

TECHNOLOGY BRIEF:

Consider an ultra-high shear mixer for your single-pass emulsification requirements. Advantages include simple operation, high throughput rates, consistent product quality, easy cleaning procedure and low maintenance.

High Shear Mixing – Single pass emulsification



Ross X-Series Ultra-High Shear Mixer

Emulsification via high shear mixing

High shear rotor/stator mixers are commonly used in the production of emulsions. The conventional rotor/stator mixer achieves its high shear characteristics through the interaction between a rotor running at tip speeds in the range of 3,000 – 4,000 ft/minute and a fixed stator featuring vertical slots, round holes or a fine screen. The two phases of the emulsion, pre-combined or metered in separately, are drawn into the mix chamber and expelled at high velocity through the stator openings, an event that subjects the components to elevated levels of mechanical and hydraulic shear. Droplets of the dispersed phase are reduced in size with every pass through the rotor/stator assembly but with diminishing effects. In an ideal scenario, with the aid of chemical surfactants or emulsifiers, a single pass through the inline high shear mixer generates the droplet size distribution required for a stable emulsion.

Challenging emulsions

Every emulsion has a shear threshold in which the optimal droplet size and characteristics will develop. Insufficient shear produces droplets that are too large they coalesce rather quickly and eventually separate from the continuous phase. On the other hand, excessive shear can irreversibly damage the product.

Ross Inline Ultra-High Shear Mixers



X-Series *US Patent No. 5,632,596*

The X-Series head consists of concentric rows of intermeshing teeth. Product enters at the center and moves outward through channels in the rotor/stator teeth. The extremely close tolerance between adjacent surfaces of the rotor and stator is adjustable for fine-tuning shear levels and flow rates.



QuadSlot

The QuadSlot mixing head is a multi-stage rotor/stator with a fixed clearance. It imparts intense shear levels at high pumping rates and is the most cost-effective ultra-high shear rotor/stator design.



MegaShear *US Patent No. 6,241,472*

The MegaShear is the most aggressive rotor/stator in terms of shear and throughput. High velocity pumping vanes force the product into semi-cylindrical grooves where it splits into different streams and collide at high frequency before exiting the mix chamber.

Of course, apart from mixing intensity, several other factors affect emulsion stability such as the type and concentration of surfactant, order of addition, processing temperature, etc. But when dealing with challenging emulsions that conventional rotor/stator mixers cannot successfully produce within a single pass (or even after multiple recirculations), manufacturers are compelled to switch to more aggressive, higher energy devices such as colloid mills and high pressure homogenizers. The downside is that these are comparatively very expensive machines and commonly associated with a number of issues including low throughput, tendency to clog, time-consuming clean-up, and intensive maintenance.

Single-pass Ultra-High Shear Mixing

New developments in rotor/stator technology offer a number of practical alternatives to traditional emulsifying equipment. Inline Ultra-High Shear Mixers like the Ross X-Series, QuadSlot and MegaShear are capable of producing a wide range of very fine emulsions within a single-pass.

Equipped with special rotor/stator generators designed to run at tip speeds over 11,000 ft/min, Ultra-High Shear Mixers are high-throughput machines that are just as easy to operate and maintain as conventional rotor/stators mixers. The high tip speeds and complex, turbulent mixing patterns generated within the X-Series, QuadSlot and MegaShear rotor/stators enable them to impart extremely high levels of hydraulic and mechanical shear without sacrificing throughput and even allow manufacturers to potentially reduce surfactant levels, reaping significant savings in raw material costs. In many applications, Ultra-High Shear Mixers deliver comparable, if not better, droplet size results compared to colloid mills and high pressure homogenizers.

Ultra-High Shear Mixers are available in laboratory (3" diameter rotor) and production sizes (up to 15" diameter rotor). Certain models can accommodate all three interchangeable rotor/stators given the right horsepower motor. Sanitary models are also available for processing sensitive applications with provisions for CIP/SIP (cleaning and sterilization in place).

Some sample emulsions being processed in Ross Ultra-High Shear Mixers:

- Cosmetic creams and lotions
- Specialty coatings
- Adhesives
- Flavor emulsions
- Food supplements
- Agrichemicals
- Fuel emulsions
- Pharmaceutical emulsions
- Silicone emulsions
- Salad dressings
- Beverages
- Wax emulsions
- Chemical additives
- Latex and rubber emulsions

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