Dissolve solids rapidly.

Dissolution matters

When large amounts of solids need to be dispersed and dissolved into a liquid batch, the type of mixer that is used primarily impacts cycle time and production cost. While solubility rules always win, waiting for powders to eventually dissolve is an inefficiency not many process lines can afford to have. Aside from a mixing standpoint, dissolution rate can be improved by raising temperature and/or reducing the size of the solid particles. Heating obviously requires additional energy consumption and in applications containing sensitive components, it is not always a viable option. Milling solids to increase dissolution rate adds another production step and is not usually practical. In most cases, it is the method of mixing that provides a better opportunity for optimization.

Low-speed agitators such as propellers, pitched-blade turbines, impellers and anchor stirrers are commonly used in dissolution processes. The lack of shear and mixing intensity in these devices often causes issues like floating powders, long cycle times and poor uniformity. Vigorous agitation leads to better contact between the solid and liquid phases but even when processed using high speed mixers like saw-tooth dispersers and conventional rotor/stators, certain solids still take a long time to dissolve completely, especially those that are prone to forming lumps or “fish eyes”.

Large-scale dissolution challenges

On a laboratory scale, solutions are readily prepared using simple agitators because solids can be added in small increments or at a very slow rate. Temperature is easily controlled and mixing time is not usually a critical variable.
Solutions prepared in large-scale are understandably more challenging. Operators climb up mezzanines carrying heavy bags of powder. Dry ingredients can only be added as quickly as the liquid will absorb them. Bulk loading could otherwise lead to floating powders and formation of large dry lumps which take even longer to dissolve. There is also the issue of dusting when handling lightweight powders which easily become airborne when poured or scooped into the mix vessel.

Sub-surface solids injection – a fast solution

For demanding dissolution requirements, consider the Solids/Liquid Injection Manifold (SLIM) Technology available on batch and inline Ross High Shear Mixers. It is a novel method for delivering solids below the surface of the liquid and right where vigorous mixing takes place. A ported rotor and stator specially designed to generate a powerful vacuum draws powders directly into the high shear zone of the mix chamber. Solids are prevented from floating on the liquid surface. Wet-out is virtually instantaneous: although the powders, pellets or granules are injected at a fast rate, it does not lead to lump formation unlike when dry ingredients are bulk loaded from the top of the batch.

Improved operator convenience and safety

Operation of a SLIM system is simple and straightforward – just turn on the mixer and start inducting powders. Solids may be fed manually or metered automatically into a hopper that sits directly on top of the mixer. The inline SLIM mixer is usually installed at floor level so operators no longer have to climb up mezzanines carrying heavy bags of powder. Alternatively, a “hose & wand” attachment may be used for dipping into bulk bags or containers to conveniently induct lightweight powders without creating a dusty environment.

How the SLIM technology works

The above illustration shows how an inline SLIM mixer works. The liquid stream (1) enters the mixer and immediately encounters the powder addition. Drawn into the mixer by a powerful vacuum, the powder (2) is injected through the ported rotor directly into the high shear zone. The resulting dispersion (3) is expelled centrifugally through the stator openings at high velocity.

For more information on the SLIM:

Click here to see a SLIM mixer in action.

Or visit the website: http://www.highshearmixers.com/slim-models.html

Sample SLIM Application: Sodium Carbonate Solutions

At a chemical facility, an inline SLIM Mixer recirculates soda ash solution through a 40-gallon vessel. While sodium carbonate powders are continuously fed to the SLIM hopper, liquids are being metered into the vessel and the mixture – a 20% solution – is constantly being drawn off. This highly-efficient system replaced a previous batch process where a layer of solids would collect at the tank bottom and remain undissolved for very long periods despite agitation.