Drying: Pharmaceutical plant vacuum dries APIs

Bagging and packaging: Fluoridation plant chooses dust-free bulk bag unloading system
Since the early 1980s, Australian authorities have been installing water-fluoridation plants in towns and cities throughout the country to promote dental health. In recent years, the pace of fluoridation has quickened as various states have introduced fluoridation programs that are backed by government subsidies. For more than 25 years, ProMinent Fluid Controls Pty Ltd., Sydney, Australia, has supplied fluoridation systems to several water treatment plants. Initially, the company supplied the systems to small rural plants, where operators manually emptied 25-kilogram bags of sodium silicofluoride powder into the fluoridation process. Later, when the company began supplying systems to larger treatment plants, it had to find an automated and dust-free way to move large amounts of powder into the process.

Upgrading the fluoridation system

In the past, operators at smaller treatment plants emptied three to five 25-kilogram bags of the sodium silicofluoride powder into a small floor hopper. A feeder then transferred the powder from the hopper into a mixing tank, where it was mixed with water to form an aqueous solution that was slowly metered into the water supply at the required dosage rate. As necessary, the operator emptied more bags into the hopper to ensure continuous fluoridation.

In 2006, the state of Queensland decreed that more than 90 percent of Queenslanders would have access to fluoridated water by the end of 2012. To accomplish this, the state provided government subsidies to large treatment plants to implement fluoridation programs. In 2008, ProMinent was awarded contracts to supply fluoridation systems to five large plants that treat 125 to 750 million or more liters of water per day and provide water for more than 50 percent of Queensland’s 4.5 million residents.

To properly fluoridate such large volumes of water, the treatment plants required 150 to 900 kilograms or more of sodium silicofluoride powder per day, depending on the plant size. The company realized that having operators manually handle enough small bags to meet these large requirements would be inefficient and labor-intensive and potentially expose the operators to the powder, which is considered toxic and subject to strict regulatory control. To resolve these issues, the company decided to receive the powder in 1,000-kilogram bulk bags and to automate and seal the bag unloading and transfer process to contain fugitive dust and ensure operator safety.

The company contacted the Sydney office of a US equipment supplier it had successfully worked with in the past. This supplier, Flexicon Corp. (Australia) Pty Ltd., Wacol, Australia, manufactures bulk bag dischargers, flexible screw conveyors, bulk bag fillers, pneu-
matic conveying systems, and other bulk material equipment. The company worked with the supplier to design an automated and sealed bulk bag unloading and transfer system that keeps the powder completely contained from the bulk bag to the mixing tank.

**The bulk bag unloading and transfer system**

The automated bulk bag unloading and transfer system consists of a model BFC bulk bag discharger, bulk bag lifting frame, dust collector, 60-liter floor hopper, and a flexible screw conveyor with a self-centering stainless steel spiral screw. The discharger is installed above the floor hopper, and the 5-meter-long flexible screw conveyor connects the floor hopper to a large storage hopper designed to hold 7 days worth of powder, which is discharged to the mixing tank as needed. An electric hoist and trolley on a cantilevered I-beam are used to lift the lifting frame and bulk bag into the discharger and then lower the lifting frame to seat the bag in the discharger.

The discharger uses the supplier’s double-wall telescoping-tube system, clamp ring, and dust collector to prevent fugitive dust. Once the bag is seated in the discharger, the operator activates the dust collector and pneumatically raises the telescoping-tube and clamp ring to the bag spout. While the spout is still tied, the operator wraps the spout bottom over the rim of the telescoping tube’s inner wall and engages the clamp ring, sealing the bag spout to the tube top to create a dust-tight seal. The tube bottom is connected to a collar in the floor hopper’s lid, further ensuring dust-free operation. Once the bag is clamped to the tube, the operator deactivates the dust collector, unties the discharge spout, and lowers the tube toward the hopper, removing any slack from the bag and creating an open pathway for the material to flow through to the hopper.

To promote material flow, the discharger’s pneumatic bag activators operate at timed intervals to raise and lower the bag’s opposite bottom edges to direct material to the bag spout. As the bag empties, the activators’ stroke lengthsens, forming the bag into a steep V shape to ensure complete evacuation. A pneumatic flow-control cinch valve installed above the clamp ring allows the operator to regulate the material flow from the bag and retie the spout of partially full bags without leakage or dusting if the storage hopper becomes full. The flow-control valve also helps keep moisture out of the bag and can isolate the bag in case of an emergency.

As the powder flows into the floor hopper, the flexible screw conveyor activates to transfer the powder from the
hopper’s bottom outlet to the storage hopper’s top inlet, which is about 4.5 meters above the plant floor. A 4-kilowatt variable-speed electric motor can convey material at up to 6,000 kg/h, and the flexible screw conveyor’s enclosed 65-millimeter-diameter polymer conveying tube prevents fugitive dust from getting into the plant. The flexible screw conveyor operates until the floor hopper is empty or the storage hopper reaches a preset weight, which is indicated by load cells installed under the storage hopper.

The dust collector is mounted on the discharger’s frame, and its tubing is connected to an annular gap in the tube top near the bag-spout clamp ring. When activated, the dust collector pulls air and dust through the annular gap, ensuring that no fugitive dust escapes from the tube into the plant before the bag spout is secured to the tube top. During bag unloading, displaced air and dust in the floor hopper move through the annular gap to the dust collector, a filter prevents dust from escaping with the outflowing air. When a bag is empty, the operator manually activates the dust collector to pull in air and dust from the bag, collapsing it and preventing fugitive dust from escaping when the bag is disconnected from the telescoping tube.

**Bulk bag discharger seals the deal**

Since installing the first bulk bag unloading and transfer system, ProMinent has worked with the supplier to develop an additional system for feeding the sodium silicofluoride powder to two storage hoppers. “In some cases, a water treatment plant may have two independent pipelines, each with its own fluoridation system,” says Neville McKee, ProMinent sales manager. “When this occurs, we can configure a single bulk bag discharger and floor hopper to feed two storage hoppers by incorporating two flexible screw conveyors with the single floor hopper and still be well within the system’s capacity.”

The supplier’s system is the only one that the company uses for fluoridation treatment plants. “We’ve found the supplier’s bulk bag discharger with double-wall telescoping tube to be the best available equipment to use in our fluoridation systems to handle a toxic powder with minimal risk of dust escaping,” says McKee. “The double-wall telescoping tube is a key element in the entire system and the only way to go to obtain extra protection against dust leakage.”

**Note:** Find more information on this topic in articles listed under “Bagging and packaging” and “Mechanical conveying” in Powder and Bulk Engineering International’s comprehensive Article Index at PBE/I’s website, www.pbeinternational.com. You can also purchase copies of past PBE/I articles there.

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