

Figure 1: Tampa Bay Seawater Desalination Plant



POWDER HANDLING EQUIPMENT AT A U.S. DESALINATION PLANT



When operating at full capacity, the plant provides the Tampa Bay region with approximately 10% of its drinking water.

By **David Boger**



Figure 2: Two Bulk Bag Unloaders Unload and Transfer 4000-6000 lb (1814-2722kg) Per Day of Diatomaceous Earth (DE) for Tampa Bay desalination plant's DE Filtration System. The Crane Deposits a Lifting Frame Holding the Bulk Bag onto the Unloader Frame.

The 30,000 sqft (2787 sqm) Tampa Bay Seawater Desalination Plant produces up to 25 million gallons (94.6 million-l) of drinking water per day, making it the largest seawater desalination plant in North America. Since March 2007, the plant has desalinated over 3 billion gallons (11.4 billion-l) of drinking water from the Tampa Bay. www.flexicon.com

In 2005, however, the plant was shut down, as it could not meet the expected operational sustainability. Tampa Bay Water, the government agency responsible for the plant, assigned remediation work to American Water and Acciona Agua, through their operating partnership American Water-Pridesa, a group that has designed and built more than 50 desalination plants worldwide.

Among the firm's many improvements is the addition of Precoat Filtration using a bulk handling system for diatomaceous earth. This has proven to be instrumental in re-establishing the plant as a major source of drinking water for the Tampa Bay region.

Reverse Osmosis Converts Seawater

Desalination plants rely on reverse osmosis (RO), which uses high pressure to force water through semi-permeable membranes that remove salt from seawater. To ensure efficient RO, seawater must be pretreated to remove particulates. During remediation at the Tampa plant, American Water Acciona Agua improved pretreatment by adding coagulation and flocculation, improving the operation of the existing sand filters and installing a diatomaceous earth (DE) filtration system to eliminate microscopic materials from the water prior to RO, reports Nacho Lopez, construction manager of the Tampa project.

DE is a silica powder (hydrated silicon dioxide) comprised of the cell walls of phytoplankton called diatoms. Applied to the pressure side of filter elements, DE traps micron-size particles that would otherwise pass through ordinary filter media. DE powder is added to seawater upstream of the filter, forming a cloud of DE particles that coats the filter medium and, in turn, traps solid contaminants as water passes through the DE coating. When contaminants build up, indicated by pressure increases, the filter is backwashed, after which another dose of DE is added to the water to re-coat the filter medium.

Figure 3: A Bag-Vac™ Dust Collector, Mounted on the Bulk Bag Unloader Lifting Frame, Vacuums Displaced Air and Dust, and Collapses Empty Bags Dust-Free Prior to Tie-off and Removal. The Bulk Bag is Supported in a Lifting Frame.



CASE STUDY



Figure 4: The 63 cu ft (1.8 cu.m) Capacity Hopper Holds the Contents of a 900 lb (408 kg) Bulk Bag Allowing Diatomaceous Earth to Transfer, Unattended, through the Flexible Screw Conveyor to the Tank. Load Cells Under the Unloader Frame Transmit Weight Loss Information to a PLC to Achieve Accurate Batch Weight Transfer.

The Tampa Bay plant consumes 4000 to 6000 lb (1814 to 2722 kg) per day of DE, which arrives in 900 lb (408 kg) bulk bags that are stored in a temperature- and humidity-controlled area to prevent compaction of the material. When the RO process calls for DE, a crane moves a bag from storage to either of two bulk bag weigh batching systems that feed the DE to a 300 gal (1136 l) tank where it is put in suspension with water to a 5% concentration. The suspension is then metered into the saltwater upstream of the filter by peristaltic pumps.

System Moves DE Dust-Free

The DE bulk handling equipment, produced by Flexicon Corp., Bethlehem, Pennsylvania, USA, consists of two identical systems, allowing cleaning and maintenance of either system with no interruption in the movement of DE from the bulk bags to the dilution tank where it is utilized.

Each system consists of a bulk bag unloader with loss-of-weight batching controls and an integral flexible screw conveyor.

The bulk bag unloaders measure 5 ft (1.5 m) square. Four vertical extension posts are adjustable in overall height from 14.5 to 19 ft (4.35 to 5.8 m) to accommodate bulk bags from 36 to 84 in. (914 to 2134 mm) tall. The unloaders are equipped with Flow-Flexer™ bag activators that raise and lower opposite bottom edges of the bulk bag at timed intervals, improving material flow into the bag's discharge spout. As the bag lightens, the stroke of the pneumatic bag activators lengthens, producing a steep "V" bag shape to promote evacuation of material.

Also promoting flow are a Spout-Lock™ clamp ring that creates a high-integrity, sealed connection with the bag spout, and a Tele-Tube™ telescoping tube that applies continual downward tension on the bag as it empties and elongates.

Above the clamp ring is a Power-Cincher™ flow-control valve whose curved, articulated rods cinch the bag spout concentrically, allowing the operator to control the flow of material through the spout after releasing the bag spout

Figure 5: At the Flexible Screw Conveyor's Discharge End, DE Flows through a Transition Adapter into the 300 gal (1136 l) Tank where the DE is put in Suspension with Water.



drawstring, as well as to close and retie the spout of partially empty bags with no leakage or dusting.

DE flows from the bulk bag through the bag spout into a 63 cu ft (1.8 cu m) capacity surge bin able to hold the entire contents of one bulk bag, effectively doubling the unattended run time of dischargers having small surge hoppers.

The sealed system is vented through a port in the hopper lid to a dust collector that vacuums displaced air and dust, and collapses empty bags dust-free prior to tie-off and removal, eliminating manual flattening and associated dusting. Reverse-jet filter cleaning allows the vacuum system to operate at high efficiency, while extending filter life.

The hopper discharges into an intake adapter that charges a Model 1250 flexible screw conveyor with DE. A cantilevered arm on the bulk bag unloading frame supports the discharge end of the 15 ft (4.6 m) long conveyor tube which is inclined at 30-degrees. At the discharge end, a gear-drive assembly with a 1 hp (0.75 kw) motor rotates the flexible screw, propelling DE through the 2.625 in. (67 mm) OD plastic tube.

Loss of Weight Batching Provides an Accurate Dosing of DE

When the DE dilution tank has discharged its contents, a level indicator signals the PLC that controls the weigh batching system to initiate a weigh batching cycle by running one of the flexible screw conveyors. Load cells supporting the bulk bag unloader frame with integral conveyor, transmit weight loss information to the PLC which reduces the conveyor speed immediately before stopping the conveyor, achieving an accurate batch weight. "Based on the amount of weight lost, the PLC also indicates when the operator needs to load a full bag of DE into the unloader," says Lopez.

Weight loss information is shown on an LCD, part of a control center that includes a keypad, custom-engineered software, and an A/C inverter with adjustable speed control and a reversing feature for the conveyor drive.

When operating at full capacity, the plant provides the Tampa Bay region with approximately 10 percent of its drinking water.

About the Author

David Boger is Vice President, Sales & Marketing for The Flexicon Corporation with the world headquarters located in Bethlehem, Pennsylvania, USA. During his tenure at Flexicon, the author has previously held the positions of Service Engineer, Applications Engineer and Sales Manager. He holds a B.S. in Chemical Engineering from Rensselaer Polytechnic Institute, Troy, New York. Flexicon is a global leader in the design and manufacture of bulk handling equipment and custom-engineered and integrated plant-wide systems, with manufacturing facilities located on four continents. An extensive research and development program continually sets new standards for bulk handling equipment performance with entirely new designs, product improvements and equipment that complies with certifications required by governmental and industry associations for chemical, food, dairy and pharmaceutical applications - both nationally and internationally.

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