage curtain**—*in grouting*, a row of open holes drilled parallel to and downstream from the grout curtain of a dam for the purpose of reducing uplift pressures.

*Discussion*—Depth is ordinarily approximately one-third to one-half that of the grout curtain.

**drainage gallery**—*in grouting*, an opening or passageway from which grout holes or drainage curtain holes, or both, are drilled. See also **grout gallery**.

**drill**—a machine or piece of equipment designed to penetrate earth or rock formations, or both.

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**drill mud**—*in grouting*, a dense fluid or slurry used in rotary drilling; to prevent caving of the bore hole walls, as a circulation medium to carry cuttings away from the bit and out of the hole, and to seal fractures or permeable formations, or both, preventing loss of circulation fluid.

*Discussion*—The most common drill mud is a water-bentonite mixture, however, many other materials may be added or substituted to increase density or decrease viscosity.

**dry pack**—a cement-sand mix with minimal water content used to fill small openings or repair imperfections in concrete.

**dye tracer**—*in grouting*, an additive whose primary purpose is to change the color of the grout or water.

**efflux time**—time required for all grout to flow from a flow cone.

**electric log**—a record or log of a borehole obtained by lowering electrodes into the hole and measuring any of the various electrical properties of the rock formations or materials traversed.

**electrokinetics**—involves the application of an electric field to soil for the purpose of dewatering materials of very low permeability to enhance stability. The electric field produces negative pore pressures near a grout pipe that facilitates grout injection.

**emulsifier**—a substance that modifies the surface tension of colloidal droplets, keeping them from coalescing, and keeping them suspended.

**emulsion**—a system containing dispersed colloidal droplets.

**endothermic**—pertaining to a reaction that occurs with the adsorption of heat.

**envelope grouting**—grouting of rock surrounding a hydraulic pressure tunnel for purpose of consolidation, and primarily, reduction of permeability.

**epoxy**—a multicomponent resin grout that usually provides very high, tensile, compressive, and bond strengths.

**exothermic**—pertaining to a reaction that occurs with the evolution of heat.

**expansive cement**—a cement that tends to increase in volume after it is mixed with water.

**extender**—an additive whose primary purpose is to increase total grout volume.

**false set**—*in grouting*, the rapid development of rigidity in a freshly mixed grout without the evolution of much heat.

*Discussion*—Such rigidity can be dispelled and plasticity regained by further mixing without the addition of water; premature stiffening, hesitation set, early stiffening, and rubber set are other much used terms referring to the same phenomenon.

**final set**—*in grouting*, a degree of stiffening of a grout mixture greater than initial set, generally stated as an empirical value indicating the time in hours and minutes that is required for cement paste to stiffen sufficiently to resist the penetration of a weighted test needle.

**fineness**—a measure of particle-size.

**finer**—portion of a soil finer than a No. 200 (75- $\mu$ m) U.S. standard sieve.

**fishing tool**—*in grouting*, a device used to retrieve drilling equipment lost or dropped in the hole.

**fissure**—a gapped fracture. (ISRM)

**flash set**—*in grouting*, the rapid development of rigidity in a freshly mixed grout, usually with the evolution of considerable heat; this rigidity cannot be dispelled nor can the plasticity be regained by further mixing without addition of water; also referred to as quick set or grab set.

**flow cone**—*in grouting*, a device for measurement of grout consistency in which a predetermined volume of grout is permitted to escape through a precisely sized orifice, the time of efflux (flow factor) being used as the indication of consistency.

**fluidifier**—*in grouting*, an admixture employed in grout to increase flowability without changing water content.

**fly ash**—the finely divided residue resulting from the combustion of ground or powdered coal and which is transported from the firebox through the boiler by flue gases.

**fracture**—the general term for any mechanical discontinuity in the rock; it therefore is the collective term for joints, faults, cracks, etc. (ISRM)

**fracture**—a break in the mechanical continuity of a body of rock caused by stress exceeding the strength of the rock. Includes joints and faults.

**fracturing**—*in grouting*, intrusion of grout fingers, sheets, and lenses along joints, planes of weakness, or between the strata of a formation at sufficient pressure to cause the strata to move away from the grout.

**free water (gravitational water) (ground water) (phreatic water)**—water that is free to move through a soil or rock mass under the influence of gravity.

**free water elevation (water table) (ground water surface) (free water surface) (ground water elevation)**—elevations at which the pressure in the water is zero with respect to the atmospheric pressure.

**gage protector**—*in grouting*, device used to transfer grout pressure to a gage without the grout coming in actual contact with the gage.

**gage saver**—see **gage protector**.

**gel**—*in grouting*, the condition where a liquid grout begins to exhibit measurable shear strength.

**gel time**—*in grouting*, the measured time interval between the mixing of a grout system and the formation of a gel.

**gravity grouting**—grouting under no applied pressure other than the height of fluid in the hole.

**grout**—*in soil and rock grouting*, a material injected into a soil or rock formation to change the physical characteristics of the formation.

**groutability**—the ability of a formation to accept grout.

**groutability ratio of granular formations**—the ratio of the 15% size of the formation particles to be grouted to the 85% size of grout particles (suspension-type grout). This ratio should be greater than 24 if the grout is to successfully penetrate the formation.

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**groutable rock bolts**—rock bolts with hollow cores or with tubes adapted to the periphery of the bolts and extending to the bottom of the bolts to facilitate filling the holes surrounding the bolts with grout.

**grouted-aggregate concrete**—concrete that is formed by injecting grout into previously placed coarse aggregate.

**grout cap**—a “cap” that is formed by placing concrete along the top of a grout curtain. A grout cap is often used in weak foundation rock to secure grout nipples, control leakage, and to form an impermeable barrier at the top of a grout curtain.

**grout gallery**—an opening or passageway within a dam utilized for grouting or drainage operations, or both.

**grout header**—a pipe assembly attached to a ground hole, and to which the grout lines are attached for injecting grout. Grout injector is monitored and controlled by means of valves and a pressure gate mounted on the header; sometimes called grout manifold.

**grout mix**—the proportions or amounts of the various materials used in the grout, expressed by weight or volume. (The words “by volume” or “by weight” should be used to specify the mix.)

**grout nipple**—*in grouting*, a short length of pipe, installed at the collar of the grout hole, through which drilling is done and to which the grout header is attached for the purpose of injecting grout.

**grout slope**—the natural slope of grout injected into preplaced-aggregate or other porous mass.

**grout system**—formulation of different materials used to form a grout.

**grout take**—the measured quantity of grout injected into a unit volume of formation, or a unit length of grout hole.

**hanging wall**—the mass of rock above a discontinuity surface. (ISRM)

**hardener**—*in grouting*, in a two component epoxy or resin, the chemical component that causes the base component to cure.

**heat of hydration**—heat evolved by chemical reactions with water, such as that evolved during the setting and hardening of Portland cement.

**hydration**—formation of a compound by the combining of water with some other substance.

**hydraulic conductivity**—see **coefficient of permeability**.

**hydraulic fracturing**—the fracturing of an underground strata by pumping water or grout under a pressure in excess of the tensile strength and confining pressure; also called hydrofracturing.

**hydrostatic head**—the fluid pressure of formation water produced by the height of water above a given point.

**inert**—not participating in any fashion in chemical reactions.

**influence value,  $I(D)$** —the value of the portion of a mathematical expression that contains combinations of the independent variables arranged in dimensionless form.

**inhibitor**—a material that stops or slows a chemical reaction from occurring.

**initial consolidation (initial compression)**—see **consolidation**.

**initial set**—a degree of stiffening of a grout mixture generally stated as an empirical value indicating the time in hours and

minutes that is required for a mixture to stiffen sufficiently to resist the penetration of a weighted test needle.

**injectability**—see **groutability**.

**in situ**—applied to a rock or soil when occurring in the situation in which it is naturally formed or deposited.

**interstitial**—occurring between the grains or in the pores in rock or soil.

**jackhammer**—an air driven percussion drill that imparts a rotary hammering motion to the bit and has a passageway to the bit for the injection of compressed air for cleaning the hole of cuttings.

*Discussion*—These two characteristics distinguish it from the pavement breaker which is similar in size and general appearance.

**jack-leg**—a portable percussion drill of the jack-hammer type, used in underground work; has a single pneumatically adjustable leg for support.

**jet grouting**—technique utilizing a special drill bit with horizontal and vertical high speed water jets to excavate alluvial soils and produce hard impervious columns by pumping grout through the horizontal nozzles that jets and mixes with foundation material as the drill bit is withdrawn.

**joint**—a break of geological origin in the continuity of a body of rock occurring either singly, or more frequently in a set or system, but not attended by a visible movement parallel to the surface of discontinuity. (ISRM)

**joint (fault) set**—a group of more or less parallel joints. (ISRM)

**joint (fault) system**—a system consisting of two or more joint sets or any group of joints with a characteristic pattern, that is, radiating, concentric, etc. (ISRM)

**jumbo**—a specially built mobile carrier used to provide a work platform for one or more tunneling operations, such as drilling and loading blast holes, setting tunnel supports, installing rock bolts, grouting, etc.

**kaolinite**—a common clay mineral having the general formula  $\text{Al}_2(\text{Si}_2\text{O}_5)(\text{OH})_4$ ; the primary constituent of kaolin.

**kelly**—a heavy-wall tube or pipe, usually square or hexagonal in cross section, which works inside the matching center hole in the rotary table of a drill rig to impart rotary motion to the drill string.

**lime**—specifically, calcium oxide ( $\text{CaO}$ ); also loosely, a general term for the various chemical and physical forms of quicklime, hydrated lime, and hydraulic hydrated lime.

**liquefaction**—the process of transforming any soil from a solid state to a liquid state, usually as a result of increased pore pressure and reduced shearing resistance.

**liquid-volume measurement**—*in grouting*, measurement of grout on the basis of the total volume of solid and liquid constituents.

**lubricity**—*in grouting*, the physico-chemical characteristic of a grout material flow through a soil or rock that is the inverse of the inherent friction of that material to the soil or rock; comparable to “wetness.”

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**lugeon**—a measure of permeability defined by a pump-in test or pressure test, where one Lugeon unit is a water take of 1 L/min per metre of hole at a pressure of 10 bars.

**manifold**—see **grout header**.

**marl**—calcareous clay, usually containing from 35 to 65% calcium carbonate ( $\text{CaCO}_3$ ).

**matrix**—in *grouting*, a material in which particles are embedded, that is, the cement paste in which the fine aggregate particles of a grout are embedded.

**metering pump**—a mechanical arrangement that permits pumping of the various components of a grout system in any desired proportions or in fixed proportions. (*Syn.* proportioning pump, variable proportion pump.)

**mixed-in-place pile**—a soil-cement pile, formed in place by forcing a grout mixture through a hollow shaft into the ground where it is mixed with the in-place soil with an auger-like head attached to the hollow shaft.

**mixer**—a machine employed for blending the constituents of grout, mortar, or other mixtures.

**mixing cycle**—the time taken for the loading, mixing, and unloading cycle.

**mixing speed**—the rotation rate of a mixer drum or of the paddles in an open-top, pan, or trough mixer, when mixing a batch; expressed in revolutions per minute.

**modifier**—in *grouting*, an additive used to change the normal chemical reaction or final physical properties of a grout system.

**moisture content**—the percentage by weight of water contained in the pore space of a rock or soil with respect to the weight of the solid material. (ISRM)

**montmorillonite**—a group of clay minerals characterized by a weakly bonded sheet-like internal molecular structure; consisting of extremely finely divided hydrous aluminum or magnesium silicates that swell on wetting, shrink on drying, and are subject to ion exchange.

**mudjacking**—see **slabjacking**.

**neat cement grout**—a mixture of hydraulic cement and water without any added aggregate or filler materials.

*Discussion*—This may or may not contain admixture.

**newtonian fluid**—a true fluid that tends to exhibit constant viscosity at all rates of shear.

**no-slump grout**—grout with a slump of 1 in. (25 mm) or less according to the standard slump test (Test Method C 143). See also **slump** and **slump test**.

**packer**—in *grouting*, a device inserted into a hole in which grout or water is to be injected which acts to prevent return of the grout or water around the injection pipe; usually an expandable device actuated mechanically, hydraulically, or pneumatically.

**paddle mixer**—a mixer consisting essentially of a trough within which mixing paddles revolve about the horizontal axis, or a pan within which mixing blades revolve about the vertical axis.

**pan mixer**—a mixer comprised of a horizontal pan or drum in which mixing is accomplished by means of the rotating pan of

fixed or rotating paddles, or both; rotation is about a vertical axis.

**particulate grout**—any grouting material characterized by undissolved (insoluble) particles in the mix. See also **chemical grout**.

**penetrability**—a grout property descriptive of its ability to fill a porous mass; primarily a function of lubricity and viscosity.

**penetration**—depth of hole cut in rock by a drill bit. (ISRM)

**penetration grouting**—filling joints or fractures in rock or pore spaces in soil with a grout without disturbing the formation; this grouting method does not modify the solid formation structure. See also **displacement grouting**.

**percent fines**—amount, expressed as a percentage by weight, of a material in aggregate finer than a given sieve, usually the No. 200 (74  $\mu\text{m}$ ) sieve.

**perched water table**—a water table usually of limited area maintained above the normal free water elevation by the presence of an intervening relatively impervious confining stratum.

**percussion drilling**—a drilling process in which a hole is advanced by using a series of impacts to the drill steel and attached bit; the bit is normally rotated during drilling. See **rotary drilling**.

**permeability**—see **coefficient of permeability**.

**permeability**—the capacity of a rock to conduct liquid or gas. It is measured as the proportionality constant,  $k$ , between flow velocity,  $v$ , and hydraulic gradient,  $I$ ;  $v = k \cdot I$ . (ISRM)

**permeation grouting**—filling joints or fractures in rock or pore spaces in soil with a grout, without disturbing the formation.

**pH, pH (D)**—an index of the acidity or alkalinity of a soil in terms of the logarithm of the reciprocal of the hydrogen ion concentration.

**phreatic line**—the trace of the phreatic surface in any selected plane of reference.

**phreatic surface**—see **free water elevation**.

**phreatic water**—see **free water**.

**piezometer**—an instrument for measuring pressure head.

**piezometric line (equipotential line)**—line along which water will rise to the same elevation in piezometric tubes.

**piezometric surface**—the surface at which water will stand in a series of piezometers.

**porosity,  $n$  (D)**—the ratio, usually expressed as a percentage, of: (1) the volume of voids of a given soil or rock mass, to (2) the total volume of the soil or rock mass.

**positive displacement pump**—a pump that will continue to build pressure until the power source is stalled if the pump outlet is blocked.

**pozzolan**—a siliceous or siliceous and aluminous material, which in itself possesses little or no cementitious value but will, in finely divided form and in the presence of moisture, chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

**pressure testing**—a method of permeability testing with water or grout pumped downhole under pressure.

**pressure washing**—the cleaning of soil or rock surfaces accomplished by injection of water, air, or other liquids, under pressure.

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**primary hole**—*in grouting*, the first series of holes to be drilled and grouted, usually at the maximum allowable spacing.

**primary permeability**—internal permeability of intact rock; intergranular permeability (not permeability due to fracturing).

**primary porosity**—the porosity that developed during the final stages of sedimentation or that was present within sedimentary particles at the time of deposition.

**proportioning pump**—see **metering pump**.

**proprietary**—made and marketed by one having the exclusive right to manufacture and sell; privately owned and managed.

**pumpability**—*in grouting*, a measure of the properties of a particular grout mix to be pumped as controlled by the equipment being used, the formation being injected, and the engineering objective limitations.

**pumping test**—a field procedure used to determine in situ permeability or the ability of a formation to accept grout.

**quick condition (quicksand)**—condition in which water is flowing upwards with sufficient velocity to reduce significantly the bearing capacity of the soil through a decrease in intergranular pressure.

**reactant**—*in grouting*, a material that reacts chemically with the base component of grout system.

**reactive aggregate**—an aggregate containing siliceous material (usually in amorphous or crypto-crystalline state) which can react chemically with free alkali in the cement.

*Discussion*—The reaction can result in expansion of the hardened material, frequently to a damaging extent.

**refusal**—*in grouting*, when the rate of grout take is low, or zero, at a given pressure.

**resin**—*in grouting*, a material that usually constitutes the base of an organic grout system.

**resin grout**—a grout system composed of essentially resinous materials such as epoxys, polyesters, and urethanes.

*Discussion*—In Europe, this refers to any chemical grout system regardless of chemical origin.

**retarder**—a material that slows the rate at which chemical reactions would otherwise occur.

**reverse circulation**—a drilling system in which the circulating medium flows down through the annulus and up through the drill rod, that is, in the reverse of the normal direction of flow.

**rotary drilling**—a drilling process in which a hole is advanced by rotation of a drill bit under constant pressure without impact. See **percussion drilling**.

**running ground**—*in tunneling*, a granular material that tends to flow or “run” into the excavation.

**sand**—particles of rock that will pass the No. 4 (4.75-mm) sieve and be retained on the No. 200 (75- $\mu$ m) U.S. standard sieve.

**sand equivalent**—a measure of the amount of silt or clay contami-

nation in fine aggregate as determined by test (Test Method D 2419).<sup>3</sup>

**sanded grout**—grout in which sand is incorporated into the mixture.

**seep**—a small area where water oozes from the soil or rock.

**seepage**—the infiltration or percolation of water through rock or soil to or from the surface. The term seepage is usually restricted to the very slow movement of ground water. (ISRM)

**self-stressing grout**—expansive-cement grout in which the expansion induces compressive stress in grout if the expansion movement is restrained.

**series grouting**—similar to stage grouting, except each successively deeper zone is grouted by means of a newly drilled hole, eliminating the need for washing grout out before drilling the hole deeper.

**set**—*in grouting*, the condition reached by a cement paste, or grout, when it has lost plasticity to an arbitrary degree, usually measured in terms of resistance to penetration or deformation; initial set refers to first stiffening and final set refers to an attainment of significant rigidity.

**setting shrinkage**—*in grouting*, a reduction in volume of grout prior to the final set of cement caused by bleeding, by the decrease in volume due to the chemical combination of water with cement, and by syneresis.

**set time**—(1) the hardening time of portland cement; or (2) the gel time for a chemical grout.

**shelf life**—maximum time interval during which a material may be stored and remain in a usable condition; usually related to storage conditions.

**shrinkage-compensating**—*in grouting*, a characteristic of grout made using an expansive cement in which volume increase, if restrained, induces compressive stresses that are intended to offset the tendency of drying shrinkage to induce tensile stresses. See also **self-stressing grout**.

**sieve analysis**—determination of the proportions of particles lying within certain size ranges in a granular material by separation on sieves of different size openings.

**silt (inorganic silt) (rock flour)**—material passing the No. 200 (75- $\mu$ m) U.S. standard sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air-dried.

**silt size**—that portion of the soil finer than 0.02 mm and coarser than 0.002 mm (0.05 mm and 0.005 mm in some cases).

**slabjacking**—*in grouting*, injection of grout under a concrete slab in order to raise it to a specified grade.

**slaking**—deterioration of rock on exposure to air or water.

**slaking**—the process of breaking up or sloughing when an industrial soil is immersed in water.

**sleeved grout pipe**—see **tube A manchette**.

**slump**—a measure of consistency of freshly mixed concrete or grout. See also **slump test**.

**slump test**—the procedure for measuring slump (Test Method C 143).

**slurry grout**—a fluid mixture of solids such as cement, sand, or clays in water.

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**slurry trench**—a trench that is kept filled with a bentonite slurry during the excavation process to stabilize the walls of the trench.

**slush grouting**—application of cement slurry to surface rock as a means of filling cracks and surface irregularities or to prevent slaking; it is also applied to riprap to form grouted riprap.

**soil stabilization**—chemical or mechanical treatment designed to increase or maintain the stability of a mass of soil or otherwise to improve its engineering properties.

**solution cavern**—openings in rock masses formed by moving water carrying away soluble materials.

**sounding well**—*in grouting*, a vertical conduit in a mass of coarse aggregate for preplaced aggregate concrete which contains closely spaced openings to permit entrance of grout.

*Discussion*—The grout level is determined by means of a measuring line on a float within the sounding well.

**split spacing grouting**—a grouting sequence in which initial (primary) grout holes are relatively widely spaced and subsequent grout holes are placed midway between previous grout holes to “split the spacing”; this process is continued until a specified hole spacing is achieved or a reduction in grout take to a specified value occurs, or both.

**stage**—*in grouting*, the length of hole grouted at one time. See also **stage grouting**.

**stage grouting**—sequential grouting of a hole in separate steps or stages in lieu of grouting the entire length at once; holes may be grouted in ascending stages by using packers or in descending stages downward from the collar of the hole.

**stop**—*in grouting*, a packer setting at depth.

**stop grouting**—the grouting of a hole beginning at the lowest packer setting (stop) after the hole is drilled to total depth.

*Discussion*—Packers are placed at the top of the zone being grouted. Grouting proceeds from the bottom up. Also called up-stage grouting.

**subsealing**—*in grouting*, grouting under concrete slabs for the purpose of filling voids without raising the slabs.

**sulfate attack**—*in grouting*, harmful or deleterious reactions between sulfates in soil or groundwater and the grout.

**suspension**—a mixture of liquid and solid materials.

**suspension agent**—an additive that decreased the settlement rate of particles in liquid.

**syneresis**—*in grouting*, the exudation of liquid (generally water) from a set gel which is not stressed, due to the tightening of the grout material structure.

**take**—see **grout take**.

**tertiary hole**—*in grouting*, the third series of holes to be drilled and grouted usually spaced midway between previously grouted primary and secondary holes.

**thixotropy**—the property of a material that enables it to stiffen in a relatively short time on standing, but upon agitation or manipu-

lation to change to a very soft consistency or to a fluid of high viscosity, the process being completely reversible.

**tremie**—material placed under water through a tremie pipe in such a manner that it rests on the bottom without mixing with the water.

**triaxial shear test (triaxial compression test)**—a test in which a cylindrical specimen of soil or rock encased in an impervious membrane is subjected to a confining pressure and then loaded axially to failure.

**true solution**—one in which the components are 100% dissolved in the base solvent.

**tube A manchette**—*in grouting*, a grout pipe perforated with rings of small holes at intervals of about 12 in. (305 mm).

*Discussion*—Each ring of perforations is enclosed by a short rubber sleeve fitting tightly around the pipe so as to act as a one-way valve when used with an inner pipe containing two packer elements that isolate a stage for injection of grout.

**unconfined compressive strength**—the load per unit area at which an unconfined prismatic or cylindrical specimen of material will fail in a simple compression test without lateral support.

**unit weight**,  $\gamma$  ( $\text{FL}^{-3}$ )—weight per unit volume (with this, and all subsequent unit-weight definitions, the use of the term weight means force).

*dry unit weight (unit dry weight)*,  $\gamma_d$ ,  $\gamma_e$  ( $\text{FL}^{-3}$ )—the weight of soil or rock solids per unit of total volume of soil or rock mass.

*effective unit weight*,  $\gamma_e$  ( $\text{FL}^{-3}$ )—that unit weight of a soil or rock which, when multiplied by the height of the overlying column of soil or rock, yields the effective pressure due to the weight of the overburden.

*maximum unit weight*,  $\gamma_{\text{max}}$  ( $\text{FL}^{-3}$ )—the dry unit weight defined by the peak of a compaction curve.

*saturated unit weight*,  $\gamma_G$ ,  $\gamma_{\text{sat}}$  ( $\text{FL}^{-3}$ )—the wet unit weight of a soil mass when saturated.

*submerged unit weight (buoyant unit weight)*,  $\gamma_m$ ,  $\gamma'$ ,  $\gamma_{\text{sub}}$  ( $\text{FL}^{-3}$ )—the weight of the solids in air minus the weight of water displaced by the solids per unit of volume of soil or rock mass; the saturated unit weight minus the unit weight of water.

*unit weight of water*,  $\gamma_w$  ( $\text{FL}^{-3}$ )—the weight per unit volume of water; nominally equal to 62.4 lb/ft<sup>3</sup> or 1 g/cm<sup>3</sup>.

*wet unit weight (mass unit weight)*,  $\gamma_m$ ,  $\gamma_{\text{wet}}$  ( $\text{FL}^{-3}$ )—the weight (solids plus water) per unit of total volume of soil or rock mass, irrespective of the degree of saturation.

*zero air voids unit weight*,  $\gamma_z$ ,  $\gamma_s$  ( $\text{FL}^{-3}$ )—the weight of solids per unit volume of a saturated soil or rock mass.

**uplift**—the hydrostatic force of water exerted on or underneath a structure, tending to cause a displacement of the structure. (IRSM)

**vane shear test**—an in-place shear test in which a rod with thin radial vanes at the end is forced into the soil and the resistance to rotation of the rod is determined.

**vent pipe**—*in grouting*, a small-diameter pipe used to permit the escape of air, water, or diluted grout from a formation.

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**viscosity**—the internal fluid resistance of a substance which makes it resist a tendency to flow.

**void ratio,  $e$  (D)**—the ratio of: (1) the volume of void space, to (2) the volume of solid particles in a given soil mass.

**critical void ratio,  $e_c$  (D)**—the void ratio corresponding to the critical density.

**washing—in grouting**, the physical act of cleaning the sides of a hole by circulating water, water and air, acid washes, or chemical substances through drill rods or tremie pipe in an open hole.

**water-cement ratio**—the ratio of the weight of water to the weights of portland cement in a cement grout or concrete mix. See also **grout mix**.

**water gain**—see **bleeding**.

**water table**—see **free water elevation**.

**wetting agent**—a substance capable of lowering the surface tension of liquids, facilitating the wetting of solid surfaces, and facilitating the penetration of liquids into the capillaries.

**working pressure**—the pressure adjudged best for any particular set of conditions encountered during grouting.

*Discussion*—Factors influencing the determination are size of voids to be filled, depth of zone to be grouted, lithology of area to be grouted, grout viscosity, and resistance of the formation to fracture.

**yield—in grouting**, the volume of freshly mixed grout produced from a known quantity of ingredients.

**Young's modulus**—the ratio of the increase in stress on a test specimen to the resulting increase in strain under constant transverse stress limited to materials having a linear stress-strain relationship over the range of loading. Also called elastic modulus.

### Committee D-35 on Geosynthetics News

Following the January 1989 meeting in Orlando, FL, Committee D-35 issued an administrative ballot to change its name from "Geotextiles, Geomembranes, and Related Products" to "Geosynthetics." Materials for which the Committee is developing stan-

dard test methods and practices include geotextiles, geomembranes, geocomposite drainage materials, geogrids, and other "geo" materials as they are developed. The name change with the accompanying change in scope, better defines and describes the interest and work of the Committee.

The Committee presently has seventeen standard test methods or practices under its jurisdiction. The four technical subcommittees have a total of 51 task groups developing various standards related to the mechanical, endurance, and permeability and filtration characteristics of geosynthetic materials.

At its January 1989 meeting the Committee sponsored a symposium on the microstructure and performance of geosynthetics. During the day long program 14 papers by authors from the United States, France, Italy, Canada, Belgium, and Poland were presented, which dealt with various aspects of the microstructure of geosynthetic products and the effects that microstructure has on the long-term performance or durability of these products. Some of the subjects included relevant characteristics of various polymers used in geosynthetics, thermal analysis techniques, microscopic evaluation of geomembrane field welding techniques, techniques for the characterization of the pore structure of geotextiles, and freezing effects on the microstructure of geotextiles. It is anticipated that the proceedings will be available in a Special Technical Publication (STP) early in 1990. This will be available through ASTM Headquarters. The coordinator for this program was Dr. Ian Peggs from GeoSyntec Inc.

The Committee has scheduled its third symposium for January 1990 in Las Vegas, NV. The subject of this program will be geosynthetic testing in waste management. Thirty-six papers have been submitted for presentation at this day-long program, which will take place Tuesday, 23 Jan. 1990 preceding the working meeting of the Committee. There will be two concurrent sessions taking place to accommodate the total number of papers which have been submitted. The papers will also be published in an STP following the symposium. Coordinator for this program is Dr. Robert Koerner of Drexel University.

Information regarding the Committee may be obtained from Jayme Hyde, Staff Manager, at ASTM Headquarters, 215-299-5518.



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