

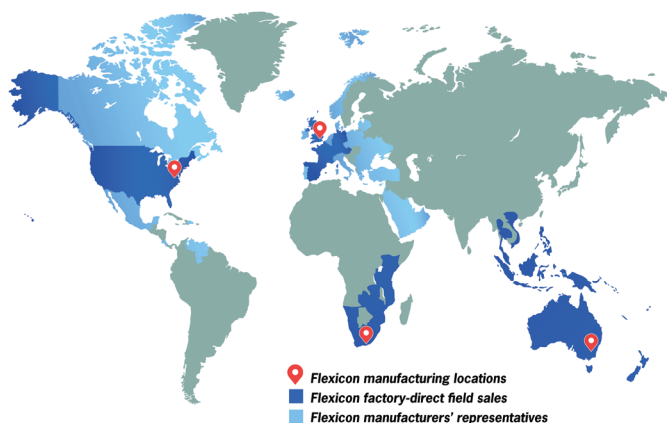
FLEXICON CASE STUDY



A bag-lifting frame is connected to the straps on the bulk bag and hoisted by a forklift into a cradle at the top of the unloader frame.

Bulk Handling System Keeps Explosives Plant Clean

T-0933



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Bulk Handling System Keeps Explosives Plant Clean

BIWABIK, MN — Minnesota Explosives Company manufactures bulk explosives that are used to blast taconite rock into small pieces, the first step in recovering iron ore. To produce the explosive compounds, sodium nitrate, which is a granular solid material, is added to a high-temperature, corrosive solution of ammonium nitrate.

Previously, the ammonium nitrate was pumped into a large, open box called a “slush box,” where the solution was circulated. An operator used a forklift to position a bulk bag containing sodium nitrate granules above the slush box and discharge it into the solution.

This operation frequently resulted in plugging of the pump and hoses in the vessel’s recycle loop, causing the ammonium nitrate solution to overflow the slush box and spill onto the floor. Furthermore, it required two operators — one to run the forklift, another to watch the slush box and stop the filling process to prevent overflows.

“We wanted a system that eliminated spillage of solution,” says Jon King, Minnesota Explosives’ general manager of operations. So the company replaced the open slush box with an enclosed material handling system consisting of bulk bag discharger, a flexible screw conveyor to handle the sodium nitrate, and two 230,000 lb (104,000 kg) capacity tanks in which to blend the material with the ammonium nitrate solution. “Except for some granules that occasionally need to be swept and put into the hopper,” remarks King, “It’s now a completely clean operation.”

In the new process, liquid ammonium nitrate is charged into two insulated blending tanks that are agitated and heated by steam coils. When the temperature drops below a setpoint, the agitators are activated and steam is fed to the coils, maintaining the desired solution temperature.

A flexible screw conveyor transports granular sodium nitrate from the bulk bag unloader to the heated tanks, where it dissolves into the ammonium nitrate. The resulting solution is transferred to a blend table, where it is combined with a mixture of four fuels, one of which serves as an emulsifier. The emulsification is pumped to a holding tank, and later pumped to another area of the plant, where solid ammonium nitrate prills are added via an auger. The final product is then discharged into a truck for delivery.

Discharging sodium nitrate from bulk bags

Each batch consumes 10,000 lb (4,535 kg) of sodium nitrate supplied in five 2,000 lb (907 kg) bulk bags, which are emptied using a bulk bag unloader manufactured by Flexicon Corporation, Bethlehem, PA. The unloader has a removable bag-lifting frame that connects to straps on the bulk bag, and is hoisted by forklift into a cradle at the top of the unloader frame. As the bag empties and elongates, POP-TOP™ bag extension devices mounted on the top of the frame stretch the bag into a cone



The unloader employs POP-TOP™ bag extension devices that stretch the bag into a cone shape as it empties, promoting total discharge of sodium nitrate granules.



A SPOUT-LOCK® clamp ring creates a high integrity seal between the clean side of the bag and the clean side of the equipment, while a TELE-TUBE® telescoping tube maintains tension on the spout to elongate the bag as it empties and elongates, promoting complete discharge.

shape, promoting total discharge of material from the bag into the hopper.

The interface between the bag spout and the 3 cu ft (0.085 cu m) hopper consists of a SPOUT-LOCK® clamp ring positioned atop a TELE-TUBE® telescoping tube. The clamp ring creates a high-integrity, dust-tight connection between the clean side of the bag outlet spout and the clean side of the equipment. The telescoping tube is raised pneumatically, allowing the clamp ring to connect with the bag spout, and then lowered, applying continual downward tension to elongate the bag and keep the spout taut, preventing material in the spout from bulging outward (creating dead pockets) or falling inward (creating flow restrictions).

A pneumatically-actuated POWER-CINCHER® flow control valve regulates material flow from the bag. The device contains a series of curved, articulated stainless steel rods that cinch the bag spout concentrically to eliminate leakage, and open to a diameter wider than that of the spout to allow unrestricted discharge.

Conveying material to the blenders

Granular sodium nitrate is conveyed from the hopper to the blending tanks by three flexible screw conveyors also manufactured by Flexicon. Each 20 ft (6 m) conveyor consists of a specially engineered heavy-duty stainless steel spiral rotated within a flexible 4.5 in. (11 cm) O.D. polymer flexible outer tube by a 7.5 hp (5.6 kw) electric motor with gearbox located at the discharge end of each unit.

The intake end of each conveyor is equipped with a U-shaped trough that serves as a charging adapter. A section of the rotating screw passes through the trough, and the screw propels the material through the tube. The outer tube of the first conveyor is attached to the hopper with a compression coupling, and the intake end of the screw extends into the hopper.

The first conveyor transports material from the hopper at a 45-degree incline and discharges into the charging adapter of a second, identical conveyor connected to it in series; together they move the material over a horizontal distance of about 28 ft (8.5 m). The second conveyor discharges into a diverter valve (operated manually with a two-way selector switch at the control panel), which feeds the product either directly into one blender or into the intake adapter of a third conveyor for transport to a different blender located 16 ft (5 m) away.

Capacitive proximity sensors monitor material levels in the hopper and throughout the system, signaling a controller to start and stop the conveyors. Level sensors in the transition regions (where the first conveyor discharges into the second and where the second discharges into the diverter valve) trigger the shutdown of a conveyor if the subsequent transition is full; when the high-level condition has cleared, the controller restarts the conveyor.

The new process eliminated slush-box-related spills, improving plant hygiene while reducing material waste.



A diverter valve directs material from the second conveyor directly into one blending tank, or into a third conveyor that discharges into another tank.



Material passes through the diverter valve and is charged to the first blending tank through a delivery tube.

"It's much easier to sweep a small amount of granular material than to clean up liquid spills, which had to be washed down into a sump and treated with the wastewater," King points out, "and we drop any granules we collect into the blender, so no material is wasted."

Costs were reduced by eliminating the need for an individual to monitor the level of the slushbox. One operator now performs all bag-unloading tasks.



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