

## Case history

# Cartridge dust collector keeps cooling air clean

A custom compounder installs a dust collection system to supply clean plant air to four fan-cooled motors.

**T**rostel Ltd., headquartered in Lake Geneva, Wis., designs and manufactures various rubber products for the automotive, agricultural, industrial, and many other markets. The company's Polymer Compounding Division (PCD) plant in Whitewater, Wis., produces custom rubber compounds that are sent to the company's molding facilities or sold to customers for manufacturing various end products. In the past, the PCD plant's four fan-cooled roller mill motors frequently failed prematurely because the motors' fans pulled in nuisance carbon black dust with the cooling air. Since the failing motors caused high maintenance costs and unacceptable production downtime, the company needed to find a way to increase the motors' operating life.

### Pulling in carbon black dust with cooling air

Trostel's PCD plant operates 24 hours a day, 5 days a week, producing various types of custom rubber strip stock and rubber pads. To produce a custom rubber compound, the plant adds the compound's various ingredients into

a large batch mixer, which discharges the gelatinous rubber compound to a dump mill that presses the rubber through two large rollers to cool and form it into a continuous strip. The rubber strip moves from the dump mill to a blend mill, where it's pressed through two more large rollers that further cool and form it to ensure batch homogeneity. From the blend mill, the rubber strip is moved to other areas in the plant for further processing before being packaged and transported to its final destination.

Since carbon black is one of the ingredients used when making the rubber compounds, a small amount often escapes into the plant from various sources, such as material transfer points. And because of its light bulk density, the dust tends to float in the air. According to Ross Lund, Trostel PCD finance director and interim general manager, the fugitive dust has never been a problem from a regulatory standpoint because the plant maintains strict compliance with all OSHA and state regulations pertaining to air quality standards. However, it did cause problems for the roller mill motors.



*A cartridge dust collector hangs from the plant's ceiling above a roller mill and provides clean cooling air to the mill's two fan-cooled motors.*

The dump mill and blend mill each have two totally enclosed fan-cooled (TEFC) DC motors, and each 125-horsepower variable-speed motor powers one roller. During operation, each motor's cooling fan continuously draws in plant air. Because the cooling fans pulled in the carbon black dust along with the cooling air, the conductive dust got into the motors' internal components and caused them to fail prematurely. When a motor failed, the plant had to replace it with a new one.

"The motors' operating life was very short," says Lund. "We had to replace each motor about once every quarter, which cost us between forty and fifty thousand dollars a year. Additionally, when a motor went down, we had to shut down the whole production line to replace it. To improve our operation, we needed to find a way to extend the motors' operating life."

### **Finding a way to clean the cooling air**

In summer 2005, the plant's manager and maintenance staff started looking for some type of dust collection system that would clean the plant air before it entered the motors' cooling fans. Additionally, the Trostel team wanted the system to reduce motor maintenance

and production line downtime costs, be mounted from the ceiling to save floorspace, and show a return on investment (ROI) in 12 months.

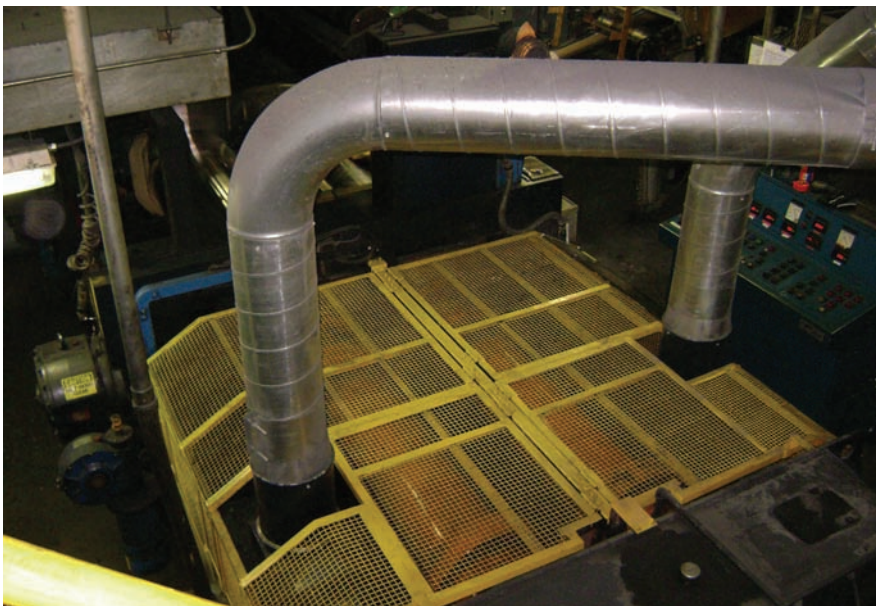
After contacting various dust collection equipment suppliers, the team was referred to Bud Kieffer, Summit Filtration Technology, a local rep for United Air Specialists (UAS), Cincinnati. UAS supplies air-purification and pollution-control equipment to companies in the industrial and commercial markets. Kieffer took all of the plant's requirements into consideration and designed a dust collection system that included two of the supplier's compact ceiling-mounted SCA dust collectors, one to be installed above each mill. The dust collectors would bring in ambient air and dust, filter out the dust, and push clean air to the motors' cooling fans via direct ducting.

The team reviewed the system design plan and, after comparing it to other options, decided to purchase the UAS equipment because it was the best-suited for the plant's operating conditions and space restrictions. In late 2005, the dust collection system arrived at the plant and a local general contractor installed it according to the design plans.

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**Duct work connects the dust collector's two clean-air-chamber outlets to the roller mill's two fan-cooled-motor air inlets.**

## The cartridge dust collector

Each compact SCA cartridge dust collector is 45 inches wide, 97.8 inches long, and 39.6 inches tall, with each unit's height including an air-intake box on its top. The unit is constructed mostly of 12- and 14-gauge carbon steel and weighs a total of 837 pounds with its four cylindrical cartridge filters installed. The ceiling-mounted unit is suspended by rigid threaded rods that allow the unit to be leveled and its height to be adjusted. A vertical tube sheet separates the unit's housing into two sections — a clean-air chamber and a dirty-air chamber. The unit has four dust collection drawers in its bottom directly below the dirty-air chamber.

The unit's four cartridge filters each weigh 18 pounds and are 26 inches long and 13.84 inches in diameter with a hollow center. The cartridges use the supplier's synthetic nanofiber filter media, which consists of a 0.5-micron-thick layer of nanofiber media applied to a 0.016-inch-thick cellulose substrate. Each cartridge has 255 square feet of media surface area and can remove particles as small as 0.5 microns from an airstream at an efficiency rate of 99.99 percent.

The four cartridge filters are installed horizontally inside the dirty-air chamber in two rows of two, with each filter being directly above one dust collection drawer. Each row of two cartridges is supported by two angled rails that run parallel with the unit's bottom from a cartridge port to the tube sheet, allowing operators to easily slide the cartridges into place. Each cartridge port is sealed with a heavy access door. When the access door is closed, the cartridges are completely sealed on both ends — one end by the access door and the other end by the tube sheet. This prevents any air in the dirty-air chamber from moving to the clean-air chamber without first passing through the cartridges.

During operation, a fan located inside the unit's clean-air chamber pulls in

2,500 cfm of air through the air-intake box and into the dirty-air chamber via a torturous path. (The fan's 3-horsepower motor is located outside the unit so there's no chance of the fan wheel getting dusty.) Each pair of cartridges' hollow center matches up with a hole in the tube sheet, and the fan pulls the air from the dirty-air chamber through the filter media, through the cartridges' center, and into the clean-air chamber. As the air is pulled through a cartridge, all dust particles are captured by the filter media and evenly deposited onto its surface.

The clean-air chamber's bottom has two square discharge outlets, and each outlet has a square boot that transitions to a round duct. This duct connects directly to a cooling fan's air inlet. The clean air is pushed by the dust collector fan and pulled by the cooling fans through the two duct runs to the roller mill motors, cooling them with dust-free air.

The dust collector's pulse-cleaning system consists of an adjustable timer board, two pulse-blast nozzles, and a compressed-air inlet. The adjustable timer board, located outside the unit near the fan's motor, controls the pulse-cleaning system's timing and frequency. Each pulse-blast nozzle is mounted on a compressed-air pipe in the clean-air chamber directly inline with the centerline of the cartridges. The pulse-cleaning system requires a 90- to 100-psi compressed-air source to produce 1.7 standard cubic feet of air per pulse every 60 seconds.

The pulse-blast nozzle, which looks like a showerhead, evenly disperses the pulse air, blasting it out at a 15-degree angle at about 1,000 ft/sec into the cartridges' center. Since the pulse only lasts about 100 milliseconds, the dust collector fan doesn't shut down during cleaning and the unit is considered to have continuous online automatic cleaning.

"The dust collector has a fairly deep, but short, clean-air plenum, so that the



***The dust collector's removable doors allow an operator easy access for replacing cartridge filters.***

pulse air grabs a lot of air from the clean-air chamber, and all of the air rushes down through the inside centers of the cartridges, hits the access door on the other end, and is reflected back toward the nozzle," says Ed Ravert, UAS senior application engineer. "But an air seal in the nozzle prevents the air from going back out the way it came in, and all that air passes through the filters to get out, knocking the dust off as it does. The blown-off dust has nowhere to go but down into the dust drawers. Some dust may fall back onto the cartridges, but the majority of it falls into the drawers."

For the PCD plant, the supplier programmed the pulse-cleaning system to activate every 60 seconds. So 60 seconds after starting the unit the first cartridge row is pulsed, then after another 60 seconds the second cartridge row is pulsed, and so on.

The dust collector's Magnehelic gauge measures the pressure drop through the filters, allowing the operators to know when it's time to replace the cartridges. To change out the filters, an operator grabs an access door handle and pulls it down, breaking the seal between the door and the housing. The operator then lifts the horizontal handle out of its bracket and pulls off the removable door. A length of cable connects each door to the housing, allowing the doors to hang in place so the operator doesn't have to worry about climbing up and down a ladder several times or accidentally dropping a 14-pound door down to the ground. The operator re-

moves the dirty filters, inserts new ones, and closes the access door.

Ravert notes, "Since the dust collection system handles a fairly light dust load, the cartridge filters have yet to be replaced. And because the nanofiber filter media doesn't have to be pulsed as often as a normal filter does, the plant has saved money by minimizing compressed-air use."

### **Improving fan-cooled motor operating life**

Since installing the two dust collectors above the dump mill and blend mill, the motors' operating life has increased to about 14 months. "The longer motor life is the biggest benefit for us because we have less maintenance costs and more up time on the production line now," says Lund. "And since the operation is more efficient with less downtime, we've been able to increase our production capacity. Plus, with the cost savings from eliminating all the downtime and motor replacements that the supplier's system provided us, we saw a return on our investment in less than twelve months." **PBE**

**Note:** To find other articles on this topic, look under "Dust collection and dust control" in *Powder and Bulk Engineering's* Article Index at [www.powderbulk.com](http://www.powderbulk.com) or in the December 2007 issue.

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