

# Reference: Glossary

**ACID NUMBER** The weight in milligrams of KOH required to neutralize the pendant carboxylate groups in one gram of polymer. (See ASTM D 974 and D 604).

**ACID VALUE** *see* [ACID NUMBER](#)

**ADDITIVE** A substance which is added to a polymer to modify one or more properties or ease of processing of the polymer.

**ALFREY-PRICE PARAMETERS** Values, **Q**, a measure of the resonance stabilization of the growing radical and the monomer and, **e**, a measure of their polarities. The values are used to calculate reactivity ratios.

**AMINE EQ. WT.** The weight in grams of material containing one amine group.

**AMINE VALUE** The weight in milligrams of KOH equivalent to the total amine hydrogen content in one gram of polymer. (See ASTM D 2073).

**AMORPHOUS POLYMER** A polymer in which the chains exist in a random coil conformation, exhibiting no long-range order, i.e., crystallinity.

**ANTIBLOCKING** A process or material that prevents two surfaces from adhering to one another.

**ANTICAKING** A process or material that prevents particles from aggregating or coalescing.

**APHA COLOR** A comparative color measurement from 0 to 500 units based on platinum-cobalt color standards.

**ASTM (American Society for Testing and Materials)** Publisher of a series of 69 volumes, divided among 16 sections, describing approved ASTM standards, proposals, and emergency standards relating to test methodologies.

**ATACTIC** *see* [TACTICITY](#)

**BINDER** A substance that causes a mixture to adhere.

**BRITTLINESS TEMPERATURE** The temperature at which a substance has hardness and rigidity but little tensile strength and fractures readily. (See ASTM D 746)

**BROMINE INDEX** A measure of unsaturation expressed in terms of the weight in milligrams of bromine that react with 100 grams of sample.

**BROOKFIELD THERMOSEL** A Brookfield viscometer employing a heated cell.

**BROOKFIELD VISCOMETER** A device that measures viscosity by immersing a rotating cylinder in the fluid being tested. Readings are made of the torque at various rotational speeds and cylinder sizes, and converted into units of poise.

**BUTYL RUBBER** A polyisobutylene (polyisobutene) copolymer, containing 0.5 - 3% isoprene units providing unsaturation sites for crosslinking.

**COLD FLOW** The ability of a material to change dimensions in a reversible or nonreversible (creep) manner at ambient temperature.

**COLOR CONCENTRATE** A dye or pigment dissolved or dispersed in a medium, often polymeric. The medium stabilizes the dispersed colorant, minimizing the mixing required to disperse the colorant in subsequent operations.

**CANNON-FENSKE VISCOMETER** A capillary viscometer in which the two arms are bent from vertical so the bulbs in each arm are in the same vertical axis; widely used for determining molecular weights by measurement of dilute solution viscosity.

**CLOUD POINT** The temperature and ionic strength of a solution at the point where phase separation begins.

**CREEP** *see* [COLD FLOW](#)

**CRITICAL MICELLE CONCENTRATION** The concentration above which a surface active material aggregates to form small colloidal clusters or micelles.

**CRITICAL SURFACTENSION** The maximum value of the surface tension of a liquid at which it will spread over the surface of a given solid.

**CURING** The process of polymerizing a monomer or oligomer or crosslinking an existing polymer.

**DART IMPACT** A test in which a dart with a spherical head of specified diameter is dropped a given distance onto a film. The energy resulting in 50% specimen failure is reported. (See ASTM D 1709).

**DEGREE OF POLYMERIZATION (DP)** An expression for the number of monomer units in a polymer chain.

**DEGREE OF SUBSTITUTION (D.S.)** A term used in polysaccharide chemistry to define the number of substituents attached to a monomer unit. For starch and cellulose, the D.S. varies from 0 to 3.

**DEXTROSE EQUIVALENT** A measure of the average molecular weight of polyglucose where glucose (dextrose) has a value of 100, a dimer a value of fifty, and high molecular weight polymer (starch), a value approaching zero.

**DILATANT** The non-Newtonian flow behavior in which the viscosity increases with increasing shear (stirring rate). Also called shear thickening.

**DRAG REDUCTION** A decrease in viscosity or friction.

**DRAWDOWN** The process of applying an ink or coating to a surface by spreading a thin film of the material, typically using a blade or wire-wound rod.

**DROP POINT, METTLER** The sample to be measured is placed in a cup and heated at a given rate. The temperature at which a drop of molten material passes through a standard orifice is recorded (See ASTM D 3954).

**DURRANS** A method of determining the temperature at which an epoxide softens and becomes visible on top of a mercury blanket (See ASTM D 1763).

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**EMF SHIELDING** A conductive coating that is applied to intercept and dissipate electromagnetic fields, often used on sensitive electronic devices.

**END GROUPS** Structural units that terminate polymer chains.

**ENGINEERING PLASTIC** A polymer with an appropriate combination of stiffness, toughness, and dimensional stability that is formed into parts such as gears, bearings, and casings.

**ESTER VALUE** The saponification number less the acid number.

**EPOXIDE EQUIVALENT WEIGHT (EPOXIDE EW)** The weight in grams of material containing one epoxide group. The epoxide EW for a diepoxide is one-half the molecular weight.

**FORD CUP** A viscosity measurement using a small cup to determine the time for a given amount of liquid to flow through an orifice in the bottom of the cup. Six different orifice sizes are typically used.

**FOX EQUATION** An equation that predicts the glass transition temperatures, based on the homopolymer glass transition temperature; ( $T_{g_x}$ ) in degrees Kelvin and the monomer weight fractions ( $W_x$ ) (for random co-polymers).

$$\frac{1}{T_g} = \frac{W_1}{T_{g1}} + \frac{W_2}{T_{g2}} + \text{etc.}$$

**GARDNER COLOR** A system of color standards based upon stable solutions of ferric chloride. (See ASTM D 523).

**GARDNER GLOSS** A value that quantifies the degree of reflection of light from a surface. It is determined by comparing the strength of reflected light from a test surface area to that from a standard surface.

**GARDNER-HOLDT VISCOSITY** A viscosity measurement based on a bubble viscometer. Viscosity is given in stoke units or as an alphabetical letter. *Also see [Viscosity Comparison chart for Newtonian Liquids](#).*

**GEL PERMEATION CHROMATOGRAPHY, (GPC)** Also called Size Exclusion Chromatography (SEC). A column chromatographic method of determining the molecular weight distribution of a polymer, based on its hydrodynamic volume. Values are often given relative to a standard, usually polystyrene.

**GLASS TRANSITION TEMPERATURE, ( $T_g$ )** The temperature at which the amorphous regions of a polymer soften from a rigid, glassy solid to a flexible, viscous liquid. The value is dependent on molecular weight, impurities, "aging" factors, and testing procedure.

**HYDROPHILE-LIPOPHILE BALANCE, (HLB)** An arbitrary value between 0 and 60 defining the affinity of a surfactant for water (>10) or oil (<10). The values are used to select a surfactant for an O/W or W/O emulsion. Ionic surfactants have recently been assigned HLB values.

**HYDROXYL NUMBER** A measure of the number of hydroxyl groups present in a polymer. The weight in milligrams of KOH required to neutralize the hydroxyl groups in one gram of polymer. Determined by acetylation using acetic anhydride and titration of the acetic acid and excess anhydride with potassium hydroxide.

**IODINE VALUE** The grams of iodine that react with 100 grams of sample. A measure of unsaturation.

**IONOMER** A polymer with repeating ionic groups, which tend to aggregate to form ionic domains that act as physical cross-links. The domains dissociate on heating allowing the material to be processed as a thermoplastic.

**ISOTACTIC** *see [TACTICITY](#)*

**IZOD IMPACT** The impact strength measured when a falling weighted pendulum strikes a rectangular specimen. The specimen may be notched or unnotched. (See ASTM D 256).

**K-VALUE, FIKENTSCHER** An empirical molecular weight value, K, based on dilute solution, viscosity,  $\eta_{rel}$ , and concentration, c.

$$(1/c) \cdot \log (\eta_{rel}) = \frac{(K_0 + 75K_0^2)}{(1 + 1.5K_0c)}$$
$$K = K_0 \times 10^3$$

**LIGHT SCATTERING** A technique used to determine the absolute weight average molecular weight,  $M_w$  using a dilute solution of the polymer.

**MACROMONOMERS** High molecular weight (a somewhat arbitrary value) functional monomers. Also called macromers.

**MARK-HOUWINK-SAKURADA CONSTANTS** K and a values in the viscosity equation  $[\eta]=KM^a$  where  $[\eta]$  is the intrinsic viscosity and M is the molecular weight polymer.

**MELT FLOW RATE** *see [MELT INDEX](#)*

**MELT INDEX (MI)** The weight of polymer extruded through a cylindrical channel under the pressure of a piston. The amount of polymer extruded is a measure of the melt viscosity and inversely proportional to the molecular weight. Tests are run at specified temperatures and piston weights/pressures. Also called melt flow index. (See ASTM D 1238 and D 3159).

**MELTING TEMPERATURE, ( $T_m$ )** The temperature at which the crystalline regions of a polymer transform from an ordered, rigid structure into an amorphous, viscous liquid. *also see [GLASS TRANSITION TEMPERATURE](#)*

**MODULUS** A ratio of the tension (stress) to the elongation (strain) of a test specimen.

**MOLAR SUBSTITUTION** A term used in polysaccharide chemistry to define the number of molecules of a reagent that are attached to a monosaccharide unit. Since the reagent may react with the monosaccharide unit singularly or to form a pendant polymer chain, the value can range from zero (no attachment) to a very large number (polymeric attachment).

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**MOLECULAR WEIGHT AVERAGES** Several averages are used to describe the molecular weight of polymeric materials.  $M_n$  is based on the number of molecules present. The  $M_w$  (weight) and  $M_z$  averages put increased emphasis on the higher molecular weight fractions.  $M_i$  is the molecular weight and  $N_i$  is the number of moles of the  $i$ th fraction.

$$M_n = \frac{\sum M_i N_i}{\sum N_i} \quad M_w = \frac{\sum M_i^2 N_i}{\sum M_i N_i} \quad M_z = \frac{\sum M_i^3 N_i}{\sum M_i^2 N_i}$$

**MONOMER** The starting material, or unit, on which a synthetic polymer is based: starting material for polymerization.

**MOONEY VISCOSITY** An arbitrary scale that defines the viscosity of a raw or partially cured elastomer, determined with a shearing disc viscometer consisting of a knurled disc rotating inside a serrated sample chamber. Viscosity is related to torque, ranging from 0 to 100 at a defined temperature, disc size, and time to reach equilibrium.

**MULTI-ANGLE LASER LIGHT SCATTERING (MALLS)** See [Light Scattering](#)

**NETWORK POLYMER** Another term for a crosslinked polymer.

**NEWTONIAN FLOW** A material that is "ideal" in that it follows Newton's law of viscosity behavior where shear stress is linearly proportional to the shear rate.

**OIL-OUT (W/O) EMULSION** An emulsion in which water is the dispersed phase and oil is the continuous phase.

**OLIGOMER** A very low molecular weight polymer, ranging from about two to twenty monomer units.

**PENDANT GROUP** A group attached to or extending from the primary backbone chain of a polymer.

**PENULTIMATE GROUP** The next to last monomer unit in a polymer chain.

**PEROXIDE NUMBER** The number of milliequivalents of oxygen contained in one kilogram of material.

**PHOTOINITIATOR** A compound that absorbs energy, either directly or indirectly, from photons to form reactive species, radical or cationic, which initiate polymerization.

**PLASTICIZER** A material added to a polymer to decrease internal viscosity and improve bulk flexibility.

**POLYDISPERSITY (PD)** A ratio of the weight average molecular weight to the number average molecular weight. A measure of the breadth of molecular weight distribution within a sample. Also called polydispersity index (PDI).

**POTTING COMPOUND** A polymer or prepolymer used to coat or encapsulate an item. Electronic components are often encapsulated in insulating polymeric materials.

**POUR POINT** The lowest temperature at which a liquid will flow when the container is inverted. (See ASTM D 97).

**PREPOLYMER** A comparatively low molecular weight polymer which is then used to make a higher molecular weight polymer by chain extension and/or cross-linking.

**PREPREG** A composite material in which fibers are embedded in a prepolymer matrix, which is subsequently polymerized. Short for preimpregnation.

**PSEUDOPLASTIC** A time-dependent change in viscosity in which the viscosity decreases with increasing shear rate. The material tends to return to its original viscosity when shearing ceases. Also called shear thinning.

**REACTIVE DILUENT** A monomer containing reactive groups that is added to reduce the viscosity of a formulation, and is incorporated into the structure of the cured polymer.

**REACTIVE OLIGOMER** Oligomers containing end groups capable of undergoing polymerization, usually by heating, to form higher molecular weight polymers.

**RESIN** Historically, exudations of specific plants which harden on exposure to air. The term also refers to synthetic polymers of various molecular weights, some are subsequently processed and may or may not undergo further polymerization.

**RHEOLOGY CONTROL** The addition of a polymer to a system to increase, decrease, or maintain viscosity over a range of conditions, such as temperature and shear rate.

**RING AND BALL SOFTENING POINT** A method in which a steel ball is placed on a test material contained in a brass ring. The sample temperature is increased at 5°C per minute and the temperature at which the ball penetrates the material is noted. (See ASTM E 28).

**ROCKWELL HARDNESS** A number which indicates the hardness of a material as measured by an indentation test. It is derived from the increase in depth of penetration as a load is increased from a minor load to a major load and then returned to a minor load. Indentors are round steel balls of specific diameters and the resulting value is based on the indenter's size, load, and dial scale used. (See ASTM D 785).

**SAPONIFICATION** The hydrolysis of an ester with an alkali to form a salt or a soap.

**SAPONIFICATION NUMBER** The number of milligrams of KOH required to saponify 1 gram of sample, based on one equivalent of KOH saponifying one equivalent of ester. The value also includes the neutralization of free acid present (acid number).

**SECONDARY STANDARD** Material that is characterized employing absolute molecular weight methods, and is indirectly compared to NIST standards.

**SELF-ACCELERATING DECOMPOSITION TEMPERATURE (SADT)** The lowest temperature at which a given amount of material undergoes self-accelerating decomposition. The value is used to conform to transportation regulations.

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**SETAFLASH TESTER** A device to measure the flashpoint of a material by heating a sample in a closed cup and periodically exposing the vapor to an ignition source. The temperature at which combustion, or flash, occurs is recorded.

**SHORE HARDNESS** A measure of the hardness or softness of a material as assessed by simple indentation involving the force of a vertical indenter against the surface to be tested. Indentor Type A is for soft materials and Type D is for hard materials. (See ASTM D 2240).

**SIZE EXCLUSION CHROMATOGRAPHY (SEC)** *see* [GEL PERMEATION CHROMATOGRAPHY](#)

**SIZING** A surface treatment applied to a fiber to lubricate the surface and prevent abrasive damage.

**SOFTENING POINT** The temperature at which a material, usually a thermoplastics material softens by a specific amount in a softening point test. *See* [RING AND BALL, VICAT](#)

**SOLUBILITY PARAMETER ( $\delta$ )** A value based on the square root of the cohesive energy density (intermolecular attraction) and used to predict mutual solubility. Materials with similar  $\delta$  values (<2 for non-polar materials) are predicted to be miscible.

**STEARIC STABILIZER** A nonionic material that stabilizes a colloidal particle by attaching to the particle's surface. The stabilizer is swollen by the solvent and prevents approach of other stabilized particles due to the volume occupied by the solvated stabilizer.

**SWARD HARDNESS** A value relating to the hardness of a film as determined by measuring the number of oscillations made by a pair of circular rockers placed on the film surface, compared with the number of oscillations made on a polished glass plate.

**SYNDIOTACTIC** *see* [TACTICITY](#)

**SYNERESIS** The exudation of a liquid from a gel.

**TABER ABRASION** A measure of the wear that results when a pair of abrasive wheels is rotated in opposite directions against a specimen mounted on a turntable. The measuring device is a Taber Abraser. (See ASTM D 1044).

**TACK or TACKINESS** Tendency of a material to stick to itself without necessarily sticking to other surfaces.

**TACTICITY** The stereospecific configuration of a polymer containing repeating asymmetric centers. An isotactic polymer has the same configuration (orientation in space) at each asymmetric center while a syndiotactic polymer has alternating configurations at sequential asymmetric centers. An atactic polymer has no repeating stereoregularity of asymmetric centers.

**TELECHELIC POLYMER** A polymer containing functional end groups that can bond to other molecules. *Also see* [REACTIVE OLIGOMER](#).

**TENSILE IMPACT** The energy delivered by a single swing of a calibrated pendulum that results in the fracture of the specimen. (See ASTM D 638).

**TENSILE STRENGTH AT BREAK** The ratio of the load (stress) at its maximum value preceding destructive failure of the sample, divided by its initial undeformed cross-sectional area. The value is both temperature and strain rate dependent. (See ASTM D 638).

**TENSILE STRENGTH AT YIELD** A ratio of the tensile load (stress) divided by the initial, undeformed cross-sectional area of sample. It is the maximum value obtained prior to the sample undergoing permanent deformation. (See ASTM D 638).

**THERMOPLASTICS MATERIAL** A material which softens on heating and hardens on cooling. Thermal cycling can be repeated a large number of times. Commercially, the most important type of high polymer.

**THETA SOLVENT** A solvent, at a particular temperature, in which the polymer is at the edge of solubility and exists in the form of a statistical coil. Long-range forces between polymer molecular segments are balanced by polymer-solvent interactions. At these conditions the second virial coefficient becomes zero and entropy is at its minimum.

**THIXOTROPIC** The rheological behavior of a polymer in which the viscosity decreases with time at constant shearing rate. When shearing ceases, the viscosity increases and tends to approach the original value

**TRIBOLOGY** The study of frictional processes, lubrication, and wear on surfaces.

**ULTIMATE TENSILE STRENGTH**  
*see* [TENSILE STRENGTH AT BREAK](#)

**VICAT SOFTENING POINT** The temperature at which a polymer softens appreciably, as measured by the penetration of a needle with a cross-sectional area of one mm<sup>2</sup>. The needle is loaded with a force of 49 N and pressed against the surface of a polymer while it is being heated at a rate of 50°C/h. The temperature at which the needle penetrates to 0.1 mm is the Vicat softening point. (See ASTM D 1525).

**VISCOSITY** Resistance to flow or internal friction of a polymer in solution or melt state.

**VULCANIZATION** The process of crosslinking a polymer. Usually refers to lightly crosslinking an unsaturated elastomer to improve mechanical properties.

**WATER-OUT (O/W) EMULSION** An emulsion in which oil is the dispersed phase and water the continuous phase.

**YIELD POINT** The point on a stress-strain curve that marks the onset of permanent (plastic) deformation. A polymer stressed beyond this critical value does not return to its original dimensions when the stress is removed.

