**TECHNOLOGY BRIEF:**

High shear rotor/stator mixers are ideal for many polymer dispersion and dissolution processes. Different configurations are available depending on the application requirements. These include batch and inline designs, multi-agitator systems for high viscosity formulations, and even special ultra-high shear rotor/stator geometries that deliver faster polymer disintegration and more intense mixing.

### Polymer grinding and disintegration

![Image of polymer grinding and disintegration](image)

**Polymer particle size reduction**

Mixing applications that demand thorough dispersion or quick dissolution of solid polymers almost always inherently require a mechanism for reducing the particle size of the resin material. The smaller the starting size of the polymer, the less shear and size reduction is required during the mixing step. For instance, powdered polymer grades will disperse and dissolve more rapidly compared to resin pellets or crumbs, but they are also typically more expensive. Heat is another factor that can accelerate solubilization however care must be taken not to exceed the temperature limit and degrade the polymer. In designing an efficient mixing system, one must take into account the variety of raw ingredients and feed forms that it can handle, shear level, viscosity range, cycle times, heating requirements, material and energy costs, etc.

**Rotor/stator mixers vs. open-blade mixers**

Rotor/stator mixers offer several advantages over open-blade mixers in the preparation of polymer dispersions and solutions. Conventional designs consist of a four-blade rotor running at tip speeds in the range of 3,000-4,000 ft/min within a close tolerance fixed stator. It generates mechanical and hydraulic shear by continuously drawing product components into the rotor and expelling them radially through the openings in the stator. The high shear conditions effectively break down the polymer into finer, smaller pieces which are then dispersed and/or dissolved in the surrounding solvent or oil more quickly.

*Continued on page 2*
Due to the differential speed and close tolerance between the rotor and stator, this mixer design delivers greater shear and faster polymer disintegration compared to devices with an open-blade geometry, even those that run at higher tip speeds. Saw-tooth disperser disc blades, for example, typically run up to 5,000 ft/min and generate a powerful vortex that draws bulk solids into the liquid phase. However, the level of dispersion achieved in this type of mixer is usually improved when a rotor/stator is utilized.

**Viscosity matters**

On its own, a batch rotor/stator mixer can handle viscosities from water-like to around 10,000-20,000 cP. Beyond this limit, it is utilized in a variety of multi-agitator configurations, the most common being a triple-shaft mixer design consisting of an anchor agitator, a saw-tooth disperser and the rotor/stator. This arrangement can process applications that are several hundred thousand cP.

Inline models of rotor/stator mixers are also available. Depending on the rotor/stator geometry, can handle viscosities up to 10,000-20,000 cP without external pumping assistance. With an auxiliary pump, an inline rotor/stator mixer can handle dispersions and solutions up to 200,000 cP.

**Ultra-high shear rotor/stators**

For more demanding applications, the use of ultra-high shear mixers in place of a conventional rotor/stator devices can dramatically accelerate cycle time and produce higher quality end product. The very high tip speeds and complex turbulent mixing patterns generated within the rotor/stator assembly of an ultra-high shear mixer enable it to quickly disintegrate and disperse pieces of polymer. Ross offers several different ultra-high shear mixer models, some of which run up to 11,000 ft/min. Testing is recommended to confirm which rotor/stator design is best suited for a specific application.

**Sample Application: Filter Membrane Material**

A developer of advanced water and wastewater filtration technologies is using their 40-gallon Ross VersaMix to prepare a special membrane material utilized in forward osmosis filters. The multistep process requires aggressive grinding of cellulose polymer, followed by continued dispersion and dissolution as numerous other ingredients are added to the casting solution. The mixing system's slow speed anchor agitator and high speed saw-tooth disperser compliments a rotor/stator mixer which does most of the work during the polymer disintegration stage. To learn more about this application, click [here](#) to view the full case history article.