# Improvements To The Mixing Step Can Lead To Big Rewards

**There are many ways that you can lessen the mess and reduce health hazards in your mixing environment.**

BY CHRISTINE ANGOS-BANASZEK

Mixing is one of the most ubiquitous unit operations in the processing world. Often, improvements specific to the mixing step lead to overall big rewards that translate well in the balance sheet. The usual challenges include maintaining batch-to-batch uniformity and optimizing blend times, but they also could be as simple as improving cleanliness — which is equally important.

Below are some ways to lessen the mess and reduce health hazards in your mixing environment, categorized by applications.

### Dry Blending And Drying Applications

In a ribbon, paddle, or vertical screw blender operation, sealing arrangements are key to keeping clean. The blender doesn't necessarily have to be vacuum-rated, just dust-tight. Covers with neoprene or silicone gaskets, clamps, vent ports with dust socks, dust-tight discharge valves, and material handling systems installed right at the blender's discharge assembly all contribute to eliminating fugitive dust issues. In addition, auxiliary dust collection systems and solvent recovery systems (for drying operations) may be used in conjunction with blending equipment.

Hydraulically or pneumatically operated lids are a common option in many horizontal blenders. They can be designed to support a full pallet of raw materials and may be installed with quick-release charging ports that can be oriented to different angles and adjusted to accept ingredients from drums, bags, or other containers.

Inside the blender, areas that present cleaning problems are stuffing boxes, corners, and discharge arrangements. Surfaces of the trough interiors and the agitator should be polished to help eliminate material sticking, buildup, and product contamination. If powders are not particularly easy flowing, special ribbon or paddle agitator designs with scrapers and a generous radius can prevent product from stagnating in the trough corners.

A split housing stuffing box is easily disassembled for cleaning and repacking. Typical packing is braided and Teflon-impregnated. For more demanding applications, there are sanitary stuffing box designs incorporating solid sealing rings and hand knobs that allow for quick disassembly. Consider an upgrade when blending abrasive materials or when contamination is a critical concern. For these cases, air or liquid-purged seals are available. Air or liquid enters the seal through a lantern ring and provides positive pressure to prevent the intrusion of contaminants that might threaten the shaft and seal integrity. For materials susceptible to oxidation, nitrogen is used.

Ross Inline High Shear Mixer with Solids/Liquids Injection Manifold (SLIM) System, shown here with a hopper attachment. The inline SLIM system can easily be disconnected and rolled over to service multiple mix vessels.

Dead spots at the trough bottom can collect stagnant material. Certain valve types can be installed with a tighter ribbon-tip-to-trough-bottom clearance and minimize the dead spot (in the case of a spherical valve) or even eliminate it (as with a flush plug valve), making between-batch cleaning faster and easier.

Horizontal ribbon or paddle blenders also can be custom-designed to feature a removable agitator that is easily and quickly detached without moving any of the drive components, saving hours of changeover and cleaning time with every batch.

In this design, the blender's agitator can be taken out of the trough in between batches, so it's extremely easy to

clean. For operations that can tolerate very low levels of contamination, a removable agitator is a very useful feature to have.

### Low-Viscosity Applications

The Ross Solids/Liquids Injection Manifold (SLIM), available in both batch and inline high shear mixers, eliminates the need to dump solids directly into an open batch vessel and virtually prevents dusting. This has led to a significant reduction in the volume of airborne particles in plants that have switched to the SLIM.

This improved method of introducing powders (using vacuum) into a liquid batch makes for a cleaner mixing environment, decreases cycle time, produces homogenous and well-dispersed finished products, and prevents shut downs associated with clogged eductor systems. The SLIM does not use an eductor to create the suction, thereby making the inline system more tolerant of flow and viscosity changes.

For emulsification processes or particle-size reduction operations, go for low-maintenance alternatives. Orifices of high-pressure homogenizers and colloid mills often clog, and mechanical seals fail too frequently. During crossovers of different batches, the cleanup procedure is labor-intensive. These types of equipment also are expensive up front and in operation.

Ross Ultra-High Shear Mixers can produce submicron emulsions and dispersions faster than any other rotor/stator mixer and far more efficiently than a high-pressure homogenizer or a colloid mill. Throughput rates of a similarly powered X Series or MegaShear ultra-high shear mixer design are much greater than high-pressure homogenizers or colloid mills.

### Medium-Viscosity Applications

A semi-continuous process is beneficial to maintaining a clean and streamlined batch mixing operation without compromising the level of control over discrete units of production. The semi-continuous mixing procedure is achieved by utilizing a change-can design mixer. With multiple vessels, one mix could be at the loading stage, another under the mixer, another at the discharge step, and yet another at the cleanup stage. The change-can design is available for most mixing systems up to 750 gallon capacities or larger.

Scraping the inner surfaces of a process vessel will improve product homogeneity by removing materials from the walls and bottom and incorporating them into the bulk of the batch. It is common practice to include wall and bottom-scraping devices in the interest of improving heat transfer across the wall of a jacketed vessel, thereby avoiding "burn-off" and having to painstakingly remove cooked or charred debris from the vessel wall.

### High-Viscosity Applications

A recent innovation has stirred up a lot of excitement in many industries that rely on high-viscosity mixers. A double planetary mixer equipped with the new patented High Viscosity (HV) Blades can replace a double-arm kneader in many applications, cut operating costs substantially, increase production, and make cleanup a breeze.

The patented High Viscosity (HV) Blades are very effective at keeping product down and accelerating powder wet-out because materials do not get a chance to climb up the blades or into the gearbox area. The blades also can be lifted cleanly off a batch, and a quick wipe down usually is enough to start the next batch.

A double-arm mixer commands about three times the price of a double planetary mixer, requires more space on the plant floor, and introduces many potential problems with shaft seals, stuffing boxes, and packing glands submerged in the product zone. The double-arm unit generally operates with more horsepower and consumes more energy than a double planetary mixer. Because of its horizontal orientation, it also cannot be supported with a set of interchangeable mix vessels, an option that often elevates double planetary mixing to a semi-continuous process.

What are the implications of using HV planetary blades with respect to clean mixing? The HV blade is fundamentally different than any other planetary blade. With the down-thrust action generated by its helical geometry, along with the absence of a lower crossbar, the HV blade is capable of handling materials at viscosities far beyond the capabilities of conventional double planetary blades and is very effective at keeping product down in the mix zone where it belongs.

The HV blade is sloped in a precisely angled, helical contour. This sweeping curve firmly pushes the batch material forward *and downward*. This unique mixing action solves the 'climbing' problem commonly experienced when processing highly filled materials.

Other clean mixer designs include the installation of dust shields or liquid seals in the gearbox area. A dust shield prevents product dust and splash from getting up into the gearbox. It therefore protects against cross-contamination and makes cleaning easier. A liquid seal, on the other hand, is a barrier that protects the gearbox drive assembly from all product contact — dusts, splashes, and even aggressive solvent vapors. Lip seals also may be provided on stirrer shafts with the appropriate elastomers. Mechanical seals are recommended when mixing aggressive solvents and for pressurized mixing systems.

The challenge with processing viscous applications does not end with mixing. The discharge step sometimes becomes a process bottleneck, although it doesn't have to be. Use of a platen-style hydraulic discharge system with a change-can design mixer improves speed, efficiency, and cleanliness of the discharge operation.

With the mix can positioned beneath the discharge system, a stainless steel platen is lowered hydraulically into the vessel. Because of the tight-machined clearance between the platen (fitted with an O-ring) and the vessel, the majority of the mix can walls are virtually wiped clean. Product is forced out through a valve in the side or bottom of the vessel or through the top of the platen. For the discharging of thermoplastic materials, the platen may be jacketed for heating.

A discharge system eliminates wasted hours of scraping heavy or sticky materials from a mix vessel. With push-button simplicity, the system automatically can discharge several hundred gallon batches in minutes — into bulk containers, filling or packaging equipment, an extruder, or downstream milling equipment. Change cans from multiple mixers can be rolled to the discharge system for fast discharge, then rolled away for cleaning as the next mix can is positioned for discharge. This flexibility can boost production on several process lines, all working with a single discharge system.

A discharge system improves plant safety because it lowers the risk of injury while scraping heavy materials from the mix vessel. It also reduces the operators' exposure to a hazardous batch and helps minimize the release of vapors into the plant atmosphere.

Laboratory discharge systems are available in sizes from one quart to four gallons. Mix cans are available with either a flush bottom ball valve or a cove cut plug for direct filling into cartridges or syringes. Other adapters can be custom-made for you. Production-capacity discharge systems are available for 10- to 1,000-gallon internally machined mix vessels.

### Conclusion

While clean mixing can be its own reward, you are likely to gain a whole lot more while trying to achieve it. It's one quest that does not lack for pleasant surprises. ■

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