Mixers uniformly blend cement products

A cement products manufacturer installs low-shear rotary drum mixers with high-shear product intensifiers to blend a variety of products.

One of the world's largest manufacturers of cement products makes thinsets, powder adhesives, underlayments, gypsum-based products, and other cement products at US mixing facilities in the Northeast, Southeast, and on the West Coast.

In 1987, the manufacturer began custom processing a line of colored ceramic tile grouts in sanded and nonsanded varieties. The grouts contain portland cement, calcium carbonate, silica sand, and a variety of chemicals and pigments. To consistently match each grout's color to specification, all the pigments must develop so no streaks appear in the finished grout. Also, the grout ingredients require uniform mixing across a wide range of batch sizes. Achieving uniformity is difficult because the ingredients vary widely in proportion (as small as 1 pound in a 4,000-pound batch), density (15 to 110 lb/ft^3), particle size (very fine powders to 20-mesh silica sand granules), and particle shape (irregular). In addition, some pigments (such as iron oxide) tend to cake.

Manufacturer seeks new mixers or blenders

The cement products manufacturer ruled out using paddle mixers to mix the grout ingredients. The manufacturer worked with a custom processor that used such units and felt they wouldn't uniformly mix the grout and would create dust. In addition, though the manufacturer found that the paddle mixers provided satisfactory large-batch mixing of nongrout products, large batches created extra products that occupied warehouse space until the appropriate customer was found.

The manufacturer was planning several new facilities to manufacture various products and so began looking for new mixers or blenders for all the products.

Defined mixing requirements lead to one mixer after several tests

In the spring of 1987, the manufacturer's facilities engineer began evaluating mixers and blenders. The engineer also sought bag-dumping and packaging equipment to complement the mixers at the new facilities. Prior to testing, the engineer defined requirements for mixer or blender performance. The mixer or blender would:

- Uniformly mix materials that vary in particle size, shape, and density across batch sizes varying by as much as a 10:1 ratio.
- Thoroughly develop grout pigments to consistently match a specified color without identifiable pigment streaks in the finished product.

Mixers are supported below bag-dump stations, shown here just after installation and before facility startup.

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• Mix the grouts in a reasonable time.

• Operate dust-free through loading, mixing, and discharging.

• Operate economically, especially in areas of power consumption, mixer maintenance, and equipment wear.

The engineer ruled out using a vertical air blender because industry associates reported that pigment development with such units required a secondary operation and the mix was neither uniform nor streak-free. The engineer tested a plow blender with a high-speed chopper, but it didn't meet his requirements. A trunnion-mounted drum mixer inadequately developed the pigments. Finally, the engineer considered a unit marketed since the early 1960s called a Rollo-Mixer, which he found advertised in a trade magazine.

Low-shear mixer also provides high-shear intensification

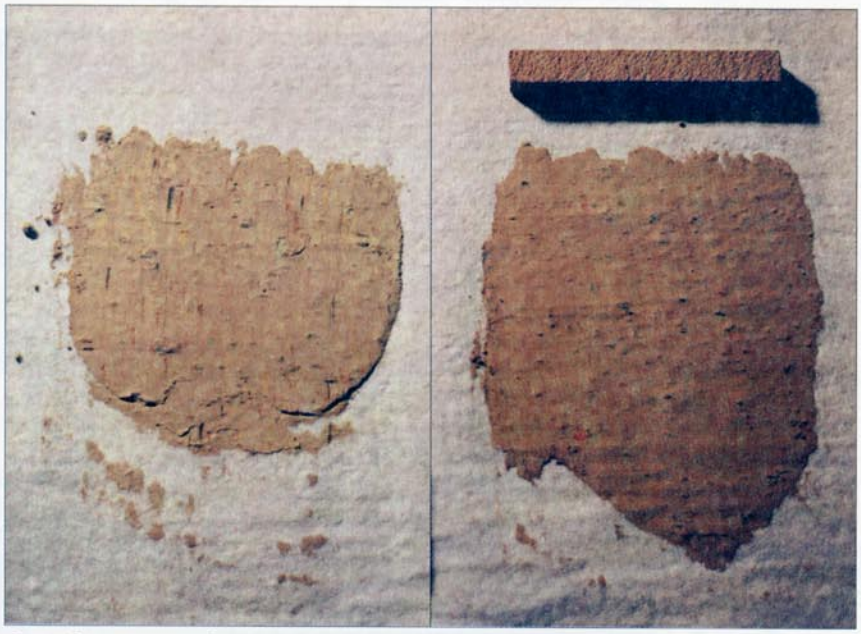
The components of the Rollo-Mixer considered include a floor-mounted chain drive system, a large solid-steel central shaft supported by two frictionless main bearings, a mixing drum with a fixed setup of internal planes, a discharge chute with a gate, and an optional attachment for more thorough pigment development, called a high-shear product intensifier.

In mixer operation, the mixing drum rotates at 3 rpm to provide low-shear blending. Within the mixer, all material moves in all planes by gravity and is positively displaced to prevent mixing dead spots. Material moves to the mixer's front end and drops in freefall across the discharge chute's gate, which either opens to completely discharge material or closes to continue mixing.

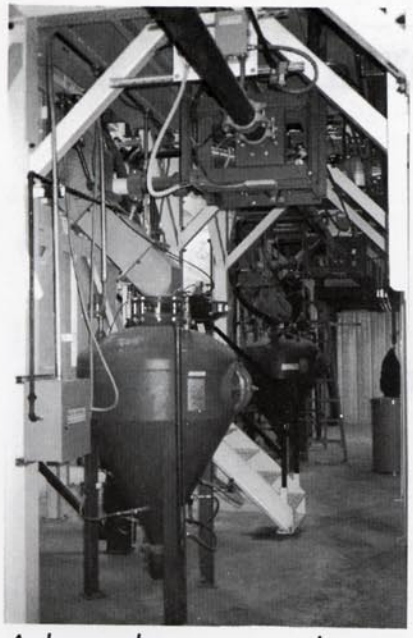
The high-shear product intensifier attachment is built into the mixer's face, next to the discharge chute. When the intensifier is activated, the unit's motor runs and material flows through the intensifier for high-shear mixing at various speeds. The material then flows back into the mixing drum and continues mixing. The intensifier is self-contained to enclose dust.

After tests, engineer selects mixers and bag-dumping and packaging equipment

In midsummer of 1987, the cement products manufacturer shipped 3,300 pounds of ingredients for its toughest-to-mix non-sanded tile grout to the mixer manufacturer's test center. Tests used a production-size test unit (Model 50-33) with 33-cubic-foot load volume. The test center would run a 3,000-pound batch and a 300-pound batch to gauge success across the cement



Streak tests on tile grout at two mixing stages reveal undeveloped pigments before high-shear intensification (left) and thoroughly developed pigments after high-shear intensification (lower right). A block of the finished grout (upper right) has consistent color throughout.



A dense-phase conveyor's pneumatic transfer vessels can either load mixers with ingredients or transport finished batches to packaging.

products manufacturer's required 10:1 batch-size ratio.

Test center workers loaded 3,000 pounds of the grout ingredients into the test mixer at rest, adding red, yellow, green, brown, and black pigments last. The workers started the loaded mixer and ran it for 1 minute with the high-shear product intensifier off. The first mixture sample was then pulled for a streak test (draw down). For the test, the cement products manufacturer's facilities engineer pulled a putty knife across the sample on a flat surface. Although the mixture appeared well-mixed, the streak test revealed a rainbow of undeveloped pigment colors mixed in with the portland cement and calcium carbonate. The mixer was restarted with the intensifier on.

After 3 minutes, a sample showed fewer pigment streaks and, after 2 more minutes, only a few streaks of undeveloped red and brown pigments remained. After another 5 minutes, no pigment streaks remained. The mixer achieved a uniform nonsanded grout color through the entire batch. The batch was then discharged into bulk bags.

Test center workers then loaded the same mixer with 300 pounds of the same ingredient formula and sampled the mixture after 1 minute with the intensifier off and after 3, 5, and 10 minutes with the intensifier on. The samples exhibited the same pigment development as in the 3,000-pound-batch test. The testing results were satisfactory.

The facilities engineer now needed to integrate the selected mixer into a system for blending and packaging products in a dust-free environment. Test center workers showed the engineer a bag-dumping and packaging system called Blend-Pak. In the system, the mixer mounts on an independent structural steel support base. A bag-dump station mounts above the mixer, and a self-contained dust collector can mount above the bag-dump station. In operation, the mixer receives a batch of ingredients (frequently from the bag-dump station), mixes the batch, then gravity-discharges the batch either directly into packaging equipment mounted on the floor beneath the mixer or into pneumatic conveyors for transport to remote packaging stations. Pleased with the system, the facilities engineer selected it for several new facilities.

The new mixers employ a high-shear product intensifier to promote development of pigment additives.

New equipment exceeds defined requirements

In system operation at each of the new facilities, all bagged ingredients and minor additives, such as pigments and chemicals, enter the mixer through the bag-dump station. The cement products manufacturer's dense-phase pneumatic conveyor moves bulk ingredients such as silica sand, portland cement, and calcium carbonate from bulk-tank silos to the mixer.

On units with an independent dust collector, a worker pushes a cleaning button and collected dust shakes back down into the batch, reducing waste. Other mixers route dust through a central dust collector. The mixers start under full load with no problem. After mixing, a pneumatic conveyor transports the finished batch to packaging.

Three different-sized mixers are installed at the various facilities. Model 31-10, with a 10-cubic-foot load volume, handles batches of 90 to 900 pounds. Model 50-33, with a 33-cubic-foot load volume, works batches of 300 to 3,000 pounds. And Model 62-67, with a 67-cubic-foot load volume, mixes batches of 600 to 6,700 pounds. Finished product densities range from 60 to 110 lb/ft^3. The mixers produce thinsets and adhesives, ceramic tile grouts, underlayments, and gypsum-based products.

The facilities engineer reports the following results:

- Product uniformity is better than anticipated, even when less than 1 pound of a minor ingredient is added to a 4,000-pound batch. The mixers produce uniform batches regardless of batch size.

- Because of each mixer's high-shear product intensifier, the mixers produce all grouts, regardless of color, without identifiable pigment streaks.

- Mix times that formerly ran 20 to 30 minutes without producing complete uniformity now are 50 percent to 60 percent shorter and produce perfect uniformity.

- The mixers operate dust-free, which keeps the workplace clean, creating happier, more productive workers.

- The mixers operate economically in the areas of power consumption, mixer maintenance, and equipment wear. The manufacturer estimates its mixers require 80 percent less energy than would paddle mixers with high-speed choppers. Mixer maintenance is limited to occasionally greasing the two main bearings, lubricating the drive chain approximately once a week, and greasing the product intensifier's top and bottom bearings once a day while the unit is running; the mixer is adjustment-free. And because of the mixer's low-shear design, sanded products don't wear the mixing drum.

In addition, warehouse space is now used more efficiently. Exact batch sizes are produced, so all finished products are shipped directly to the customer.

To sum up results, the facilities engineer said, "The Rollo-Mixer can't be beat for our purposes. It's one of those machines that does more than you expect of it, and does it better. It has revolutionized the way we operate. As a matter of fact, our lab technicians use a production unit for research and design testing, because it's more accurate than our lab mixers." **PBE**

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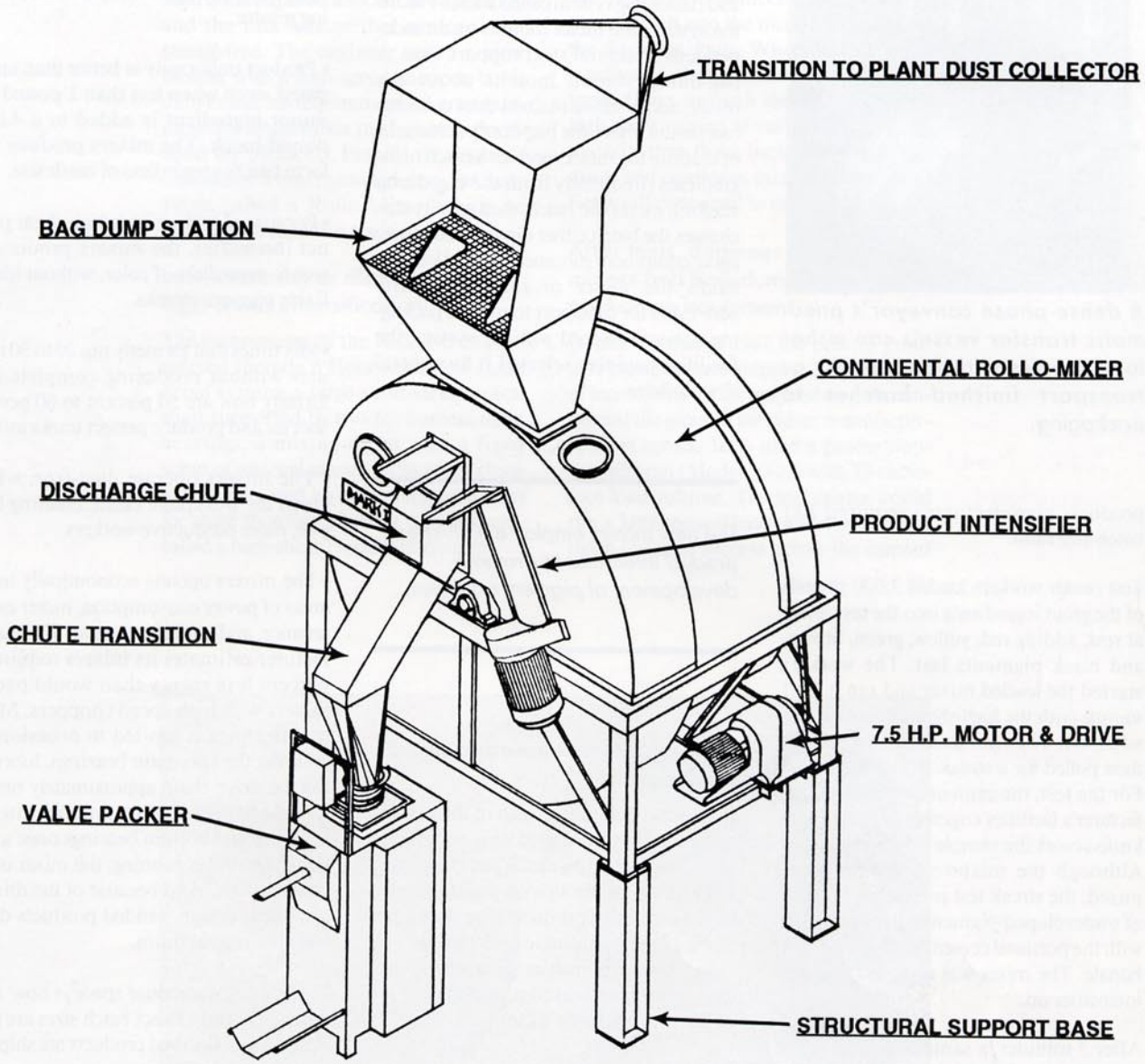
CONTINENTAL "BLEND-PAK" SYSTEM



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