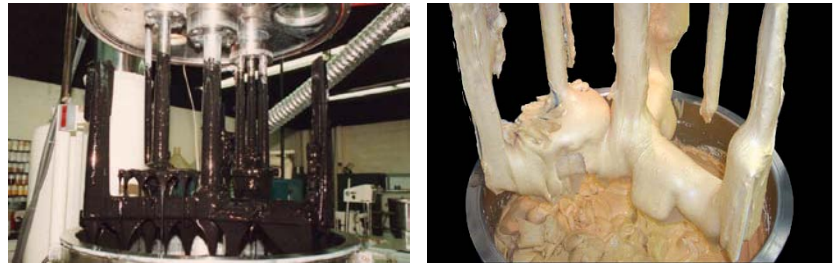


## TECHNOLOGY BRIEF:

Mixer selection for high solids formulations depends on viscosity rather than percent solids. Regardless of solids concentration, low-viscosity mixtures can be prepared in single-shaft rotor/stator mixers or high speed dispersers. For products that undergo a high viscosity phase, multi-agitator and planetary mixing equipment are commonly employed.

# Mixing high solids formulations



High solids formulations vary in viscosity. They can be in the form of a thin slurry, a pourable liquid (like some contact cements, left photo), a viscous gel, a thick paste (like certain adhesives, right photo) or a heavy dough-like mixture.

## Solids content vs. viscosity

While the term “high solids” is commonly used within different markets including adhesives, sealants, paints and coatings, there are no standards defining the minimum or average solids content of high solids formulations in general. “Solids” can refer to the non-volatile materials or the inorganic components of a mixture.

Depending on the chemistry of the raw materials, high solids compositions take on a wide range of viscosities. For example, solvents with good solvency and low-molecular weight polymers are used to obtain low viscosity and acceptable flow in sprayable high solids coatings. Even 100% solids hot melt adhesives can be almost water-like in viscosity during processing at appropriate temperatures. Conversely, a gel formulation containing only 5% solids can be unpourable and behave like a semi-solid.

Therefore, mixer selection is generally dictated by viscosity rather than percent solids. The starting viscosity of the solvent(s), the maximum viscosity reached by the mixture during processing and the final viscosity of the end product (if different from maximum viscosity) are all important considerations.

## Single-shaft mixers

Conventional single-shaft mixers such as propellers and turbines are capable of preparing high solids formulations in the low viscosity range; however cycle time could be prolonged due to low levels of shear input. To accelerate dispersion or dissolution of solids, high speed devices such as saw-tooth dispersers and rotor/stator mixers may be used instead.

## Mixers for High Solids Formulations

### Low to Medium Viscosity



High Speed Dispersers and Rotor/Stator Mixers

### Medium to High Viscosity



Multi-Shaft Mixers

### High Viscosity



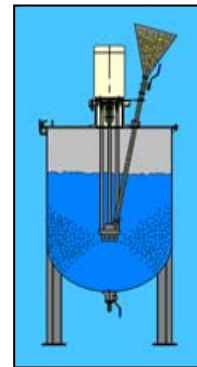
Double Planetary, Hybrid Planetary and Sigma Blade Mixers

For more information on Ross Mixers, visit [www.mixers.com](http://www.mixers.com).

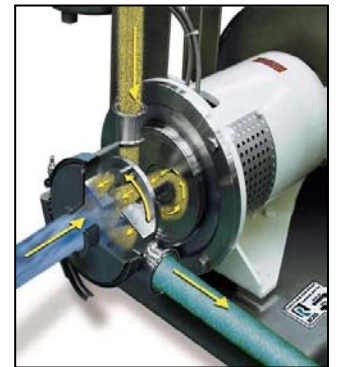
## High speed powder induction

Specially designed rotor/stator sets are capable of inducing a wide variety of solids, from fine powders to friable pellets. Available on Ross High Shear Mixers, this technology is called SLIM, short for Solids/Liquid Injection Manifold. A ported rotor generates an intense

vacuum which draws solids right into the high shear zone of the mix chamber, where they are dispersed instantly into the liquid. In the processing of low viscosity high solids formulations, the SLIM offers the convenience of fast and dust-less mixing. For optimal performance, liquid viscosity must remain below 20,000cP during powder induction. Sample applications include magnesium hydroxide slurries of up to 65% loading and titanium dioxide pigment dispersions containing 70% solids.



Batch SLIM



In-line (Continuous) SLIM

## Multi-agitator and planetary mixers

With moderate to high viscosity formulations, the disperser and/or rotor/stator mixer are used in combination with a low speed anchor agitator. The anchor agitator helps to exchange materials from different parts of the vessel, essentially "feeding" the high speed device(s) with product that would otherwise not flow towards it.

As viscosity rises, however, even a multi-shaft mixer arrangement will eventually fail to produce sufficient flow. The logical solution is to utilize agitators that move through the batch regardless of product flow. This is the forte of planetary mixers and sigma blade mixers (kneader extruders). In a planetary mixer, two or more blades rotate on their own axes as they orbit on a common axis. The agitators continually advance into the batch and contact fresh product all the time. Helical blades allow double planetary mixers to handle viscosities as high as 8 million cP.

### Sample Application: Soy-based Adhesive

Ross Dual-Shaft Mixers are being used at Columbia Forest Products for batching their soy-based wood adhesive formulation. Viscosity is over 200,000cP.

The dual-blade disperser provides plenty of shear to mix the soy flour (more than 30% loading) with water and other minor additions. The two-wing anchor promotes bulk flow and scrapes material from the bottom and sidewalls which aids in the mixing and discharging processes. The independently driven agitators enable the operator to fine-tune flow patterns and shear levels.

