Bulk Bag Unloading

Handling System Upgrades Calendering Operation

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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.

Fig. 1: **Oplex installed a BFC Series bulk bag unloader from Flexicon Corp. to improve the quality and productivity of its PVC compounding operation.**

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.

Previously, workers had manually loaded 25 kg 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 such as plasticisers, stabilisers and lubricants.

During the process, manual loading created problems, notably in quality control. Oplex were mixing six batches per hour, (144 per day) each batch weighing 200 kg, 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 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 and the 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 kg or 1000 kg 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 labour required in batch loading and mixing.

The company developed a specification for a PVC materials-handling system that demanded equipment compatibility with a programmable logic control (PLC) and in-house software. Calcium carbonate ($CaCO_3$) would still be loaded by hand from 50 kg sacks because it is not packaged in bulk bags. Oplex, nevertheless, still intended to install a more efficient hopper and additive mixing station for $CaCO_3$.

The first part of the system is a bulk bag unloader as shown in Fig. 1. The unloader features an electric trolley hoist on a cantilevered beam that lifts bags weighing up to 1450 kg into place above a carbon steel frame about 2.2 m tall.

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, which prevents the spout from bulging outward (creating 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 also improves plant cleanliness and reduces the risk of product cross contamination.

A pneumatically actuated flow-control valve allows an operator to close partially emptied bulk bags should the need arise. Four elliptically contoured cincher bars close concentrically around

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Fig. 2: Below the hopper on the bulk bag discharger frame, a drop-through rotary valve meters PVC resin into two Flexicon pneumatic conveying lines.

Fig. 3: A Flexicon flexible-screw conveyor empties calcium carbonate into the smaller weigh hopper. Both ingredients are then gravity fed to the mixer on the floor below.

the bag's outlet spout in an overlapping fashion to eliminate trickle flow of material.

The Oplex operational facility is in an old building with little horizontal space, so operations are spread over several floors. A Flexicon 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 (Fig. 2), which meters the material into one of two 75 mm diameter pneumatic conveying lines transporting it 60 m to the 1000 mm diameter filter-receiver above the mixer.

The bulk bag discharger is equipped with load cells to allow the PLC to receive loss in 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 dust collector for loading $CaCO_3$ has been installed. Material from the dump station is transported to a small weigh hopper on the third floor by a flexible screw conveyor. A flexible stainless steel screw, designed to move difficult-to-handle materials, rotates in a 90 mm diameter, 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 4 kw motor at the discharge end where the $CaCO_3$ enters the weigh hopper through a transition adapter (Fig. 3). Load cells under the weigh hopper permit precise weights of $CaCO_3$ 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. 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 $CaCO_3$ 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 processing, the batch is metered into two compounding machines.

One compounder, a Buss Kneader, processes up to 1200 kg/h. The compound is discharged to a two-roll mill for aeration and then into a calender where it produces sheet 1.8 m 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 wide. An important factor when designing the pneumatic system was Mexico City's altitude; at 2240 m above sea level air is thin. This issue has been successfully addressed to maintain proper performance and make certain that the fans that cool the motors generated enough air flow to be effective. According to Carlos Barra, Oplex' Director of Operations, Flexicon's efforts in these areas, and the overall installation, were on target. ■

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