RECOMMENDED MIXING EQUIPMENT FOR
Textile Emulsions

APPLICATION SUMMARY:

In textile processing, specially formulated emulsions impart various characteristics to fabrics such as water repellency, softness, improved sewability and wrinkle recovery as well as resistance to staining, tearing and shrinkage.

This bulletin describes two high shear mixing technologies utilized in the production of textile emulsions. Mixer selection is based on a number of factors including shear level, order of raw material addition and processing mode (batch or inline).

High Shear Mixers

Producers of textile chemicals rely on a range of high speed mixers to accomplish emulsification and fine solids dispersion. For instance, in the manufacture of textile emulsions, rotor/stator style High Shear Mixers are commonly used. Available in both batch and inline designs, these mixers are comprised of a rotor that turns up to around 3,000 to 4,000 ft/min within a stationary stator. As the blades rotate, product is continuously drawn into one end of the mixing head and expelled radially at high velocity through the openings of the stator. The differential speed and close tolerance between the rotor and stator generate high levels of hydraulic shear, producing uniform droplets with a tight mono-modal distribution.

A sample procedure is to charge melted wax, oil and surfactant into the vessel and thoroughly blend these liquid components. Mixer speed is then ramped up and hot water is slowly added as the emulsion thickens up and eventually inverts. The batch may be mixed for a few minutes after inversion until a homogenous consistency is observed. Any remaining water is then added to the batch, also at a controlled rate.

To ensure adequate flow, batch-style High Shear Mixers are sized according to the volume of the mix vessel, in addition to emulsion viscosity and density. On the other hand, inline rotor/stator mixers are typically installed within a recirculation loop and thus can service virtually any size tank. It is quite common for large gently-stirred vessels to incorporate an inline High Shear Mixer for recirculation. The greatest extent of droplet size reduction occurs within the first few passes. Past this stage of sharp decrease in droplet size, the emulsion hovers at an equilibrium state despite subsequent recirculation. It is useful to determine the point at which droplet size enters into equilibrium to avoid excessive temperature rise and possible over-processing.
Ultra-High Shear Mixers and Powder Injection Systems

Very fine emulsions may require agitation at greater shear levels to achieve stability. When conventional rotor/stator devices fall short in producing an acceptable equilibrium droplet size distribution, the next practical step is to evaluate an Ultra-High Shear Mixer. Several designs are available including the Ross X-Series (US Patent No. 5,632,596), a unique inline rotor/stator engineered to run at tip speeds over 11,000 ft/min. Product enters from the center of concentric rows of intermeshing teeth and moves outward through multiple channels. The extremely close tolerance between adjacent surfaces of the X-Series rotor and stator is adjustable for fine-tuning shear levels and flow rates.

In a typical production set-up, a batch mixer is used to combine the raw materials and the resulting rough emulsion is then pumped through the X-Series whose shear intensity may allow for reduced quantities of chemical emulsifiers. For many formulations, a single pass drives median droplet size to submicron levels. Simple to operate and maintain, the X-Series is a practical alternative to expensive colloid mills and high pressure homogenizers as it delivers high throughput emulsification at a fraction of the cost and time.

Emulsions containing pigments and other solids that require fine dispersion are ideal applications for Ross High Shear Mixers with SLIM (Solids/Liquid Injection Manifold) Technology. Powders such as titanium dioxide, kaolin clay, starch, silica and calcium carbonate are conveniently drawn into the liquid sub-surface and rapidly dispersed without creating a dusty environment. Simultaneous powder injection and high shear mixing is accomplished by the SLIM’s special rotor/stator without the use of pumps or eductors.

For more information on Ross Mixers

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