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CHEMICAL PROCESSING

- Mind mixer mechanical design*
- Outsourcing moves up the maintenance ladder*
- Draw insights on distillation*
- Meet SIS "user approval" mandates*
- Ribbon blender boosts powder production*

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Ribbon blender ups production of powders

New mixing process increases annual capacity by almost 900%

By Charlie Divine, Munson Machinery Company, Inc.

DENTAL LABORATORY NEEDS ARE A SPECIALTY of Diversified Chemical Products, Inc. (DCP), Wilmington, Del. Its business includes products for fabricating dental prostheses, cleaning dental instruments, and dissolving dental cement, in addition to other custom powders for dental laboratories, jewelry cleaning, and industrial applications. Since 1974 the company has worked closely with customers, developing products that meet a particular need, manufacturing those products on a private-label or contract basis, and packaging them in the most convenient form for the end user.

For one of its clients, DCP's development team helped enhance the properties of an enzymatic cleaner for dental instruments. The client wanted a cleaner capable of dissolving dental cement in addition to biological waste such as blood and mucous. "It was a unique mixture that fit a nice niche for one of our customers, and it grew into a rather large product for

us," says Jim Longo, Jr., president of DCP. The innovation was so successful that orders quickly exceeded the capacity of the plant's two 35-gal (133-liter) planetary mixers. An expansion of plant capacity was desperately needed to avoid losing business.



>> New mixing system

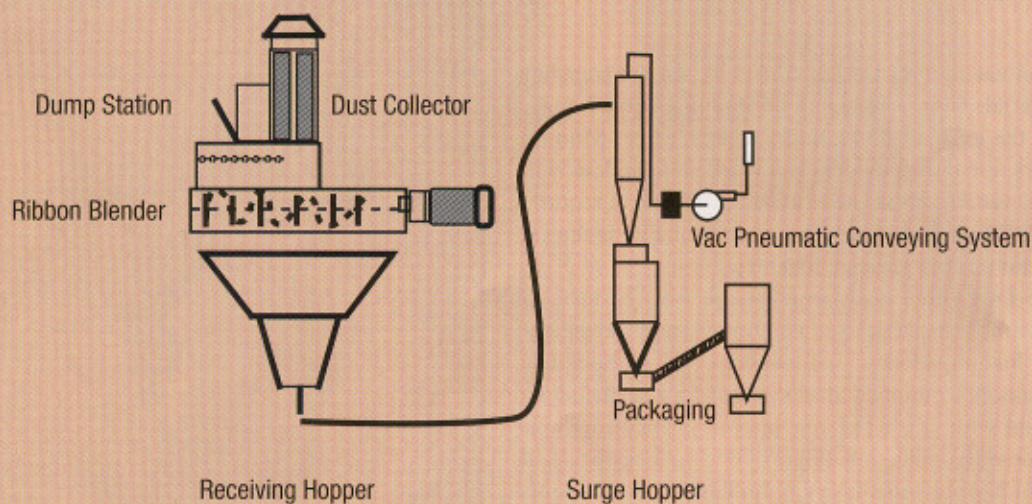


Figure 1. Ribbon blender offers easier cleaning and more versatility than planetary mixer previously used.

>> Internals of ribbon blender



Figure 2. Blades of mixer move in opposite directions, promoting solid blending.

Complete system solution

The solution is an integrated system to load, mix, and convey the enzymatic cleaner. A Munson ribbon blender incorporates a bag dump station, a receiving hopper, and a pneumatic conveying system (Figure 1). The system was installed in July 2002. All internal finishes meet a 2B FDA requirement; welds were polished with a 120 grit wheel. The construction material is Type 316 stainless steel. Figure 2 shows the internals of the ribbon mixer.

“Labor hours have been cut by over 60%, excluding hours spent for rework.”

A K-tron vacuum pneumatic conveying system transfers the materials from a receiving hopper to a surge hopper feeding the existing filling and packaging line. Munson engineers tested the powders and worked in tandem with the other vendors to assure satisfying all levels of requirements. DCP worked with Jerry Spross of EPI Technical Sales, who put the package together.

Since DCP often deals with powders in the form of low-micron dust particles, dust containment during the manual loading process was essential. The integral bag dump station is mounted atop the blender and includes a dust hood with two PTFE one-micron pleated cartridge filters for dust collection (Figure 3). The bags are laid on top of a grate and slit open, discharging the contents directly into the blender. A hinged, gasketed cover on one side opens to add minor ingredients, which are pre-weighed, or sometimes pre-mixed with small mixers, and

added with buckets. Additional improvements were considered but limited by budgetary constraints.

Blended powder discharges into a transfer hopper that feeds a pneumatic conveying system taking the product to a surge hopper and on to a semi-automatic auger filler. Less free-flowing material is loaded into drums and transferred via handheld pneumatic wand to a fully automatic vertical form-fill-and-seal bagging machine.

Why ribbon blending?

After testing, Munson custom-designed the 52-ft³ (1.5-m³) ribbon blender for process requirements. The ribbon was the most economical mixer able to meet the DCP's dual objectives of efficiently blending a variety of ingredients with dissimilar properties, including both low-micron-size ingredients and minor ingredients in small amounts, and also handling a range of batch sizes. Ingredients include free-flowing granules, and powders that compact or cake. The ribbon blender provides sufficient shear for non-free flowing materials as well as moderately lumpy materials and can handle friable, shear-sensitive materials.

Ribbon blenders can efficiently mix components in batches smaller than rated capacity, although blending time increases as batch size decreases. For example, at 40% batch capacity, a typical blend can require as much as twice the blend time, compared to full capacity, to effectively disperse minor ingredients such as dyes and enzymes. The mixer was designed to fit DCP's typical batch size of 2,000 lbs. (907 kg); through experimentation, Longo has evaluated the turn-down of the mixing system. DCP has been successful mixing batches from 800 lbs. to 2,200 lbs. (360 kg to 1,000 kg).

>> Addition station



Figure 3. Solids are fed to the mixer with hood cover and exhaust fan for containment.

The counter-flow agitation in the blender mixes materials rapidly and completely, and is particularly efficient at blending ingredients of widely varying quantities, densities, and particle sizes, a good fit for DCP's requirements. Most products require colors, dyes, or fragrances in very small amounts, as small as 1 to 2 lb. (0.45-0.9 kg) in a 2,000-lb. (900-kg) batch. The ribbon blender efficiently disperses these minor ingredients, according to Longo, producing a homogeneous product in five to 15 minutes, depending on batch size. A five-to-10 minute batch would be a free-flowing material batch, ranging from 75% to 100% of the batch capacity with little or no liquid addition. A 15-minute mix time would be for a batch at less than 50% capacity for a non-free flowing material, with, or without, liquid addition.

This is a substantial improvement compared to the old 35-gallon planetary mixers. A typical batch size with the old mixer was 150 to 200 lb., depending on product density.

Uniform blending is a consequence of the mixer's design and fabrication. A pilot study was completed at Munson's laboratory to validate the new ribbon blender design. The U-shaped vessel is constructed with large-radius fillet welds, ground smooth inside the body to eliminate rough spots that might trap material and prevent complete blending. An exceptionally small clearance, 1/8-in. or 3 mm, between blade and shell, further enhances complete mixing, with no dead spots, pockets, or corners.

The ribbon blade element consists of a central shaft that rotates two spiral or helical ribbons, inner and outer, with reversed pitches that force material in opposing

directions (Figure 2). For optimum results, the blade's geometry is customized for specific feed properties, making testing critical to the engineering process. The agitator element is easy to remove, designed in an assembly that may be lifted out if necessary for cleaning or maintenance, although ribbon blenders are well known as tough designs that rarely need maintenance.

Since many of DCP's products involve addition of liquids, the blender is equipped with an internal spray line. Ribbon blenders are well-suited to adding liquid ingredients to powders, and will not plug up with damp or pasty mixtures. A paddle-type, lever-operated gate opens wide for complete discharge of blends, whether free-flowing, or damp, and leaves little or no residue to contaminate subsequent batches. This is important because of cleaning requirements.

DCP must meet the standards for Good Manufacturing Practices (GMP), i.e., 21 CFR Parts 110, 210, 211, and 820, which means that the blender must be amenable to cleaning. To clean the system, the ribbon is left in place while the safety grating, bag dump baffle and PTFE cartridge filters are removed; these are cleaned in a wash-out/drying station. The blender is simply washed with pressurized tap (sanitary) water and allowed to dry. Rarely is scrubbing required. When it is, DCP follows a lock-out, tag-out procedure. During cleaning, all outer surfaces are wiped down thoroughly and equipment is reassembled, tagged out, and made ready for the next product blend.

Success story

The success of the new blender has caught on. Since its installation, the blender's use has been extended beyond the enzymatic cleaner. It is now used to mix 10 different products (Figure 4). "The ribbon blender has worked out very well for us," concludes Longo. "It has enabled us to garner some larger business accounts that we weren't able to handle previously." Prior to the installation, DCP was processing approximately 35,000 to 40,000 lbs. of product annually. The addition has now enabled the firm to process approximately 400,000 lbs. of product annually. This is almost a 900% increase! This capital expenditure has reduced the workload of a typical order from 52 batches in the old planetary mixers to 5 batches in the ribbon blender. Labor hours have been cut by over 60%, excluding hours spent for rework. Product homogeneity has been substantially increased. **CP**

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>> Complete mixing and packaging system



Figure 4. Use now has been extended to 10 different products.