Case history

Drum mixer improves production and batch quality

A company decreases mixing times and increases production output when it installs a horizontal rotary drum batch mixer.

Kemin Industries, Des Moines, Iowa, has manufactured agricultural and food products for the animal and livestock feed industries since 1961. Kemin also manufactures and markets liquid non-nutritive additives such as flavorings, feed-grade antioxidants, and mold inhibitors, which are sprayed directly onto the raw feed materials prior to packaging.

Until recently, Kemin used a 3,000-pound- 100-cubic-foot-capacity batch ribbon blender with a 40-horsepower electric motor, a rotating shaft fitted with helical mixing blades (*ribbons*), and several external spray lines to coat raw feed materials with a sequence of liquid additives. After charging the mixer with a batch of raw feed ingredients, several liquid additives were sprayed in sequence onto the batch's top surface as the ribbons mixed the material. Spraying and mixing continued until all of the raw feed particles were coated with liquid additives.

However, the ribbon blender didn't uniformly disperse the liquids throughout the batch, and this led to unwanted balling and lumping. So, to complete the blending and eliminate the balls and lumps, the batch was discharged from the mixer and conveyed to a hammermill. The hammermill reduced the coated feed product to a consistently blended, ball- and lump-free batch that met Kemin's quality control requirements. The batch was then discharged from the hammermill and conveyed to holding bins prior to packaging.

"Basically, we were spraying liquids onto the top surface of the raw dry feed ingredients and depending on the ribbon's agitation to properly blend the batch. In some cases that didn't happen so well," says Herb Elliott, Kemin's dry production manager. "The hammermill did break up the balls and lumps and did disperse the coated material particles evenly throughout the batch. But this added time and expense to the process. We

A worker adds 50 pounds of microingredients to the mechanical conveyor's inlet chute, which are then conveyed to the mixer's inlet chute.

felt that there had to be a better way to get the liquids onto the particles that required less processing time."

Wanted: Effective and efficient mixer

In early 1998, Kemin began looking for a more effective and efficient way to apply liquid additives onto its raw feed materials. Elliott had seen literature and advertisements for the ROLLO-MIXER Mark VI horizontal rotary drum batch mixer made by Continental Products Corp., Milwaukee, Wis., and was aware of some of its mixing capabilities. But he wasn't sure if the mixer was capable of meeting Kemin's processing needs. So Elliott and Brandon Wilson, senior engineer, attended the May 1998 Powder & Bulk Solids Exhibition at the Donald E. Stephens (formerly Rosemont) Convention Center in Rosemont, Ill. There they met with Continental representatives, who gave them information about the mixer and the company's Wisconsin test facility.

"We saw great promise in Continental's mixing process," says Elliott. "It looked like it could spray several liquids on all of the raw feed particles in the batch instead of on just the top couple of inches, as our ribbon blender was doing."

Putting the rotary drum mixer to the test

In December 1998, Kemin sent a 1-ton sample of raw dry feed ingredients and three different liquid additives to Continental's test facility. The raw feed material's average particle size was less than 60 mesh. Both Elliott and Wilson attended the product tests, in which several 350-pound batches were run on a 350-pound- 10-cubic-foot-capacity batch test mixer. The test results were later scaled up to Kemin's required mixer size.

The tests showed that the mixer had uniformly dispersed the liquid additives onto the dry feed particles without creating any lumps or balls during the mixing process. The finished test batches were as uniform and consistent as any of Kemin's previous batches that had been produced with the ribbon blender and hammermill. Elliott realized that if they put the rotary drum mixer into Kemin's pro-

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A worker dispenses the coated material from the holding bin and packages it.

duction process, the hammermill might no longer be needed.

"We were impressed with what we saw. The dispersion on the product was superb; it matched or exceeded anything we were able to do here with our ribbon blender and hammermill," says Elliott. "But we still brought samples back with us to Des Moines and ran them through our company's quality assurance laboratories. After that proved successful, we decided to purchase a 6,000-pound- 200-cubic-foot-capacity Mark VI rotary drum batch mixer with a 15-horsepower motor."

Found: One rotary drum mixer

Kemin purchased the mixer in February 1999. Its stainless steel rotating drum assembly with internal mixing flights is mounted on a rotating shaft. The drum assembly's rotating shaft is supported at each end by a pillow-block bearing mounted on a steel frame. A front hood assembly encloses one end of the drum assembly and houses the mixer's inlet and discharge chutes.

The mixer's steel frame is placed on load cells so batch ingredients can be weighed automatically as they enter the mixing drum rather than individually prior to mixing. The steel frame sits on a specially constructed steel support base that elevates the mixer 6 feet off the ground.

An electric motor and a drive chain that's wrapped around the drum assembly's rear head rotate the drum assembly for mixing. The drum assembly rotates independently of the front hood assembly.

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The inlet chute is at the top center of the mixer's front hood assembly and the discharge chute is on the front hood assembly's face just beneath the inlet chute. The inlet and discharge chutes are independent of the rotating drum assembly, so dust-tight connections can be made to both for a dust-free mixing process. Material is fed into the inlet chute either by pneumatic or mechanical conveyor or by gravity.

As the mixer rotates at about 3 rpm, the drum's mixing flights gently carry and release the particles and divide the batch 25 times per revolution into continuous particle streams that randomly flow into and through each other. The mixer creates a free-falling curtain of material, exposing each particle's surface area and allowing for the uniform dispersion of liquid additives. This mixing process is known as *free-fall processing*.

To coat the particles with the liquid additives, three independent spray lines run through the front hood assembly's upper right-hand quadrant and into the rotating drum assembly at the height at which free fall occurs. Each spray line has a spray lance assembly with three spray nozzles that are aimed at the cascading particles. The mixer doesn't depend on its mixing action to uniformly disperse the liquid additives onto the particles as Kemin's ribbon blender did; rather it relies on the liquid additives contacting each particle's surface area during free fall.

After the particles have all been coated with liquid additives, the discharge chute's gate is automatically extended into the free-falling particles' path, redirecting their flow so they exit through the discharge chute. The drum continues rotating as the particles are discharged. The entire mixing process for a 6,000-pound batch takes as little as 6 minutes — about 3 minutes to uniformly coat the particles and then about 3 minutes to empty the mixer.

The new mixing process

Kemin installed the rotary drum mixer in June 1999.

"The mixer's installation was fairly easy; it took us about 3 weeks to do it ourselves," says Elliott. "We were in the process of rebuilding our production facility, and the mixer's arrival coincided with the construction of a 50-foot-square, 12-foot-tall elevated mezzanine [mixing platform]. So we just slipped the mixer right into place and built the mezzanine around it, with the mixer's top half above the mezzanine and the bottom half below it. This allows a worker to add microingredients — dry ingredients added in 50-pound increments — to the mixer at waist height, which is a safe operating level."

Kemin uses a pneumatic conveying system to transport raw feed material in bulk to the mixer's inlet chute. As the material enters the mixer, a worker reads the load cells weight reading and manually shuts down the conveying system after the mixer is charged to a preset batch weight.

Soon, Kemin will be adding a computer to its process, which will control the pneumatic conveying system and spraying system. As the material enters the mixer, the load cells will send a

weight reading to the computer. When the mixer is charged to a preset batch weight, the computer will shut down the pneumatic conveying system.

Kemin uses a mechanical conveying system, which is mounted above the mixer, for applications requiring the addition of microingredients. After the mixer reaches its preset batch weight, a worker manually adds the microingredients to the conveyor's inlet chute, which is located 3 feet off the mezzanine at the drum assembly's rear-head end. The conveyor transports the microingredients to the mixer's inlet chute.

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After batch weight has been achieved, the mixing drum begins to rotate and the liquid additives are consecutively sprayed onto the particles during free fall. A computer will soon control each spray line's activation order and spraying time. Each liquid additive's spraying pressure is determined by its viscosity, the number of spray nozzles per spray lance assembly, and each nozzle's spray design. The spray nozzles create a fine mist that uniformly disperse the liquid additives onto the particles.

When the spray cycle is completed, the coated material is discharged from the mixing drum into a bucket elevator, which conveys the entire batch to a holding bin. From there, it's dispensed by a semiautomatic bagging system and packaged by a worker.

Once the batch is discharged from the mixer, a worker can open an access panel on the rotary drum's top and sweep the remaining material loose from the drum's sides and mixing flights. The mixer is run again and the discharge gate opened, discharging the remaining material. A drain in the mixer's bottom allows the mixer to be washed out. For this, a worker opens the access panel and uses a pressure washer to wash down the rotary drum's sides and mixing flights with water. The drain is opened and the water and material exit the mixer into a catch basin. Because Kemin makes many runs of the same product — sometimes for an entire week — the mixer is washed out only after a product run is completed.

Problems solved

Since adding the mixer to its production process, Kemin has reduced its mixing times and increased its production output.

"The quality and consistency of our products are much better now, as is our ability to mix more products in less time," Elliott says. "We basically doubled what we're capable of mixing in one shift. When we were using the old ribbon blender we could make about five 3,000-pound batches in a day. Now we can make about six 6,000-pound batches in a day. Basically, we mix the same number of batches, but they're twice the size."

Kemin's maintenance costs have also decreased. Previously, every six weeks the hammermill's milling blades had to be replaced with new ones, which resulted in costly maintenance expenditures and production downtime.

"The ROLLO-MIXER rotary drum batch mixer requires very little downtime for regular maintenance because there are so few moving parts. Basically, we grease the two main bearings and oil the drive chain every couple of months. And due to the mixer's low mixing rpm [revolutions per minute], the mixing flights should last for the mixer's life." **PBE**

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