Mixing, Blending and Dispersion Equipment for Food Applications

An Online Training Tool From ROSS
Webinar Overview

- **Dry Blending**
  - Ribbon Blenders
  - Vertical Blenders
  - Tumble Blenders

- **High Speed Mixing**
  - High Speed Dispersers
  - Rotor/Stator Mixers

- **High Viscosity Batch Mixing**
  - Multi-Shaft Mixers
  - Planetary Mixers
DRY BLENDING

Ribbon Blender
DRY BLENDING

Ribbon Blender Design

- U-shaped trough
- Horizontal shaft
- Inner and outer helical ribbons
- Axial and radial flow
- Tip speed: ~300 fpm
- Center or end discharge
Many sizes available: 1/2-cu.ft. to 1,000-cu.ft.
DRY BLENDING

Ribbon Blender Features

- FDA-compliant cover gasket
- Spray bar
- Discharge extruder assembly
DRY BLENDING

Ribbon Blender Features

Safety grating

Sight/charge port

Controls

Caster wheels
DRY BLENDING

Ribbon Blender Features

All stainless steel construction

Pneumatically-actuated discharge valve

Load cells
DRY BLENDING

Ribbon Blender Features

- Paddle agitator
- Compact gearmotor design
- Heating/cooling jacket
- Vacuum design
DRY BLENDING

Just a few Ribbon Blender applications:

- Breads, cereals, cakes and muffins (dry mixes and batter)
- Trail mixes, dried fruits, snack foods
- Spices, seasonings, flavors, sugar
- Coffee beans, instant coffee
- Tea leaves, herbs, iced tea blends
- Food and beverage additives
- Drink mixes
DRY BLENDING

Vertical (Cone Screw) Blender
DRY BLENDING

Vertical Blender Design

- Conical vessel
- Auger screw
- Gentle agitation
- Flexible batch size
- Complete discharge
DRY BLENDING

Vertical Blender Features

- Dual-post lift
- Lump breaker
- Fully top-supported screw
- Absence of bottom support bearing
- Vacuum construction
- Heating/cooling jacket
Drying and roasting requirements
Fragile solid blends
Vitamin supplements
Food & beverage additives
Nutritional bars and snacks
Vegetable blends
Flavor extraction
Soups
DRY BLENDING

Tumble Blender
DRY BLENDING

Tumble Blender Design

- V-shaped or double cone vessel
- Vessel is partially loaded with product and rotated
- 5 – 25 revolutions per minute
- Low impact blending
- Complete discharge
DRY BLENDING

Tumble Blender Features

Controls

Safety railings

High Speed Intensifier bar
DRY BLENDING

Just a few Tumble Blender applications:

- Free-flowing solids such as spices, seasonings, flavors, additives
- Coffee, milk, cocoa, powdered drink mixes
- Food supplements
- Friable solid blends
- Recipes with trace ingredients
HIGH SPEED MIXING

Saw-tooth Disperser  Rotor/Stator Mixer
HIGH SPEED MIXING

High Speed Disperser

- Saw-tooth disc blade
- Tip speed: 5,000 feet/min
- Simple tool for powder wet-out
- Viscosity range:
  Water-like up to ~50,000 cP
- 1 HP for every 10 gallons
HIGH SPEED MIXING

High Shear Mixer

- Four-blade rotor
- Different style stators
- Close tolerances
- Tip speed: 3,000 - 4,000 feet/min
- Viscosity range:
  - Water-like up to ~10,000 cP
- Batch and inline
SOLIDS DISPERSION

Just a few High Speed Disperser and High Shear Mixer applications:

- Food color dispersions
- Purees, salsas
- Flavor concentrates
- Food and beverage emulsions
- Marinades, sauces, broths
- Dressings and spreads
- Candy coatings
- Beverages
# High Speed Mixing

## Design Comparison

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Possible mixing issues:

- Dusting
- Floating powders
- “Fish eyes” or agglomeration
- Long cycle times
- Inefficient use of raw materials
- Inadequate dispersion
- Unsatisfactory product quality
SOLIDS DISPERSION

Opportunities:

- Reduce cycle times.
- Make full use of raw materials / generate less waste.
- Eliminate floating powders, lumps, fish eyes and dusting.
- Obtain higher quality finished products...consistently.
- Improve operator safety.
- Streamline the mixing process.
SOLIDS DISPERSION

Ross Solids/Liquid Injection Manifold (SLIM) Technology

BATCH

INLINE
**SOLIDS DISPERSION**

**Batch SLIM**

- Used with fixed or portable tanks.

- Powders are manually fed via a hopper, drawn through a hose or delivered by an automatic feeding device.

- Ideal for batches over ~500 gallons (by itself).

Larger capacities are possible when batch SLIM mixer is used in combination with other agitators.
SOLIDS DISPERSION

Batch SLIM
SOLIDS DISPERSION

Inline SLIM

• Portable for use with single or multiple tanks.

• Powders are manually fed via a hopper, drawn through a hose or delivered by an automatic feeding device.

• Ideal for recirculation tanks with capacities up to several thousand gallons

• Induction rates up to several hundred lbs/min.
SOLIDS DISPERSION

**Inline SLIM**

- Suitable for virtually any size tank.

- Not self-priming. Typically, mixer is located on ground level and is as close to the outlet of the tank as possible. Discharge tubing is kept to the minimum possible length.

- Can be used to pump finished mixture to downstream equipment or process.

- Easy to clean in place.
SOLIDS DISPERSION

Inline SLIM
SOLIDS DISPERSION

Methods of Feeding Powders through the SLIM

Hose & Wand Attachment

Hopper Attachment
SOLIDS DISPERSION

Common powders injected through the SLIM:

- Alginates
- Calcium carbonate
- Carrageenan
- Carboxymethylcellulose (CMC)
- Citric acid
- Granulated sugar
- Guar
- Gum Arabic
- Milk
- Potassium sorbate
- Pectin
- Starch
- Vanilla powder
- Whey
- Xanthan gum
- Yeast
SOLIDS DISPERSION

Just a few SLIM applications:

- Flavorings
- Gum dispersions
- Thickened solutions
- Food emulsions
- Syrups and pastry fillings
- Dressings and condiments
- Beverages
- Ready-to-drink supplements
EMULSIFICATION & PARTICLE SIZE REDUCTION

High Shear Mixer
EMULSIFICATION & PARTICLE SIZE REDUCTION

Ross Ultra-High Shear Mixers

PreMax with Delta Rotor/Stator

Series 700 Mixers with X-Series, QuadSlot and MegaShear Rotor/Stators
EMULSIFICATION & PARTICLE SIZE REDUCTION

PreMax

- Delta rotor/stator (US Patent No. 6,000,840)
- Tip speed: 5,000 feet/min
- Viscosity range:
  - Water-like up to ~50,000 cP
- Batch
EMULSIFICATION & PARTICLE SIZE REDUCTION

PreMax

- Double vortex
EMULSIFICATION & PARTICLE SIZE REDUCTION

GEL EMULSION TEST

Viscosity: ~15,000 cP at 12 rpm

Droplet Size

PreMax

Conventional Rotor/Stator

Mixing Time, minutes
EMULSIFICATION & PARTICLE SIZE REDUCTION

Series 700

- Three rotor/stators:
  - X-Series
  - QuadSlot
  - MegaShear
- Tip speed: over 11,000 feet/min
- Viscosity range:
  - Water-like up to ~10,000 cP
- Can handle higher viscosities with pumping assistance.
EMULSIFICATION & PARTICLE SIZE REDUCTION

Series 700 Mixers

X-Series (US Patent No. 5,632,596)

- Consists of concentric rows of intermeshing teeth.
- Product enters through the center of the stator and moves outward through radial channels in the rotor/stator teeth.
- Gap between adjacent surfaces of the rotor and stator is adjustable for fine-tuning shear levels and flow rates.
EMULSIFICATION & PARTICLE SIZE REDUCTION

Series 700 Mixers

QuadSlot

- Four-stage rotor/stator
- Fixed clearance
- Produces high shear energy and high pumping rates
EMULSIFICATION & PARTICLE SIZE REDUCTION

Series 700 Mixers

MegaShear

• Capable of producing very high peak shear and throughput levels.

• Consists of high velocity pumping vanes and parallel semi-cylindrical grooves in the rotor and stator.

• Different streams are induced within the grooves, colliding at high frequency before exiting the mix chamber.
EMULSIFICATION & PARTICLE SIZE REDUCTION

Series 700 Mixers

Laboratory Model

Production Models
EMULSIFICATION & PARTICLE SIZE REDUCTION

Series 700

OIL-IN-WATER EMULSION TEST

Droplet Size $D_{(V,0.9)}$, microns

Number of Passes

- Conventional High Shear Mixer with Slotted Stator and Four-blade Rotor
- Ultra-High Shear Mixer
EMULSIFICATION & PARTICLE SIZE REDUCTION

Just a few Ultra-High Shear Mixer applications:

- Flavor emulsions
- Dressings
- Condiments
- Sauces
- Desserts
- Juice concentrates
- Beverages
HIGH VISCOSITY MIXING

MULTI-SHAFT MIXER

- High Shear Mixer
- High Speed Disperser
- Anchor Agitator
HIGH VISCOSITY MIXING

MULTI-SHAFT MIXER

- Dual-shaft or triple-shaft configuration
- Viscosity range: up to ~1 million cP
- Superior heat transfer
HIGH VISCOSITY MIXING

Just a few Multi-Shaft Mixer applications:

- Sauces and flavorings
- Liquid dietary supplements
- Beverages
- Candies and syrups
- Starch pastes
- Soup bases
- Peanut butter, hummus
  and other spreads
HIGH VISCOSITY MIXING

DOUBLE PLANETARY MIXER

- Two Identical stirrers:
  - Rectangular blades
  - High Viscosity “HV” blades
    (US Patent No. 6,652,137)

- Viscosity range: up to ~6 million cP
HIGH VISCOSITY MIXING

DOUBLE PLANETARY MIXERS

High Viscosity “HV” Blades

Rectangular Blades
HIGH VISCOSITY MIXING

DOUBLE PLANETARY MIXERS
HIGH VISCOSITY MIXING

Just a few Double Planetary Mixer applications:

- Food gels
- Doughs
- Cheese tortas
- Capsule wall materials
- Candies
- Gum bases
- Cake icings and frostings
- Sauces
HIGH VISCOSITY MIXING

PLANETARY DISPERSER

- High Speed Disperser
- Planetary Stirrer
- Viscosity range: up to ~2.5 million cP

POWERMIX (US Patent No. 4,697,929)
HIGH VISCOSITY MIXING

PLANETARY DISPERSER

- Agitators contact fresh product all the time
- Precise control of shear
- Uniform heat distribution

POWERMIX (US Patent No. 4,697,929)
HIGH VISCOSITY MIXING

PLANETARY DISPERSERS
HIGH VISCOSITY MIXING

Just a few Planetary Disperser applications:

- Cheese spreads
- Sausage casings
- Mashed potato mixes
- Chocolate and fruit fillings
- Viscous pastes, candies
  and syrups
MIXER SELECTION TIPS

- Different styles of mixers and blenders often have overlapping functions and applications.

- Determine:
  - Working volume
  - Viscosity
  - Shear level
  - Available footprint and space
  - Discharge requirements
  - Friability / shear-sensitivity
  - Vacuum
  - Heating/cooling
  - Cleanability
  - Economics

- Choose scalable mixing equipment.

- Run a mixing trial.
Evaluate a Ross Mixer for your process.

Visit our Test & Development Center located in our Hauppauge, NY facility.

Trial/rental units from our multi-million dollar inventory of new and reconditioned equipment are available for testing in your plant.
For additional information on

Ross Mixing, Blending and Dispersion Equipment

e-mail us at sales@mixers.com
visit our website www.mixers.com

or call us

Phone: 1-631-234-0500
Toll Free Number: 1-800-243-ROSS