



**Cleveland  Eastern
Mixers**
DIVISION OF
EMI INC. TECHNOLOGY GROUP

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1-800-243-1188

GLOSSARY OF MIXING TERMS

AGGLOMERATION: The recombining of finely dispersed particles into larger particles, usually caused by a rearrangement of surface forces resulting from a change of environment. It is the opposite of dispersion.

AGITATOR: A device consisting of at least a Power Package, a shaft and an Impeller to provide agitation of the contents of a vessel.

ANCHOR PADDLE: An Impeller whose contour closely conforms to the vessel bottom and walls.

APPARENT VISCOSITY: The flow resistance of a Non-Newtonian Fluid at some arbitrary point on its stress-flow curve and the consistency of a material at some particular velocity.

AXIAL FLOW: The movement of a fluid generally from the top to the bottom of the tank.

AXIAL TURBINE: A Turbine with pitched blades (usually 45°) whose discharge is a mixture of Axial and Radial Flows.

BAFFLE: A stationary device usually installed at, or near tank walls to prevent liquid swirl and promote vertical flow in the vessel.

BEARING LIFE: Bearing life is most often reported as B-10 life, which is the number of hours of operation under a given set of load conditions during which a bearing has a 10% chance of failure. The B-10 life is about one-fifth the average life.

BLADE: One of the vanes on any type of impeller, sometimes misused to indicate the whole impeller.

BLENDING: Mixing two or more miscible liquid components into a more uniform mass.

BREAKER BARS: Baffles positioned adjacent to the path of the Impeller or the Paddle to prevent the entire mass from rotating with the Impeller.

BULK DENSITY: The Density of a granule or powdered solid material including the voids between the particles. It is always less than the true Density.

CENTIPOISE, CENTISTOKE: See Viscosity.

CONSISTENCY: The resistance of a fluid to deformation when subjected to shear stress, usually synonymous with Viscosity.

CRITICAL SPEED: The rotational speed of a shaft equal to the frequency of the natural harmonic vibration of the shaft.



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CRYSTALLIZATION: Formation of a solid phase from a liquid solution. It is the opposite of dissolving.

DENSITY: The mass per unit volume of a substance. See Bulk Density & Specific Gravity.

DILATANT FLUID: a material in which the (Viscosity increases with increasing shear rate. It is the opposite of Pseudo-plastic.

DISPERSION: A two-phase system in which one phase is broken into discrete particles which are completely surrounded by the second phase. Particles may be solid, liquid or gas. For Mixing purposes, the second phase is generally a liquid. Not to be confused with Solids Wetting.

DRAFT TUBE: A hollow stationary cylinder mounted concentric with and above or around the Impeller to promote increased vertical fluid flow during agitation.

DRYWELL: A weir or hollow quill designed around the output shaft of a drive unit to prevent leakage of the gear lubricant down the shaft.

EMULSION: A colloidal dispersion of two or more liquids, which are immiscible with each other. See Dispersion.

EQUIVALENT SHAFT WEIGHT: The effective weight of a shaft if it were concentrated at the lower end of the shaft, used in critical speed calculations.

EQUIVALENT IMPELLER WEIGHT: The weight, which if placed at the end of a shaft, would have the same effect as one or more Impellers located elsewhere on the shaft.

EXTRACTION: A process involving material transfer from one phase to another.

FLASH MIXER: An agitator used to mix a small amount of additive into a continuous stream where the Residence Time is extremely short (usually less than one minute). It most often refers to addition of chemicals, which cause or aid Flocculation in water or waste treatment operations. A flash mixer is usually used where all of the addition is at a single point, whereas Rapid Mixers are used where addition is made at several points in a channel; however, the terms are somewhat interchangeable.

FLOCCULATION: A mixing process whose object is to cause fine particles to collide and/or Agglomerate to larger sizes or to adhere to larger particles so they can more easily be separated from the liquid.

FLOODING: In gas-liquid mixing, an accumulation of gas which collects with in the impeller, reducing liquid circulation to a small fraction of normal, and thereby reducing mixing effectiveness. It can also occur when air is drawn into the liquid from the surface, either from Vortexing or accompanying solids, which are being wetted.

FORD CUP: A common tool for measuring Kinematic Viscosity, used in the paint industry.



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FULL VACUUM: A zero pressure on the absolute pressure scale. Theoretically, no molecules are left in the system; practically, it is the minimum pressure obtained with the vacuum equipment being used and should be defined numerically. It is usually 26-27" of mercury (29.95" = theoretical limit).

GATE IMPELLER: An Anchor type Impeller having additional horizontal and vertical blades.

GEAR RATING: The horsepower capability of a drive unit meeting life and strength standards established by the American Gear Manufacturers Association.

GEAR TYPES

- **SPIRAL BEVEL:** A curved-tooth gear form used to connect intersection shafts.
- **HELICAL GEARS:** An angle-tooth gear used to connect parallel or non-intersection shafts.
- **WORM GEARS:** A gear form used for obtaining large speed reduction between non-intersection shafts whose axes are at a 90° angle from each other.
- **INVOLUTE HELICOID WORM GEAR:** A high efficiency type of Worm Gearing equivalent to wrapping helical teeth around a cylinder rather than around the edge of a disc.

HELIX: A type of Impeller consisting of one or more narrow ribbons which spiral around the shaft, affixed to arms mounted on the shaft, affixed to arms mounted on the shaft, and having a diameter near that of the vessel. It is used for high viscosity liquids or solids.

HINDERED SETTLING: Behavior of a Slurry having a high frequency of particle collisions, evidenced by reduced Settling Velocity and Non-Newtonian behavior of the Slurry. Generally, it becomes noticeable at solids concentrations above 40-50% by volume, but may occur at much lower concentrations if the particles are extremely fine or highly irregular in shape. Most Non-Newtonian Slurries are Pseudoplastic but a few are Dilatant.

HOLD-UP: In gas-liquid mixing, the increase in batch volume over the liquid volume, resulting from the gas which is Dispersed in the liquid.

IMPELLER: The portion of the Agitator imparting force to the material being mixed. Propellers, Turbines, Gates, Anchors and Paddles are all types of Impellers.

INTERFACIAL AREA: The average total area between phases in a dispersion. As interfacial area is increased, more power is required to create and/or maintain it.

KREBS UNIT (KU): A common method of reporting Consistency of paint and other coatings.

LAMINAR FLOW: Fluid flow characterized by long, smooth flow currents, mainly in the same direction as the bulk of the flow with little interaction between them. See Turbulent Flow.



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MECHANICAL SEAL: A device for sealing against pressure where the agitator shaft enters the vessel. It consists of two rings, one of which is stationary and the other rotating with the shaft. The accurately machined faces of these rings are forced together either by springs or by the tank. For higher pressures. Double Mechanical Seals consisting of two opposed seals in a pressure-tight housing are used. A pressurized liquid lubricant and coolant is introduced to or flushed through the cavity between the seals. Many variations in construction and materials are available to meet special requirements.

MIXER: See Agitator.

MIXING: The process of putting power into a system, usually for the purpose of producing greater material uniformity.

NEWTONIAN FLUID: A fluid whose rate of flow is proportional to the stress applied to it. The Viscosity is therefore constant and independent of shear rate.

NON-NEWTONIAN FLUID: A fluid whose rate of flow is non-proportional to the stress applied. The Viscosity is variable and may increase or decrease with shear rate, with time, or with a combination of both. See also Pseudoplastic, Thixotropic, Dilatant.

PADDLE: A two-bladed Impeller whose diameter is usually greater than 60% of the tank diameter.

PARTICLE DIAMETER: The size to which the individual bodies of the dispersed phase are reduced in a two-phase Dispersion. Often called drop diameter if the dispersed phase is a liquid or bubble diameter if the dispersed phase is a gas. The smaller the particle size, the larger the Interfacial Area.

PASTE MIXER: A mixer with a modified Anchor Impeller, having several vertical bars or fingers which intermesh with stationary Baffles extending down from the tank top. Used to make low to medium Viscosity pastes such as caulking compound.

PITCH: For a turbine, the angle the blades make with a horizontal plane.

POISE: The absolute unit of Viscosity in the C.G.S. system. One Poise equals one dyne-second per square centimeter, equals one hundred Centipoises.

POWER NUMBER: A dimensionless ratio used in calculating Impeller power loadings. Impellers of similar design but different sizes will have equal power numbers under dynamically equal conditions.

POWER PACKAGE: The portion of an Agitator, normally above the vessel, to which the Agitator shaft is coupled. It converts power into the mechanical energy for mixing.

PROPELLER: A three or four-bladed Axial Flow Impeller, having helically shaped blades.



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PROXIMITY FACTOR: A correction factor used in Impeller power calculations to allow for geometric variations, such as Impeller-to-tank bottom distance. Impeller-to-liquid surface distance, multiple impeller spacing, etc.

PSEUDO-PLASTIC LIQUID: A liquid or slurry in which the Viscosity decreases with increasing shear rate.

PUMPING RATE: The volumetric discharge rate of an Impeller operating at a given speed, measured at the Impeller.

RADIAL FLOW: The movement of a fluid generally from the center of the tank to the wall.

RADIAL TURBINE: A turbine whose blades are vertical and whose discharge is a Radial Flow.

RAPID MIXER: See Flash Mixer.

RESIDENCE TIME: The average time a process component remains in the mixing environment in a continuous process.

REYNOLDS NUMBER: A dimensionless number used to characterize fluid flow data. The ratio of inertial to viscous forces.

SAYBOLT SECONDS, UNIVERSAL (SSU): A method of reporting Kinematic Viscosity, most common in the petroleum industry; 100 centistoke: equals 462 SSU.

SCRAPERS: Flexible or hinged members attached to the outer periphery of an Anchor Impeller to scrape the vessel wall, preventing buildup and improving heat transfer.

SERVICE FACTOR: A numerical rating system c gear trains based on operating time, type of drive and duty required. See Gear Rating.

SETTLING VELOCITY: The velocity attained b a particle freely falling in a fluid due to gravity. See Terminal Settling Velocity and Hindered Settling.

SHEAR: As applied to liquid mixing, it is that portion of the applied power, which appears as turbulence, velocity head, recycling, drag on the blades, etc. It is the action, which produces intimate mixing on a microscopic and molecular scale.

SLINGER: (1) A device attached to a shaft above the liquid level to prevent the liquid from climbing or splashing up on the shaft.

SLURRY: A mixture of liquids and insoluble solid a Solid Suspension.



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SOLID SUSPENSION: A mixture of an insoluble solid material in a liquid. There are three degrees of suspension used in mixing: (1) "Complete motion" wherein all solid particles are merely maintained in motion. (2) "Complete suspension" wherein the solid particles are all lifted from the bottom but not necessarily to the top. (3) "Complete uniformity" where the heaviest particles approach the surface frequently and particle distribution is uniform through all but the top 3 - 5% of the liquid. See Hindered Settling.

SOLIDS WETTING: Dispersing solid particles so that a liquid film coats each particle.

SPARGER: A pipe or pipe construction for introducing fluid below the liquid surface in a tank; most often a ring or spider with many small holes, located below the Impeller, through which gas is bubbled.

SPECIFIC GRAVITY: The Density of a material, compared to the Density of water at standard conditions. In the metric system, water has a density of 1 gram/ml, so density and specific gravity are numerically equal.

STABILIZER: A device attached to an Impeller which directs the fluid flow pattern generated by rotation so as to resist shaft deflection, thereby allowing the use of longer shafts without Steady Bearings.

STEADY BEARING: A radial shaft support bearing mounted in the vessel bottom used to reduce deflection in long shaft installations. Sometimes called a "foot bearing."

STUFFING BOX: A device for sealing against pressure where the agitator shaft enters the vessel. It consists of a stationary tube around the shaft with several rings of close fitting braided fibrous packing (such as glass-filled Teflon) in the annular space between the tube and shaft. Usually included are means to lubricate the packing, a lantern ring to store and distribute lubricant, and a follower or gland to compress the packing further as it wears. Many special variations or features are available.

SUPERFICIAL VELOCITY: An average velocity value used in computations of fluid flow due to the complexity of velocity distribution in the system. Usually encountered in gas-liquid systems where it is the volumetric gas flow rate divided by the cross sectional area of the tank.

SWIRL: The rotation of a liquid about an agitator shaft where little relative motion within the liquid is obtained.

THIXOTROPIC: A material whose viscosity drops gradually even at a constant shear rate, as opposed to materials whose viscosity changes instantaneous with changing shear rate.

TORQUE: The torsional moment exerted by a boi (such as an Impeller) rotating at constant speed.

TURBINE: A multi-bladed (usually 4 or more) relatively short armed Impeller. The Impeller diameter to tank diameter ratio usually varies from 0.2 to 0.5 for turbines. ***CURVED BLADE TURBINE:*** A Radial Turbine whose blades form arcs. ***SINGLE INLET TURBINE:*** A Radial Turbine with one face shrouded for the purpose of controlling the direction of fluid flow. See Lifter Turbine. ***LIFTER TURBINE:*** A single Inlet Turbir which is open at the bottom of the blades.



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UMBRELLA SEAL: A liquid trap around a shaft to prevent vapor leakage from the vessel, used one in very low pressure systems.

VISCOSITY: The measure of resistance of a fluid to flow when a force is applied to it. See Apparent Viscosity. *ABSOLUTE VISCOSITY* is usually measured in centipoises (cp.). Water at room temperature has a viscosity of 1 cp. *KENEMATJC VISCOSITY* is reported in many different forms depending on the measuring instrument. It is convertible into centistokes. Centipoises equals centistokes multiplied by Specific Gravity of the fluid.

VISCOSITY FACTOR: The correction factor applied to standard Impeller power draw to account for the difference caused by high liquid Viscosity.

VORTEX: A depression occurring in a liquid surface when an agitator Swirls the liquid; a whirlpool.

WATER HORSEPOWER: The standard brake HP an Impeller will draw when operated in a water-like liquid (Viscosity = 1 centipoise, Specific Gravity = 1.0) under standard conditions of Baffling and geometric arrangement.

WETTING: See Solid Wetting.