New installation

Bulk bag filler helps company grow bottom line

A company that recovers nutrients from wastewater and then converts them to fertilizer pellets uses a gain-in-weight bag-filling system to efficiently fill the pellets into bulk bags.

Founded in 2005, Ostara Nutrient Recovery Technologies Inc., Vancouver, B.C., provides nutrient recovery and phosphorus management solutions for wastewater treatment facilities. The company's patented chemical precipitation process removes phosphorous and ammonia (nitrogen) from a treatment facility's dewatering stream and creates highly pure crystalline pellets that are marketed as a commercial fertilizer called Crystal Green. To transport the fertilizer from a treatment

The struvite pellets, which are stored in four flexible-fabric storage silos directly above the bulk bag filler, discharge from a silo to a common feed chute that directs them into a bulk bag.

facility to a fertilizer distributor, the company needed to find a reliable way to fill the pellets into bulk bags.

Recovering nutrients from wastewater

In ecologically sensitive areas, many municipal wastewater treatment facilities have mandates that limit the amount of phosphorous and ammonia that can be discharged into a watershed. To ensure regulatory compliance, a facility must remove a percentage of these chemicals from the wastewater stream before the treated water can be discharged from the facility. To accomplish this in an environmentally friendly manner and generate a revenue-producing product, Ostara developed a proprietary technology that removes up to 90 per-

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After a bulk bag is filled, the bag-filling system's powered roller conveyor moves it out of the filling zone to an indexing roller conveyor.

cent of the phosphorus and 40 percent of the ammonia from the sludge-dewatering stream.

The controlled process creates magnesium ammonium phosphate hexahydrate pellets (also called *struvite*), which are composed of 5 percent nitrogen, 28 percent phosphorous (as phosphorous pentoxide), and 10 percent magnesium. The mineral-rich struvite pellets are used as a slow-release fertilizer, providing nutrients that promote plant growth in turf, nursery, and other specialty agriculture applications. Removing the phosphorus and ammonia from the dewatering stream also helps prevent struvite scale formation in pipes, pumps, and valves, which is a problem that can severely impact a facility's operation, efficiency, and maintenance costs.

To make struvite pellets, the company adds magnesium chloride and, if necessary, sodium hydroxide to a concentrated dewatering stream and feeds it into a fluidized-bed reactor, in which minute struvite particles begin to form via a controlled chemical precipitation process. The controlled reaction method and retention time cause the struvite particles to layer and grow in diameter, like pearls, until they reach the desired size, which is typically between 1 and 3.5 millimeters.

The pellets discharge from the reactor in a water stream that carries them to a dewatering screen. The pellets are then moved through a dryer with a cyclonic dust collector to remove surface moisture and any dust from the pellets. A bucket elevator gently moves the pellets from the dryer to a three-deck classifying screener, which sizes the pellets into four product categories, each of which is conveyed to a dedicated flexible-fabric storage silo. An operator later discharges pellets from a silo into a palleted bulk bag, which a forklift moves to a storage area prior to transport to a fertilizer distributor.

Finding a bag-filling system

In 2007, the company successfully completed several field trials using a single-reactor installation to treat a small percentage of the wastewater streams at wastewater treatment facilities, ethanol biofuel plants, and food processing plants in the US and Canada. The next year, the company began planning its first full-scale commercial operation for the Durham Advanced Wastewater Treatment Facility in Tigard, Ore. Because this multiple-reactor installation would treat 100 percent of the wastewater stream, the company needed to find a cost-effective and efficient bag-filling system to fill 40 tons of pellets per month into polyethylene-lined, 1-ton-capacity bulk bags.

"When we first started searching for a bag-filling system, we looked at three different equipment suppliers," says Aynul Dharas, Ostara vice president of projects. "We found one supplier's system better suited to our application than the others. Their bag-filling system was robust and simple to operate, requiring just one operator. And the system suited what we were trying to achieve — four silos feeding into one chute to fill the bags. It also was the best price, which was another important factor for us, so we decided to purchase one for the Oregon facility."

This supplier, Spiroflow Systems, Monroe, N.C., supplies standard and custom powder handling equipment, specializing in bulk bag fillers and dischargers, mechanical and pneumatic conveyors, small bag packers and unloaders, and flexible storage silos.

The bulk bag filler

In spring 2009, the supplier delivered one model C2-2R bag-filling system to the Oregon wastewater treatment facility, and Ostara engineers installed it under a large structural steel frame that holds the four flexible-fabric storage silos. A three-position slide-gate valve installed at each silo's outlet controls pellet discharge, and a common feed chute below the slide-gate valves directs the pellets into a bulk bag. The bulk bag filler is 60 inches wide by 74 inches deep by 110 inches tall, its filling zone where the pallet sits is about 15 inches above the floor, and the filler's framework sits on load cells for accurate gain-in-weight bag weighing. The filler requires an 80-psi compressed-air source (at 7.5 cubic feet per cycle) to operate its pneumatically actuated quick-release bag-loop hooks, inflatable neck seal, bag-liner inflator, and air springs.

The bag-liner inflator's venturi combines compressed air with free air to create a positive pressure that inflates the bag in about 15 seconds.

To fill a bulk bag, an operator places an empty pallet on a powered roller conveyor in the filling zone and hangs the bulk bag's bag loops in the loop hooks located on the bag-hanging frame. Next, the operator pulls the bag's neck over the inflatable neck seal, which is attached to the end of the filling nozzle and creates a dust-tight seal with the bag when inflated. The filling nozzle is a dual concentric filling spout with an integral bag-liner inflator that allows the pellets to enter the bag by gravity through the center annulus and the displaced air to exit through the outer annulus. The bag-liner inflator's venturi combines compressed air with free air to create a positive pressure that inflates the bag in about 15 seconds.

The operator accesses the filler's custom-programmed controller to close the loop hooks and inflate the neck seal, bag liner, and air springs, which are installed under a vibration table in the filling zone. When inflated, the air springs raise the vibration table and pallet above the roller conveyor to provide a secure filling platform. The operator then selects the silo to be discharged and activates the system, and the controller opens the appropriate slide-gate valve to begin the bag-filling process. As the pellets fill into the bulk bag, the load cells continuously send weight readings to the controller, and the vibra-

tion table's two variable-frequency 1-horsepower motors activate as programmed to vibrate the pallet and bag to consolidate the pellets.

When the bag is about 95 percent full, the controller partially closes the slide-gate valve to slow the filling rate to a trickle for the remaining 5 percent. Once the bag hits the target weight, the controller closes the slide-gate valve, opens the loop hooks, and deflates the neck seal and air springs to lower the pallet onto the powered roller conveyor. The controller also prints out a label detailing the bag weight, pellet size, date bagged, bag sequence number, and other pertinent information to ensure quality control. The operator then puts the label on the bag, removes the neck seal from the bag, and activates the powered roller conveyor to move the palleted bag out of the filling zone to an inclined gravity roller conveyor for indexing.

Reliable, efficient bag filling

Since installing the supplier's bag-filling system in the Oregon facility, Ostara has purchased seven more systems for wastewater treatment facilities in the US, Canada, and the UK, and has plans to purchase more. "The whole bag-filling process only takes a couple of minutes; it's very fast," says Dharas. "And the bag-filling system has a low air consumption and energy draw and is very reliable, which keeps maintenance and energy costs low and minimizes downtime."

The bag-filling system is easy to install and easy for the operators to use. "We gave the supplier some feedback from our operators, and they were able to modify some things for us based on our input," says Dharas. "They've continued to improve the bag-filling system and have come up with some newer models that are even easier to use and require less maneuvering from the operators than the earlier model. Since we've been involved with the supplier, we've worked together to make a better bag filler."

According to Dharas, the supplier has been responsive when the company has had technical or operational issues with the equipment or needs additional equipment. "A couple of times we've been caught behind the eight ball and needed a system in a hurry, and they've been very understanding and able to deliver when we've needed the equipment within a tight timeline. They've always come through for us." **PBE**

Note: Find more information on this topic in articles listed under "Bagging and packaging" in *Powder and Bulk Engineering*'s comprehensive Article Index in the December 2011 issue and at *PBE*'s website, www.powderbulk.com. You can also purchase copies of past *PBE* articles at www.powderbulk.com.

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