

# PLANT ENGINEERING

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## After the flood

Getting a waterlogged plant  
safely back on line 35

Disaster recovery workers at the  
Cargill plant in Cedar Rapids, IA

Oplex installed a bulk-bag unloader to improve the quality and productivity of its PVC compounding operation. Below the hopper on the bulk bag discharger frame, a drop-through rotary valve meters PVC resin into two pneumatic conveying lines.



All photos courtesy of The Flexicon Corporation

# Mixing safety

## with productivity

*Bulk bag unloading, conveyor system improve product quality, repeatability and worker safety*

**David Boger**

*The Flexicon Corporation*

One of the largest plastics processors in Mexico City streamlined material handling, improved process quality, created a safer work environment and made more efficient use of its workers by installing a bulk bag unloading system with pneumatic and flexible screw conveying.

Oplex S.A. de C.V. calenders polyvinyl chloride (PVC) sheet for applications such as advertising banners, automotive seat covers and door-panel liners, truck canopies, shower curtains and synthetic leather. The company produces sheet on two calendering lines that receive PVC compounds from a central

batch mixing system. Workers had manually loaded 55-pound paper sacks of PVC resin and calcium carbonate into a mixer and used a special conveyor system of the company's own design for adding liquid components: plasticizers, stabilizers and lubricants.

Carlos Barra, director of operations at Oplex, said manual loading created problems, notably in quality control. Oplex mixes six batches per hour – 144 batches per day – each weighing 440 pounds. With one batch mixed and discharged every 10 minutes, workers were rushed, which led to mistakes. It was not unusual for them to forget how much product had been added to a batch, Barra noted.



**At the bag-spout interface**, a clamp ring creates a dust-tight seal while a telescoping tube maintains constant downward pressure as the bag empties to promote discharge.



**PVC from the bulk bag unloader** is pneumatically transported to a 36-inch-diameter filter-receiver and hopper on the third floor of the plant. The flexible-screw conveyor empties calcium carbonate into the smaller weigh hopper. Both ingredients are then gravity fed to the mixer on the floor below.

Since bags were opened with knives, particles of paper sometimes fell into the mix. The repetitious work also created the potential for injuries from carrying bags to the mixing station. Empty bags also had to be collected and disposed of, increasing production costs.

Oplex decided to automate the mixing of the PVC resin with a bulk bag unloading system, reasoning that it would both improve batch quality and allow the company to use several dozen 1,540- and 2,200-pound bulk bags in place of hundreds of 55-pound sacks. An automated system would also create a safer work environment by reducing the amount of manual labor required in batch

**An important factor in designing the pneumatic system was Mexico City's altitude. The pneumatic conveying system had to be adjusted to maintain proper performance and make certain that the fans that cool the motors generated enough air flow to be effective.**

loading and mixing.

The company developed a specification for a PVC material handling system. Among the requirements was that equipment had to be compatible with a PLC and Oplex's in-house software. Calcium carbonate would still be loaded by hand from 110-pound sacks because of its unavailability in bulk bags. Oplex, however, wanted to install a more efficient hopper and additive-mixing station for it.

The first part of the system is a bulk bag unloader from Flexicon Corp., Bethlehem, PA. The unloader features an electric trolley hoist on a cantilevered beam that lifts bags weighing up to 3,200 pounds into place atop a carbon-steel frame.

PVC resin flows from the bag through a telescoping tube that attaches manually to the bag spout with a clamp ring, creating a dust-tight connection. The tube pneumatically raises and lowers, applying continuous downward tension to elongate the bag and keep the spout taut to prevent flow restrictions. A bin vent dust collector mounted on the discharger frame also keeps dust from escaping into the plant, safeguarding worker health by reducing airborne particles, improving plant cleanliness and reducing the risk of product contamination from tramp particles.

A pneumatically actuated flow control valve regulates material flow from the bag. Four elliptically contoured cincher bars close concentrically around the bag's outlet spout in an overlapping fashion to eliminate trickle flow of material. The valve, which stops resin flow when a preset load fills the hopper below the telescoping tube, is controlled by the PLC.

Oplex's operations are spread over several floors. A vacuum pneumatic system conveys the PVC resin to a filter receiver on the third floor of the plant. A hopper



**After workers load calcium carbonate additive** into a bag-dump station on the second floor of the plant, a flexible-screw conveyor (at right) transports the additive 30 feet to a weigh hopper on the third floor.

integral to the bulk bag discharger directs the PVC resin to a drop-through rotary valve, which meters the material into one of two 3-inch-diameter pneumatic conveying lines, transporting it 200 feet to a 36-inch-diameter filter/receiver above the mixer.

The bulk bag discharger is equipped with load cells, allowing the PLC to receive loss of weight data as material is conveyed from the discharger. This enables the PLC to control the feed of the pneumatic conveyor so that the required weight of PVC resin is delivered to the filter receiver, then dropped through a chute to the mixer. The two separate pneumatic conveying lines prevent cross contamination when running different products.

On the second floor, a bag dump station with a dust collector for loading the calcium carbonate was installed. Material from the dump station is transported to a small weigh hopper on the third floor by a flexible screw conveyor. Designed to move difficult-to-handle materials, the conveyor screw rotates in a 3.5-inch-diameter, 30-foot-long plastic tube set at a 45-degree incline, self-centering as it rotates to provide clearance between the screw and the tube wall and to prevent grinding of the material. The conveyor is powered by a 5-hp motor at the discharge end where the calcium carbonate enters the weigh hopper through a transition adapter. From the hopper, the weighed batch passes through a slide-gate valve to the mixer.

The accuracy of the automated system's loading, weighing and mixing operations has improved overall product quality and repeatability, Barra said. Moreover, by permitting the use of bulk bags in place of 55-pound sacks of PVC, the automated material handling system reduces the amount of valuable floor space needed for material storage.

From the third floor, the PVC resin and calcium carbonate are gravity-fed from the filter receiver and the weigh hopper, respectively, to the mixer on the main floor. There, the liquids are added. After the batch is processed, it is metered into two compounding machines. One compounder,

filter receiver on the third floor of the plant. A hopper integral to the bulk bag discharger directs the PVC resin to a drop-through rotary valve, which meters the material into one of two 3-inch-diameter pneumatic conveying lines, transporting it 200 feet to a 36-inch-diameter filter/receiver above the mixer.

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Barra noted that an important factor in designing the pneumatic system was Mexico City's altitude: at 7,349 feet above sea level, air is thin. The pneumatic conveying system had to be adjusted to maintain proper performance and make certain that the fans that cool the motors generated enough air flow to be effective. **PE**

*David Boger is vice president, sales & marketing for The Flexicon Corporation, where he previously held the positions of service engineer, applications engineer and sales manager. He holds a bachelor's in chemical engineering from Rensselaer Polytechnic Institute, Troy, NY.*