Engineering solution

Rolling vibrators deliver good vibrations to rotary drum mixers

A custom-designed rolling vibrator aids discharge of challenging material from horizontal rotary drum mixers.

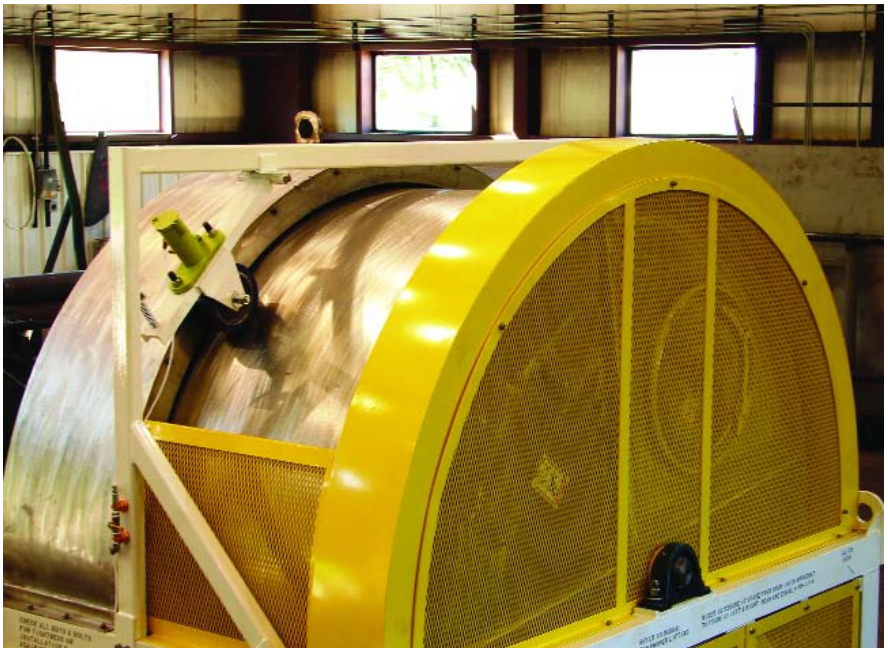
Continental Products Corp., Milwaukee, designs and manufactures horizontal rotary drum mixers (called Rollo-Mixers) for particle mixing, accurate distributive mixing, and liquid addition to powders or granules. The mixers, which are virtually self-cleaning, provide homogeneous blending, gentle and uniform mixing, and quick cycle times. In the past, customers with challenging products experienced problems discharging sticky materials that built up on the mixing drum interior, leading to long cleanout times between production runs and excessive product waste. To solve this problem, the mixer supplier worked with a vibrator supplier to custom-design a rolling vibrator that helps release material clinging to the drum.

The rotary drum mixer

The horizontal rotary drum mixer's stainless steel rotating drum assembly (or batch vessel) with internal mixing flights is mounted on a rotating shaft supported at each end by a pillow-block bearing mounted on a steel frame. An electric drive motor connected to a speed reducer, which is linked to a drive chain around the drum assembly's rear head, rotates the drum assembly at the required rpm. The mixer can have a spray system to direct liquid ingredients onto the material. As the drum assembly rotates, the mixer's unique turbine section creates a free-falling curtain of material that exposes each particle's surface area and allows for the uniform dispersion of liquid ingredients.

Problems with discharging a sticky material

About 3 years ago, a company that produces various polymer-coated fertilizers was experiencing problems discharging material from the mixer. After loading the fertilizer into the mixer and starting it, an operator activated the mixer's spray system that applies multiple microfilm layers of a two-part polymer onto the fertilizer particles to create slow-release fertilizers for use on golf courses, lawns, and gardens. The fertilizer particles are initially tacky after the polymer is sprayed



The rolling vibrator's rubber wheel doesn't wear because it rotates with the mixing drum.

onto them. After the polymer cures, the fertilizer particles become free-flowing again. However, during the curing time, some of the particles naturally stick to the drum's interior and build up over time as the company produces multiple batches of the same product.

When the company switched to another product, an operator had to manually clean out the mixing drum between product runs. To do this, the operator had to scrape the product off of the interior flights and walls. This wasted manpower and time and also added to product waste since the company couldn't use the product cleaned from the drum.

The mixer supplier's engineers decided that a piston-style vibrator mounted on top of the mixer's rotating drum assembly would prevent these problems. The vibrator would produce enough vibration by continuously impacting the rotating drum's exterior to release the fertilizer particles.

Custom-designing a solution

In summer 2003, the mixer supplier contacted Cleveland Vibrator Co., Cleveland, a supplier of industrial vibrators and vibratory equipment, to discuss the fertilizer company's problem. The vibrator supplier recommended a model FEP pneumatic piston vibrator with a 2-inch-diameter piston that produces 2,200 vibrations per minute at 60 psi with no electricity. The mixer supplier specified a replaceable rubber tip for the metal piston to reduce the noise caused by continuous metal-on-metal impact.

In September 2003, the mixer supplier purchased one FEP pneumatic piston vibrator, and its engineers custom-designed a mounting frame and installed the unit on the mixer in the fertilizer company's plant. This concept proved successful, reducing the material buildup inside the mixer by 80 percent.

Because of this success, the mixer supplier purchased another pneumatic piston vibrator to install on a mixer in another company's plant. This company uses the rotary drum mixer to handle titanium dioxide (TiO_2) powder. And, much like the polymer-coated fertilizer, the TiO_2 powder naturally tends to stick to and build up on the mixing drum's interior.

With this customer, too, the pneumatic piston vibrator proved to be an

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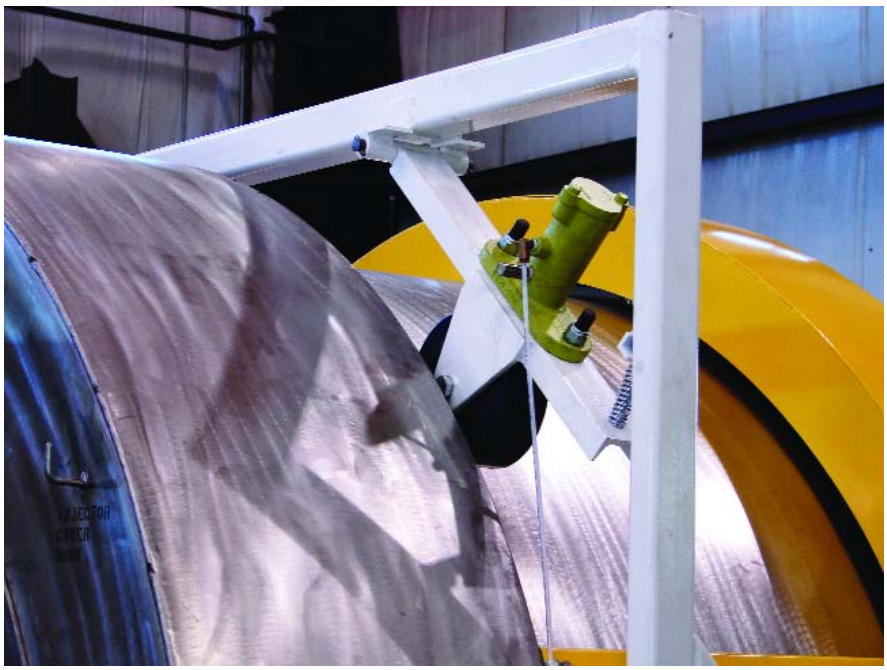

The custom-designed mounting frame's spring keeps the wheel securely pressed against the drum's top.

effective solution. However, the mixer supplier noticed some problems: The pneumatic piston vibrator was excessively loud when operating, and the rubber tip would frequently wear out and need replacing because of the friction caused by the rubber tip impacting the rotating drum.

Redesigning and refining the solution

A Missouri company that produces various powdered color pigments uses several of the rotary drum mixers to make its products. Like the fertilizer and TiO_2 powder, the color pigments were sticking to and building up on the mixing drums' interiors, so the mixer supplier mounted a pneumatic piston vibrator on each mixer to help remove the material from a drum's interior and reduce the time needed to clean out a drum between product runs. The vibrators effectively released the material sticking to the drums' interiors, but the noise and the need to frequently replace the rubber tips prompted the pigment company and mixer supplier to look for a better way to vibrate the drums.

After several discussions, they came up with the idea of developing a rolling vibrator in which the vibration would be transferred to a mixing drum's top via a spring-mounted metal channel and rubber wheel.

"Even though the pneumatic piston vibrators maximized material discharge from the mixing drums," says Bill Callaghan, Continental Products director of engineering, "we still had some glitches to work out. We needed to find a way to reduce the noise and eliminate the friction between the vibration source and rotating drum."

At the time, Tom Callaghan, Continental Products plant manager and production supervisor, was working with one of the pigment company's engineers to resolve these issues. After several discussions, they came up with the idea of developing a rolling vibrator in which the vibration created by the vibrator would be transferred to a mixing drum's top via a spring-mounted metal channel and rubber wheel.

"Tom brought the rolling vibrator concept back to our engineering department, and we developed and refined it," says Bill Callaghan. "The idea was that we'd connect a vibrator to one end of a metal channel and a three-inch-wide, twenty-five-pound rubber wheel to the other end. A custom-designed mounting frame with a spring connected to the metal channel would keep the wheel securely pressed against a rotating drum's top. During operation, the vibrator would create vibration that would move through the metal channel to the wheel and then to the drum's top. We believed that this design would transfer more vibration to the drum than the continuous single-point impacts delivered by a piston could, and that the rubber wheel wouldn't wear because it would rotate with the drum."

In spring 2006, the mixer supplier contacted the vibrator supplier to discuss the rolling vibrator concept. The vibrator supplier supplies vibrators designed for stationary targets, so it recommended that the mixer supplier purchase a model 1200 VMRAC air-cushioned pneumatic vibrator and adapt it for the rolling vibrator's vibration source.

The air-cushioned vibrator produces 2,700 vibrations per minute at 60 psi with no electricity. Unlike the pneumatic piston vibrator, it doesn't have an extended piston. Instead, its bottom is sealed, and an internal piston in an air pocket transmits vibration to an object without directly striking it. The number of vibrations per minute can be increased or decreased by adjusting the air pressure — the more air pressure, the more vibrations per minute, and vice versa. This allows the mixer supplier to set the vibrator

The rolling vibrator transfers more vibration to the mixer's drum than a pneumatic piston vibrator can.

to produce the minimum number of vibrations per minute needed for the maximum amount of material release. It also allows the mixer supplier to use the vibrator in a wide range of applications.

After successfully testing the custom-designed rolling vibrator, the mixer supplier replaced the pigment company's pneumatic piston vibrators with the new rolling vibrators.

"We took a vibrator that was made for stationary vibration and adapted it to develop a rolling vibrator that eliminates the issues that plagued the original design," says Bill Callaghan. "We eliminated the rubber-tip wear problem and greatly reduced the noise factor. The rolling vibrator also increased the amount of vibration transferred to the drum, which decreased the amount of residual material remaining in a drum at the end of a production run by at least ten percent. This decreased the pigment company's product waste and time needed to clean out a drum between production runs."

Delivering good vibrations

Since perfecting the rolling vibrator design, the mixer supplier has replaced many of the installed pneumatic piston vibrators with rolling vibrators that use the vibrator supplier's air-cushioned vibrator. "Our engineers designed the rolling vibrator to be readily adaptable to any of our mixers," says Bill Callaghan. "For

companies that use our mixers to handle sticky materials such as carbon black, titanium dioxide, pigments, and polymer-coated products, we'll use the rolling vibrator to maximize material discharge and reduce the time needed to clean out the mixing drum between product runs. And depending on the application, we can install multiple rolling vibrators on a mixer."

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"The people at Cleveland Vibrator have been great to work with, not only on what we're trying to develop but on the back and forth and testing to see which vibrator would work best," says Bill Callaghan. "Their engineering department thoroughly understood what we were trying to accomplish. And since they gave us great technical support and customer service, we plan to continue working with them in the future." **PBE**

Note: To find other articles on this topic, look under "Solids flow" and "Mixing and blending" in *Powder and Bulk Engineering*'s Article Index at www.powderbulk.com or in the December 2006 issue.

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