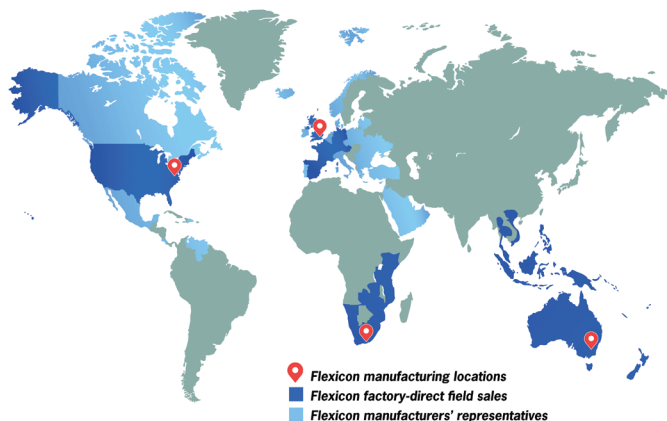




Worker loads calcium carbonate additive into bag-dump station on the second floor of the Oplex plant. The flexible screw conveyor, located on the right, transports the additive 30 ft (9 m) to a weigh hopper on the third floor.

Bulk-solids handling system upgrades calendering operation

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Bulk-solids handling system upgrades calendering operation

MEXICO CITY — One of the largest plastics processors in Mexico City streamlined materials-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 like advertising banners, automotive seat covers and door-panel liners, truck canopies, awnings, 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 25 kg (55 lb) paper sacks of PVC resin and calcium carbonate (CaCO_3), the solids components of the formulations, 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, says manual loading created problems, notably in quality control. Oplex mixes six batches per hour — 144 per day — each weighing 200 kg (440 lb), including liquid additives. 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 notes. And since bags were opened with knives, particles of paper sometimes fell in the mix. The work was repetitious, which 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 PVC resin with a bulk-bag unloading system, reasoning that this would not only improve batch quality, but permit the company to use several dozen 700 or 1000 kg (1540 or 2200 lb) bulk bags in place of hundreds of 25 kg sacks. An automated system would also create a safer work environment by reducing the amount of manual labor required in batch loading and mixing.

The company developed a specification for a PVC materials-handling system. Among the requirements was that equipment had to be compatible with a programmable logic control (PLC) and software Oplex developed in-house. Calcium carbonate would still be loaded by hand from 50 kg (110 lb) sacks because it's not packaged in bulk bags. Oplex, however, wanted to install a more efficient hopper and additive mixing station for CaCO_3 .

The first part of the system is a BFC Series Bulk Bag Unloader from Flexicon. The unloader features an electric trolley hoist on a cantilevered beam that lifts bags weighing up to 1450 kg (3200 lb) into place atop a carbon steel frame about 20 ft (6 m) tall.

PVC resin flows from the bag through a TELE-TUBE® telescoping tube that attaches manually to the bag spout with a SPOUT-LOCK® clamp ring, which creates a dust-tight connection. The tube pneumatically raises and lowers, applying continuous downward tension to elongate the bag and keep the spout taut, which prevents the spout from bulging outward (creating



Oplex installed a BFC Series bulk bag unloader from Flexicon to improve the quality and productivity of its PVC compounding operation. Features include a cantilevered I-beam and hoist, Bag-Vac dust collector, FLOW-FLEXER® bag activators beneath the bag for positive material flow, TELE-TUBE® telescoping tube and SPOUT-LOCK® clamp ring at the bag spout interface, hopper, and PLC-controlled rotary valve.

dead pockets) or falling inward (creating flow restrictions), for complete evacuation. A bin vent dust collector mounted on the discharger frame also keeps dust from escaping into the plant. This not only helps to safeguard worker health by reducing airborne particles, but improves plant cleanliness and reduces the risk of product contamination from tramp particles.

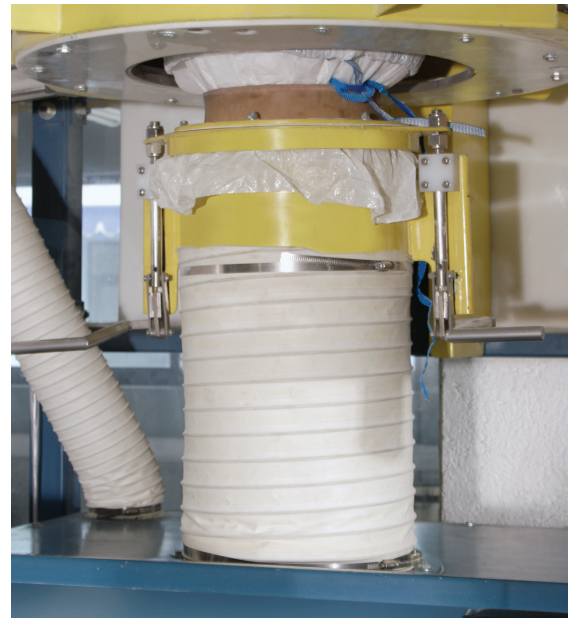
A pneumatically actuated POWER-CINCHER® flow control valve allows an operator to close partially full bulk bags should the need arise. Four elliptically contoured cincher bars close concentrically around the bag's outlet spout in an overlapping fashion to eliminate trickle flow of material.

Oplex is in an old building with little horizontal space, so operations are spread over several floors. A vacuum pneumatic system conveys PVC resin from bulk bags to a filter receiver on the third floor of the plant. A hopper integral to the bulk bag discharger directs PVC resin to a drop-through rotary valve, which meters the material into one of two 3 in. (7.6 cm) diameter pneumatic conveying lines transporting it 200 ft (60 m) to the 36 in. (91.4 cm) diameter filter receiver above the mixer. The bulk bag discharger is equipped with load cells to allow 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 and then dropped through a chute to the mixer. The two separate pneumatic conveying lines prevent cross contamination when running different products.

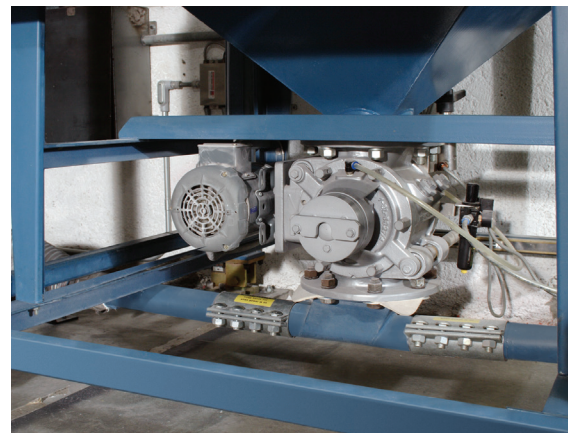
On the second floor, Flexicon installed a bag dump station with dust collector for loading CaCO₃. Material from the dump station is transported to a small weigh hopper on the third floor by Flexicon's BEV-CON™ flexible screw conveyor. A flexible stainless steel screw, designed to move difficult-to-handle materials, rotates in a 3.5 in. (8.9 cm) diameter, 30 ft (9 m) long plastic tube set at a 45-degree incline. The screw self-centers as it rotates, providing clearance between the screw and tube wall to prevent grinding of the material. The conveyor is powered by a 5 hp (3.7 kw) motor at the discharge end where the CaCO₃ enters the weigh hopper through a transition adapter. Load cells under the weigh hopper permit precise weights of CaCO₃ to be measured. 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 says. "Moreover, by permitting the use of bulk bags in place of 25 kg sacks of PVC, the automated materials-handling system reduces the amount of valuable floor space needed for materials storage."

From the third floor, the PVC resin and CaCO₃ are gravity-fed from the filter receiver and the weigh hopper, respectively, to the mixer on the main floor where the liquids are added. After the batch is processed, it is metered into two compounding machines. One compounder, a Buss Kneader, processes up to 1200 kg (2640 lb) per hour. The compound is discharged to a two-roll mill for aeration and then into a calender where it produces sheet 1.8 m (5.9 ft) wide. The other line uses a Banbury Mixer that processes compound at the same rate and discharges it into a two-roll mill and an extruder-strainer, and then into a second calender, which produces sheet 1.6 m (5.25 ft) wide.



At the bag spout interface, a SPOUT-LOCK clamp ring creates a dust-tight seal while a TELE-TUBE telescoping tube maintains constant downward pressure as the bag empties/elongates, promoting complete discharge.



Below the hopper on the bulk bag discharger frame, a drop-through rotary valve meters PVC resin into two pneumatic conveying lines.

Barra notes that an important factor in designing the pneumatic system was Mexico City's altitude: At 2240 m (7349 ft) above sea level, air is thin. Flexicon had to adjust the pneumatic conveying system to maintain proper performance and make certain that the fans, which cool the motors, generated enough air flow to be effective. "Flexicon's efforts in these areas, as with the installation overall, were on target," Barra says.



PVC from the bulk bag unloader is pneumatically transported to a 36 in. diameter (91.4 cm) filter-receiver and hopper on the third floor of the Oplex 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.



PVC from the bulk bag unloader is pneumatically transported to a 36 in. diameter (91.4 cm) filter-receiver and hopper on the third floor of the Oplex 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.



Two pneumatic lines convey PVC from the ground-floor bulk bag discharger unit to the filter-receiver on the third floor of the Oplex plant.

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