

Plant expansion

Starting from scratch

An equipment supplier helps a rubber compound producer design a new processing facility.

Expanding a plant or adding a new processing line can be a daunting task. Each piece of equipment in the process must be selected not only for how well it handles your product, but also for how it interacts with other equipment both up and downstream. You can get help from equipment suppliers who take a system wide approach to helping you install your system from the ground up.

Lauren International, located in New Philadelphia, Ohio, produces a variety of molded and extruded rubber products, many of which are used in the automotive industry. Lauren's primary product is an extruded rubber seal.

To make the rubber products, Lauren Manufacturing, the rubber manufacturing division of Lauren International, receives dense- and sponge-rubber compound as raw material. The raw material, shipped to the manufacturing plant in small strips between 2 and 5 inches wide, is made primarily from carbon black, calcium carbonate, and talc. Lauren Manufacturing puts the

rubber compound strips through various extrusion processes to meet final product specifications. In the past, the company purchased most of its rubber compounds from outside vendors.

Controlling every variable

During the early 1990s, demand for Lauren International's products began to rise. Consequently, the plant needed more rubber compounds. As business increased, so did the cost of the rubber compounds the plant needed.

To meet company demand for raw material and keep costs low, Lauren International decided to begin producing its own rubber compounds. The company determined that by doing so it could keep up with its own manufacturing demands for raw materials needed to produce the extruded rubber products and curb rising costs.

This also allowed control of the rubber compounds' content. When buying raw material from outside vendors,



Compound ingredients are fed through a rotary valve and carried by the dense-phase pneumatic conveyor to the appropriate receiving bin. Pictured are the tops of each receiving bin.

the manufacturer had little control over the quality of the compounds they received. Often, when the compound consistency didn't match the manufacturer's needs, much of the compounds were scrapped, which also raised production costs.

In an effort to meet growing demand, combat rising rubber compound costs, and control the compounds' content, Lauren International chose to build its own facility for making rubber compounds. Producing the compounds would require designing and

building a new processing facility, literally from the ground up.

Planning for the new facility began nearly 5 years ago. To produce the compounds, Lauren International formed a new company: LMI Custom Mixing. Located in Cambridge, Ohio, LMI Custom Mixing is a joint venture between Lauren International and a German manufacturing company, Meteor Gummiwerke. Together, the two companies also formed a joint manufacturing company to produce extruded rubber products — Lauren-

Meteor, located in Dover, Ohio. Instead of purchasing the premixed rubber compounds, both Lauren International and Lauren-Meteor would rely on LMI Custom Mixing to produce the needed materials.

Starting from scratch

To produce rubber compounds, LMI Custom Mixing required a processing system that could move the major ingredients — carbon black, calcium carbonate, and talc — from large storage silos, batch the correct amounts of material, and mix them together with polymers and other chemicals to form the compounds. Jon Hull was hired as general manager of LMI Custom Mixing to find the proper equipment and oversee plant construction.

Hull wanted to find a single supplier that could provide equipment to handle every step in the processing line — from unloading trucks of raw material to mixing the ingredients for the rubber compounds. The heart of the processing line was pneumatic conveying. To move the ingredients from storage silos to receiving bins for batching, Hull said, Lauren International had considered many pneumatic conveying configurations.

"We didn't want to go strictly dense-phase conveying, because we were concerned about having high-pressure vessels," he said. "We didn't want to go with dilute phases because we wanted to keep the fines generation down, but we didn't feel this was critical to the point where we needed to have completely dense phase."

Responding to advertisements in many trade journals, Hull examined product brochures from several suppliers that handle complete system design. Hull said most of the suppliers' systems had similar designs for handling bulk solids.

The criteria for selecting the proper supplier obviously included the nature



A screw feeder delivers compound ingredients from a receiving bin into a weigh hopper, which discharges into the mixer.

of the project itself, Hull said, and the requirements for the system his employer wanted to build. The carbon black was in pellet form, with a bulk density of 22 lb/ft³. The remaining raw ingredients are in powder form. The calcium carbonate has a bulk density between 52 and 97 lb/ft³, and the talc has a bulk density of 55 lb/ft³.

Hull said the supplier they chose for the project must also have a testing facility "where the supplier could prove any of the concepts they were proposing."

The field quickly narrowed to one when Hull approached a manufacturer at the 1997 Powder & Bulk Solids show in Chicago. Hull was familiar with the supplier's work and had received quotes from the supplier for similar projects at a previous employer's facility. Hull decided to have the raw materials tested at the supplier's test center.

Visiting a test center

Hull and his plant manager brought between 500 and 1,000 pounds of each ingredient — carbon black pellets and calcium carbonate and talc powders — to the supplier's test center for testing a dense-phase pneumatic conveyor. At the test facility, test center staff filled a hopper with each material to be conveyed in successive runs.

"Basically, we conveyed it to a receiving bin in the same manner that we would be doing it on our site," Hull said. "And [the test center] had control hookups where we could receive data on pressures, air cfm, velocity, and other variables. We could tell what was going on, and we would test several runs of material."

For testing, material dropped into a pneumatic conveying line through a high pressure rotary valve. Compressed air moved the material through the pneumatic conveyor. The test center staff originally planned to move the carbon black without pneumatic conveyor airline injectors.

"Sometimes you need to use airline injectors," Hull said. "You want to put so much air in your system to move the material, but you don't want to put the air all up front. So at different points along the conveying line airline injectors provide additional air. In the end, material moves through the line like a rolling slug."

Because of the carbon black's pellet form, test center staff didn't think the airline injectors would be necessary. "But we found out real quickly we needed to [use airline injectors]," Hull said, "because we plugged the line. It was quite a mess."

Among Hull's concerns was whether the carbon black pellets would generate excessive fines during pneumatic conveying. However, the tests showed Hull that carbon black could be handled with little product degradation. The tests also showed that the talc aerated greatly during conveying.

"We found the talc's bulk density to be near 40 pounds per cubic feet," Hull said. "After we conveyed it, the bulk density dropped to 18 pounds per cubic feet. It was just like water. So that presented some challenges."

By conducting the tests and learning more about their materials' conveying characteristics, Hull said, LMI Custom Mixing was able to prepare for many handling challenges before installation.

"The fortunate thing is I had done some other projects with pneumatic conveying, and I have a good background in that area," Hull said. "So I had a pretty good feel for what I was looking for. But I had never done anything with carbon black, and I had heard the horror stories. That's why the testing was critical."

Hull said the test center staff was able to explain the testing process and how the supplier's equipment would function



Trucks bring carbon black to this area in the plant's unload area. The power boot lift connects the trucks to the dense-phase pneumatic conveyor, which carries the pellets at a rate of 24,000 lb/h more than 175 feet to two storage silos.

with the materials being tested. "They sat down and went through the different components with us," Hull said. "They explained each components' construction and function, and I think they did a real good job with that."

As a result of the positive test results and the supplier's specific proposals for LMI Custom Mixing's processing line, Hull decided to use equipment provided and configured by Nol-Tec Systems for the new processing plant.

"I felt their company was strong in engineering," Hull said. "The price was very competitive. The research I did showed that what [the supplier] was proposing made the most sense. Then we proved that with testing. I just felt they truly knew what they were doing."

Construction on what would become LMI Custom Mixing began in December 1997. The custom rubber mixing facility was completed in November 1998.

From the ground up

Nol-Tec Systems supplied its own equipment, along with that made by other manufacturers, to complete the entire processing system for making rubber compounds. LMI plant operators put the system together using drawings provided by the supplier. Hull said he was pleased with how easy it was to assemble the processing equipment.



From the storage silos, the carbon black is fed through a rotary valve into a dense-phase pneumatic conveyor and is dense-phase conveyed at 6,000 lb/h over 360 feet to two receiving bins.

"The supplier did a good job with their engineering and drawings," Hull said. "If you had a certain part, you could look at the drawings, look at their parts list, and tell exactly where that part was supposed to go. And on a big project like this, that was tremendous. I received many comments from our pipe fitters, who said they actually had drawings they could work with. It sounds like a small thing, but when you have hundreds of parts it's really nice."

In operation, trucks deliver the carbon black, calcium carbonate, and talc to the plant. The carbon black pellets, unloaded from gravity-feed, hopper-bottom trucks, pass through a rotary valve into a dense-phase pneumatic conveyor, which carries the pellets at a rate of 24,000 lb/h more than 175 feet to two storage silos.

"It is a very, very clean system," Hull said. "I emphasize clean. We bring a truck in, unload the carbon black, and when it leaves you can't tell that we've had a truck in here. It's wonderful."

The calcium carbonate powder arrives at the plant in a self-unloading blower truck. The powder is dense-phase pneumatically conveyed from the truck directly into a single storage silo. The talc powder arrives at the plant in the same manner as the calcium carbonate. It is unloaded through a diverter valve into one of two storage silos.

Each of the plant's five storage silos has a capacity of 2,373 cubic feet and is constructed to handle materials with a bulk density between 22 and 99 lb/ft³.

From the storage silos, the carbon black is fed through a rotary valve into a dense-phase pneumatic conveyor and is dense-phase conveyed at 6,000 lb/h over 360 feet to two receiving bins. Calcium carbonate and talc are also conveyed from the storage silos to receiving bins, one for calcium carbonate and another for talc. Like the carbon black, both the calcium carbonate and talc are fed through a rotary valve and carried by the conveyor to the appropriate receiving bin.

"The four receiving bins are on a keep-full basis," Hull said. "Each bin has a high level and a low level. Once we drop below the low level, the system signals that it needs to transfer more material, and it automatically does that."

From the receiving bins, a screw feeder meters the rubber compound ingredients into one of two weigh hoppers, which weighs the correct amounts of material needed for the compound. From the weigh hopper the ingredients are gravity-fed into a single mixer. "And we have made provisions so that we can handle more capacity when we add a second or third mixer," Hull said.

"We have a mixer operator, and basically he will do a check on the scale and then add the appropriate chemicals and polymers [solids] into the mixer," Hull said. "The ingredients will then drop out of the mixer into what we call a drop mill, which is basically where we knock the heat out of the compound. From there it goes to a blending mill and then to our batch-off system."

In the batch-off system, the blended material, which has formed a consistent solid during mixing, is cut into strips and dipped in a mix that keeps the strips from sticking to each other. Fans cool the final strips of rubber compounds.

"Basically, we take raw ingredients, polymers, fillers, accelerating agents, curing agents, and some other chemicals, weigh them, and mix them," Hull said. "We put them out in a final form that is compatible with extruding."

Greater control, more savings

By making its own rubber compounds, Hull said, Lauren International has been able to meet demand for its production needs while gaining control over the compounds' quality.

"We have very good communication with the Lauren companies [using the rubber compounds]," Hull said. "We do see a good consistency of the mixing operation. We are also able to be very responsive to the other companies' needs."

"We have seen some improvements in their scrap rates as well, which saves on production costs. That is a result of a combination of things, but the rubber compounds have a large part to do with that."

Hull said the costs of making the rubber compounds has remained competitive with the costs of buying them. The plant is also exploring the possibility of supplying rubber compounds to manufacturers outside Lauren International. Overall, Hull said, he is pleased with the system wide approach the supplier took and the installation's results.

"I feel that engineering is a real priority with the supplier. They did a fantastic job with that," Hull said. "They were very good to work with. They know their stuff." **PBE**

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