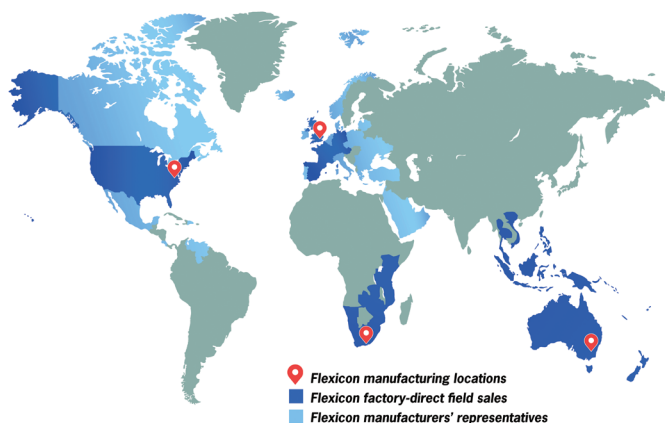




Bulk Bag Discharger Systems Handle Fluoride Powder for Potable Water Treatment

Y-0251



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Bulk Handling System Triples Capacity, Cuts Staff by Two at Theo Chocolate

SYDNEY, AUSTRALIA — For many years various Australian authorities have been slowly installing water-fluoridation plants in a general endeavor to promote dental health. In the last few years, though, the pace of fluoridation has quickened as various states have introduced fluoridation programs, backed by state government subsidies. Queensland, for example, decreed in 2006 that 90% of Queenslanders would have access to fluoridated water by 2012.

ProMinent Fluid Controls Pty Ltd. has supplied more than 60 fluoridation systems over the past 25 years. Many of the earlier installations were for rural water supplies in relatively small water treatment plants. Initially, 55 lb (25 kg) bags of sodium silicofluoride powder (Na_2SiF_6) were manually loaded into a hopper; later installations used a vacuum loader designed by ProMinent. A dry chemical feeder meters the Na_2SiF_6 into a mixing tank of water, where it is dissolved before being added to the water supply. (Other chemicals used for fluoridation are sodium fluoride powder and hydrofluorosilicic acid).

Dust control

More recently, however, the company has supplied equipment for much larger plants, including five that started up in Queensland around the end of 2008. The plants range in size from approximately 33 MGD (125 MLD) to 200 MGD (750 MLD) and serve more than 50% of Queensland's population of approximately 4.5 million, says Neville McKee, a ProMinent sales manager.

For plants of this size, ProMinent has designed a fully automated process in which the Na_2SiF_6 is completely contained in a sealed transfer system from the time it is received until the moment it is put into the mixing tank. Sealing is important for dust control, because the plants use up to 1,930 lb/d (875 kg/d) of Na_2SiF_6 , which is subject to strict regulatory control. Bulk bags of Na_2SiF_6 are unloaded into a transition or floor hopper, from which a flexible screw conveyor transfers the material to a storage hopper that feeds the mixing tank.

The transition hopper is small, with a capacity of only 4.9 cu ft (60 l). In contrast, storage hoppers may be as large as 309 cu ft (8,750 l) or more for a 200 MGD (750 MLD) plant, and designed to hold up to seven days' supply of Na_2SiF_6 .

The major pieces of equipment are the bulk bag discharger, a dust containment system, and the flexible screw conveyor, all supplied by Flexicon Corp. (Australia) Pty Ltd., Brisbane. Bulk bags of 2,200 lb (1,000 kg) are lifted into place on the discharger frame by an electric hoist and trolley on a cantilevered I-beam.

Powder is discharged from the bag into the transition hopper through a double-wall TELE-TUBE® telescoping tube. The tube is secured to the bag spout by a patented SPOUT-LOCK® clamp ring that creates a dust-tight



Two flexible screw conveyors feed fluoride powder from the bulk bag discharger into two seven-day storage hoppers from which the powder is metered into two mixing tanks for dosing into the main water supply.



Powder remains enclosed from the time it is received until it enters the mixing tanks. The BAG-VAC dust collector, on the right of discharger frame, prevents any dusting during bag loading and removal and collapsing of empty bags.

seal, while the bottom of the tube is connected to a collar in the lid of the sealed hopper.

The clamp ring, in the open position, is raised pneumatically to the bag spout. The spout is pulled over the rim of the tube's inner wall and the ring is locked in place over it. At this point the pneumatic pressure that raised the tube is released, causing the telescoping tube assembly to exert downward pressure on the spout. The continuous downward pressure on the bag keeps the spout taut at all times and helps maintain a steady flow by preventing excess material in the spout from bulging outward and creating dead spots, or falling inward and restricting the flow.

The double-wall telescoping tube is a key element in the entire system, says McKee. In this design, errant particles are drawn into the dust collector through an annular gap that encircles the bag spout seal. "This is the only way to go to obtain extra protection against dust leakage," he says.

Flexicon's BAG-VAC® dust collection system is activated prior to connecting the telescoping tube to the bag. The system, attached to the discharger frame, conveys dust pneumatically to a water trap tank. Once the clamp ring has been secured, the dust extractor is turned off and the spout drawstring is untied, allowing the powder to flow into the transition hopper.

The dust extractor remains inactive throughout the unloading process. However, air displaced by the flow of material exits via the dust collection system. A filter prevents Na₂SiF₆ from being entrained in the outflowing air.

Stopping the flow is a cinch

A special feature of the unloader unit is a pneumatic POWER-CINCHER® flow control valve that can close the bag at any time, so that a partially empty bag can remain in place until more material is needed. This is important for the fluoridation plants, which use approximately 265 lb/d (120 kg/d) of Na₂SiF₆ per 26.4 MGD (100 MLD) of water. The cincher also helps to keep moisture out of the bag and can isolate the bag in the case of an emergency.

Promoting flow are FLOW-FLEXER® bag activators — two pneumatically driven plates that rhythmically raise and lower opposing bottom edges of the bag to direct material to the outlet. As the bag empties, the stroke of the plates lengthens, forming the bag into a steep V shape and promoting total evacuation. An adjustable timer controls the frequency of the strokes.

The dust tight system is vented to a Bag-Vac dust collector that removes residual powder and collapses the empty bag prior to tie off, preventing dust generated when empty bags are flattened manually.

As mentioned earlier, a flexible screw conveyor transports the Na₂SiF₆ from the floor hopper to a storage hopper that feeds the mixing tank. The conveyor consists of a rotating, stainless steel spiral screw, housed in a 2.5 in. dia (65 mm dia) polymer tube. The lower end of the roughly 16.5 ft long (5 m long) tube passes through the wall of the floor hopper, near the bottom, and the top end discharges the powder through a chute into the top of the storage hopper some 14.5 ft (4.5 m) above the plant floor.



Double wall TELE-TUBE® telescoping tube provides extra protection against dust leakage during transfer from the bag. Tube is secured to the bag spout by a SPOUT-LOCK® clamp ring that creates a dust-tight seal.



Fluoride powder flows from double outlet hopper through sealed connections to the two flexible screw conveyors that move it to the two storage hoppers.

A self-centered conveyor

As the screw rotates, it self-centers within the tube, providing ample clearance between the screw and the tube wall to prevent grinding of the product. A 5 hp (4.0 kW) electric motor, located above the discharge point, rotates the screw at a variable rate of up to 13,228 lb/hr (6,000 kg/h). The flexible screw conveyor is inherently enclosed throughout its length to avoid airborne dust.

As the bag's contents empty into the floor hopper, the conveyor is activated. The transfer of powder to the storage hopper continues until either the transition hopper is empty or the weight of the storage hopper reaches a preset high level, as indicated by four load cells underneath the hopper. The control system signals the conveyor to stop when the high level is reached.

From the storage hopper, a dry chemical feeder meters the fluoride powder into a mixing tank through a sealed unit that prevents the escape of dust. The flow of powder is automatically matched to the inflow of water to the tank in a ratio that results in a 0.2% Na₂SiF₆ saturated solution. The tank has a high-speed mixer and a retention time of 10 min.

Finally, the solution is carefully metered into the flowing water supply by a peristaltic pump (or a progressive cavity standby pump). The dosage rate varies from 0.6 to 1 ppm (0.6 mg/l to 1 mg/l), depending on local requirements.

In rare cases, a water treatment plant may have two independent pipelines, each with its own dosing system. This situation occurs, for example, when a town or city has grown and added more treatment capacity.

These cases require separate storage hoppers and dosing systems for each pipeline, says McKee. However, a single bulk bag discharger and one transition hopper can feed two storage hoppers by incorporating two separate flexible screw conveyors into the single common transition hopper. Feeding two storage hoppers is well within the capacity of the system. McKee points out that a single conveyor delivers material at a rate of around 11,000 lb/h (5,000 kg/h), while the seven-day storage capacity of a large hopper is only about 19,250 lb (8,750 kg).

The Flexicon system is the only one that ProMinent uses for fluoridation plants, says McKee. "We have only ever promoted Flexicon bulk bag unloaders with double-wall telescoping tubes for fluoride, as we found it to be the best available to handle a toxic powder with minimum risk of dust," he says. "I think it would be a brave water supply authority to try a different brand at the moment, as we have promoted this since the application arose for bigger bulk type fluoride installations (about three years ago)."



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