

Case history

Rotating drum mixer is worth all the tea in China

To solve supply-chain and product-quality problems, Adagio Teas purchases a batch mixer and brings production in-house.

Plain black or green tea is like plain coffee or espresso,” says Michael Cramer, chief operations officer at Adagio Teas. “If all you sell is plain coffee or espresso, you probably won’t sell a lot. But when you add milk or chocolate or other flavors and ingredients, your sales will really take off. It’s the same thing with tea.” In the past, the company imported various preflavored teas and sold them to customers via the Internet. Unfortunately, legislation enacted after 9/11 interrupted the company’s supply chain

and made the delivery of the imported teas unreliable. The company needed to find a way to bring the tea-flavoring operation in-house.

Since 1999, Adagio Teas Inc., Clifton, N.J., has been selling plain and flavored black and green teas to customers around the world via its Internet storefront at www.adagio.com. Customers range from individuals who order small amounts to retailers who order in bulk and then repackage it for resale. When



The spraying system (lower right) sprays the liquid flavoring onto the tea leaves at 0.2 gallons per minute as the mixer’s batch vessel rotates at 3 rpm.

the company first started, it imported preblended and preflavored teas in bulk from a supplier in Germany. The company then repackaged the various teas in smaller containers, which it sold and delivered directly to its customers.

However, after 9/11, importing the tea from Germany became problematic because the shipping containers could sit in port for weeks before passing inspection by the FDA, the US Department of Agriculture, and other agencies as specified by new legislation passed by Congress.

“This interrupted our supply chain,” says Cramer, “and we could never

count on our products being here on time and being available when we needed them, even when we ordered them in advance.”

Another problem the company experienced importing the teas concerned quality control. “When a customer buys a flavored tea from us, it should look and taste the same every time, regardless of how much they buy or when they buy it,” says Cramer. “But since we were relying on another company to make the products for us, we weren’t in charge of the quality control, and we’d often find slight differences in the products from one order to the next.”

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The 100-kilogram-batch-capacity mixer, which requires minimal floor space for installation, has enabled the company to increase its output and diversify its product line.

To eliminate these problems, the company began searching for ways to streamline the supply chain and improve quality control.

Looking at the options

Toward the end of 2002, the company began looking at various options for producing the flavored teas in the US. "Our first notion was to directly import plain black and green tea from Asia and outsource the blending and flavoring operation to a company in the US," says Cramer. "However, we quickly discovered that very few US companies do this type of operation on a large scale, and the companies that do charge very high fees."

To avoid the high costs of outsourcing, the company decided to look into bringing the blending and flavoring operation in-house. "We called other companies in the industry, and we talked with them about the types of equipment and processes they use to produce products similar to ours," says Cramer. "We soon discovered that not a lot of companies do this type of operation in a smart way. To make their products, most companies we talked to use a very basic, small-capacity, ten-kilogram batch mixer that, much like a cement mixer, just throws the material from one side to the other as an operator with a hand-held spray bottle stands above the inlet and manually applies a liquid flavoring."

Cramer knew that a 10-kilogram batch mixer wouldn't work for his operation: "We wouldn't have been able to offer a volume discount to a customer who ordered one hundred kilograms of tea because we still would've had to process their order one ten-kilogram batch at a time and charge them the full cost of each batch produced," says Cramer. "With a larger mixer, we'd be able to process a one-hundred-kilogram batch of tea in one-tenth the time, using less energy and less labor."

Cramer also realized that a mixer with a stationary batch vessel and internal moving paddles or ribbons couldn't

be used because the mixing action would degrade the brittle tea leaves. "We needed a mixer that would gently blend the tea leaves without damaging them or creating fines and that would allow us to uniformly and evenly coat all of the tea leaves with a precise amount of liquid flavoring," says Cramer. "These requirements narrowed our search to batch mixers with a rotating batch vessel and no internal mixing paddles."

Narrowing the choices

From late 2003 into early 2004, Cramer searched the Internet and various trade magazines for suppliers of batch mixers with rotating batch vessels, eventually finding eight potential suppliers. Cramer also found that not a lot of third-party information was available. "We were only able to get information about a supplier's mixer from its Web site or sales people," says Cramer. "And because it's their job to negate the advantages of the other suppliers' mixers while emphasizing the advantages of their own, we got a very mixed picture as to how the various mixers really compared to each other. It wasn't like buying a car or a TV, where you can read a *Consumer Reports* magazine or other third-party reviews to get unbiased information."

So when Cramer called the suppliers for information about their mixers, he also asked each to provide a list of customer references. Cramer then called and asked the customers about their reasons for choosing the mixer they did and how the mixer's features compared with those of the other mixers on the market. "Unfortunately, most of the people I talked with who had experience using the mixer hadn't gone through the purchasing process," says Cramer. "So again, the information was one-sided because these people only talked positively about the mixer they were using."

In May 2004, Cramer traveled to the biennial Powder Show in Chicago, where he was finally able to see the various suppliers' mixers in action and objectively compare and contrast their features. Based on customer refer-



To avoid flavor cross-contamination between batches, an operator cleans the mixer's hopper and the batch vessel's interior with water.

ences and information gathered at the show, Cramer narrowed his list of mixers to two. To decide between the two, Cramer compared each mixer's mixing action and liquid-addition method.

One supplier's batch mixer had a lower purchase price. "However," says Cramer, "as this mixer's batch vessel rotates, the material stays in the vessel's bottom and is continuously shifted laterally with the top layer eventually rotating to the middle, then to the bottom, then to the middle again, and then back to the top. As this occurs, the liquid flavoring is applied from above to only the top layer, so there's no systematic way to ensure that the liquid is applied uniformly and evenly to all of the tea leaves in a batch."

In contrast, when the higher-priced mixer's batch vessel rotates, internal mixing flights gently carry the material from the vessel's bottom up to a certain point where the material releases from the mixing flights and free-falls back to the vessel's bottom, creating a solid curtain of free-falling material. The liquid flavoring is sprayed onto this curtain, uniformly coating all of the tea leaves. The mixer's mixing action also divides a batch 25 times per revolution by generating continuous particle

streams that randomly flow into and through each other. As a result, after 6 to 9 revolutions the mixer achieves a homogeneous blend.

“We wanted a mixer that would uniformly blend the tea leaves without degrading them, and both mixers could do this,” says Cramer. “However, we also wanted a mixer that would allow us to uniformly distribute the liquid flavorings on all of the tea leaves so that each teaspoon of tea in a batch, and therefore each cup of tea, would be the same. Because only the higher-priced mixer could do this and cost wasn’t a factor, we decided to purchase one for our operation.”

Shortly after making this decision, Cramer contacted the mixer supplier, Continental Products Corp., Milwaukee, and sent 20 pounds of tea leaves and a couple of gallons of liquid flavoring to the supplier’s test facility. The supplier used the material samples to fine-tune the mixer’s spray system so that it would be ready to use upon delivery to the company.

The batch mixer

The Model 31-10/90S Continental Rollo-Mixer Mark VII-I batch mixer is 3 feet 2 inches deep; 6 feet 3 inches wide, including the controls and drive system; and 8 feet tall. The 100-kilogram-batch-capacity (220-pound-batch-capacity) mixer’s rotating drum assembly (or batch vessel) with standard internal mixing flights is mounted on a rotating shaft, which 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 interior and all material contact parts, including the inlet and discharge chutes, are made of Type 304 sanitary stainless steel.

The mixer’s control box, which is connected to the company’s safety switches, operates a three-phase, 60-cycle, 480-volt, 5-horsepower variable-frequency drive motor. The drive motor, which is linked to a drive

chain that’s wrapped around the drum assembly’s rear head, can rotate the drum assembly at up to 4.5 rpm. (The typical operating speed is 3 rpm.) The drum assembly rotates independently from the front-hood assembly and is the mixer’s only moving part.

An inlet chute is at the top center of the mixer’s front-hood assembly, and a 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 a dust-tight connection can be made to both for dust-free mixing. The company discharges the tea leaves from the original shipping containers into the inlet chute by gravity via a sanitary stainless steel hopper with a cover.

As the mixer’s drum assembly rotates clockwise (when facing the front-hood assembly), the internal flights create the free-falling curtain of material that exposes each tea leaf’s surface area and allows for the uniform dispersion of the liquid flavorings. Because the rate at which the mixer rotates affects the material curtain, the mixer is typically configured to operate at 3 rpm with a predetermined material amount. If less material is being mixed, the mixer’s revolution rate will need to be increased to maintain a consistent material curtain, and vice versa.

The mixer’s spray system consists of a 5-gallon bottom-discharge pressure tank, a scale, a flow valve, two pressure gauges, a 3/8-inch-diameter flex hose, and a spray lance with two spray tips. The tank sits on the scale, and the flex hose connects the tank’s bottom discharge to the spray lance. The spray lance is mounted in the mixer’s upper right quadrant near the inlet, and the spray tips are pointed at the free-falling material curtain. The supplier provided the company with two model 6502 spray tips, each rated for 25 psi. Each spray tip creates an elliptical spray pattern and handles 0.2 gallons per minute of liquid flavoring. The company also purchased two other types of spray tips to use with liquid flavorings that have different viscosities.

The company applies 4 percent liquid flavoring (or 8.8 pounds, which is slightly more than 1 gallon) to each 100-kilogram (220-pound) batch at about 2 pounds per minute. It takes about 4 minutes to uniformly coat an entire batch of tea leaves with liquid flavoring.

Making a batch of flavored tea

The company currently imports pre-processed black and green tea leaves from Sri Lanka, China, Japan, and Taiwan. The tea arrives at the company’s facility in 100-kilogram-capacity aluminum bags. The company purchases its liquid flavorings from various US flavoring suppliers.

To make a batch of flavored tea, an operator first adds the correct liquid flavoring to the tank and pressurizes it to 15 psi. (The tank scale indicates the liquid flavoring amount in the tank, and a pressure gauge on the tank indicates the tank’s pressure.) The operator then uses a bulk-bag lift to raise a bulk bag of tea leaves above the mixer’s hopper. Before discharging the tea leaves into the mixer, the operator selects the proper mixing speed at the mixer’s control box and starts up the mixer. “For herbal teas, which are more fragile than black or green teas, we’ll run the mixer at a slower speed,” says Cramer.

As the mixer rotates, the operator discharges 100 kilograms of tea leaves into the batch vessel, filling it to about shaft-center. After several revolutions, the operator activates the spray system by manually opening the flow valve located beneath the tank. Liquid flavoring discharges from the tank’s bottom discharge, flows through the flex hose to the spray lance, and discharges from the spray tips onto the material curtain. Because an increase or decrease in the spray system’s pressure changes the delivery rate and the spray pattern produced by the spray tips, a pressure gauge mounted on the mixer allows the operator to monitor the pressure at the spray tips to ensure proper liquid-flavoring addition.

When the scale shows that the proper amount of liquid flavoring has discharged from the tank, the operator closes the flow valve and lets the mixer run for about 1 minute. During this time, the operator adds any required dry ingredients, such as dried fruit or flower petals, to the mixer via the hopper. The various dry ingredients, which have dissimilar particle sizes and densities, are added to visually enhance the finished product. "After we add the dry ingredients we let the mixer run for about ten more revolutions to ensure that they're uniformly distributed throughout the batch," says Cramer. "The operator then discharges the uniformly coated and blended batch from the mixer into a bulk storage container."

To discharge the batch, the operator pulls down a lever located on the front-hood assembly below the hopper that extends the discharge chute's gate into the curtain of free-falling material. As the mixer continues rotating, the material hits the gate and is redirected out the discharge chute. It takes about 3 revolutions to completely empty the mixer. "The overall batch time is about six minutes," says Cramer, "which includes loading the tea into the mixer, adding the liquid flavoring and dry ingredients, and discharging the batch into a storage container."

The company cleans the mixer between batches to avoid flavor cross-contamination. "The mixer is designed for easy cleaning," says Cramer. "Its back panels are held together with screws, so all we have to do is remove the screws and open it up. We then spray it down with water and point a fan at it to speed up the drying process."

"The spray tips are also very easy to change out," he says. "The operator simply releases two quick-release clamps located on the outside of the mixer and pulls the spray lance out, pops the spray tips out, pops the new ones in, and pushes the spray lance back into the mixer."

Drinking one fine cup of tea

Since installing the new mixer and bringing the blending and liquid-flavoring operation in-house, the company hasn't experienced any production slowdowns caused by supply chain problems. "We aren't at the mercy of another company for our finished products anymore," says Cramer. "We buy the tea in bulk and make sure that it's always on hand, so we don't have any delays with that. And if we need a flavoring, we just order it and it's delivered the next day, so our production remains on schedule. The mixer is also simple to use and requires little maintenance or energy to operate."

Adagio Teas has also improved product quality and consistency, because it's now able to control the quality of all of the ingredients. "If you use a third party to make the product, you may have three or four vendors to choose from, and you may like the tea quality of one vendor and the flavoring quality of another and the dry ingredients of another," says Cramer. "But it's rare to find one vendor that provides all three. So by doing things in-house, we have control over the quality of the tea, flavorings, and dry ingredients, which allows us to make the best-quality product possible."

Additionally, the company has been able to increase its output and diversify its product line. "We've just about tripled the number of products that we offer," says Cramer. "After we took control of the production process, we gained the ability to do custom orders. We can make just about anything that a customer could want, which includes items not listed on our Web site."

Besides wanting to improve the company's production rate and product quality, Cramer says, "Another reason we chose the supplier's mixer is that they're a family-owned and -run business, and we could talk with the people who designed and made our mixer before purchasing it. The good thing about that is that five or ten years from now, if we have any issues with the mixer or decide to upgrade it, we'll be talking with the same people we did when we originally bought it. In contrast, when you deal with a supplier that uses a manufacturers' rep, the rep might not even be around one year after you buy the mixer, so whatever promises were made and whatever trust was built won't be there either." **PBE**

Note: To find other articles on this topic, go to www.powderbulk.com, click on "Article Index," and look under the subject heading "Mixing and blending," or see *Powder and Bulk Engineering's* comprehensive "Index to Articles" in the December 2004 issue.

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