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Quick Reference Guide for Mixing

Mixing Terms

Mixing is a key operation for many processes - it's a necessity when two or more ingredients must be blended together. We are often asked to provide a definition of mixing versus agitation or blending. Sounds simple enough, but not so when you add other "mixing" terms such as dispersing, hydrating, suspending or emulsifying! In other words, depending upon the ingredients involved, "mixing" or "blending" may not properly describe the operation required. Here are brief descriptions to define each situation:

Mixing

The generic term for the operation encompassing all the variations that follow.

Agitating

Typically defined as a low speed blending operation with turbine type blades or paddles.

Blending

Mixing or agitating two or more miscible liquids of similar viscosity (or solids only) and density, often done inside a vertical helical screw blender.

Dissolving

Where the dissolution of a solid in a liquid is necessary, as with salt or sugar solutions. Simple agitation techniques are normally sufficient if time is not a factor, although high shear techniques are required when other solids (ingredients) may block dissolution of the primary solid or when faster dissolution would be beneficial.

Dispersing

The action of scattering immiscible particles, droplets or gas bubbles in a matrix liquid. The results can properly be called dispersions, but more often they are given more specific names:

- Suspension: when solid particles, usually above colloidal size, are dispersed
- Emulsion: when droplets are dispersed, such as oil in water or water in oil
- Lyosol: when air or gas bubbles are dispersed

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Homogenizing

This term is usually applied to a very intense mixing action, but literally it only means that all components are so thoroughly mixed that they are "made alike." This term should not be limited to the action of one particular type of equipment.

Hydrating

Many ingredients when used as binding or stabilizing agents will "swell" when activated by high shear and attach themselves to other molecules. Hydrocolloids such as gums, stabilizers, polymers, etc. require a high shear device to be thoroughly dispersed for 100% hydration.

More than Mixing - Size Reduction

In order to speed up the mixing process, modern machines introduce a high degree of kinetic energy. This very often results in a reduction of particle or droplet size. This can mean the break-up of agglomerations, and can be done in batch or in-line mode, or more typical is the shear action of tearing droplets apart or the crushing or slicing of solid particles.

Adding Gums, Hydrocolloids, Powders or Thickeners

For these ingredients, conventional "sprinkling" into the tank can actually be detrimental because the viscosity builds slowly and the pumpability of the medium decreases. In high shear/high flow applications, the powder needs to be incorporated and hydrated quickly, before it gets a chance to build viscosity.

- Make sure there is a good vortex and high bulk fluid velocity in tank with the liquid phase
- Add powder quickly - all at once!

You'll see that the powder is incorporated, dispersed, or hydrated more easily.

Mixer Placement

Bridge-mounted Mixers - Cylindrical Tanks
Baffled: Place mixer dead center.
Unbaffled: Place mixer 1/6 to 1/4 tank diameter off center.

- 1/6 will provide strong vortex
- 1/4 will provide very little vortex

Square or Rectangle Tanks
Baffled or Unbaffled: Place mixer dead center.

Clamp-mounted mixers: Typically limited to small portable mixers, clamp-mounts are usually on the side wall of the tank or a separate bracket attached to the tank or mixing vessel. General shaft position is at a 10 to 15 degree angle (from a side view, vertical position) into the tank. Also, for swivel-type clamps, the option is to angle the shaft at a 10 to 20 degree angle to the right, as viewed from the top looking down into the mixing tank.

Location of Mixing Head

High Shear Mixing
Optimal: One (1) mixing head diameter off bottom
1.5 to 2 mixing head diameters minimum coverage

Low Speed Agitation
As close as ½ impeller diameter off bottom

1.5 to 2 mixing head diameters minimum coverage

Size of impeller or Mixing Head

High Shear Mixing
Ratio of mixing head diameter (D) to tank diameter (T) should be 1/10th or greater.

Low Speed Agitation

Ratio of impeller diameter to mixing tank diameter should be 0.25 or better depending upon viscosity. High viscosity requires a minimum 0.35 - 0.4 ratio.