



*TECHNICAL ARTICLE SERIES*

## WRP Conveying Pebble Lime Pneumatically Ends Elbow Failure



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CENTREVILLE, VA — The Upper Occoquan Water Reclamation Plant in Centreville, Virginia reclaims over 30 million gallons of water per day, providing a source of potable water for a population of more than 300,000 across portions of Fairfax and Prince William Counties. Its chemical treatment system relies on a steady supply of pebble lime that raises pH to levels at which phosphorous can be removed. The lime is conveyed pneumatically to six indoor silos during offloading, but it previously wore through elbow walls due to its three to four percent grit content and high conveying velocities.

In one typical failure, Robert Forgione, P.E. and his team at the water reclamation plant needed to clean up pebble lime and dust that had escaped from a failed elbow in the conveying line. While the hole in the elbow wall measured only 1/2-inch in diameter, it had spewed the abrasive powder over the building until the high pressure conveying system could be shut down. The blowout created a potential slip-and-fall situation, threatened acceptable indoor air quality levels, and put electronic controls at risk. He and his team found themselves dealing with elbow failures every six months. "We had to fix this situation," said Forgione, the director of the operations and maintenance division for the Upper Occoquan Service Authority (UOSA), but conveying high volumes of the abrasive material proved too demanding for every type of elbow Forgione, his mechanics and his engineers tested. Iron elbows lasted nearly a year and longer 10-foot radius long-sweep elbows lasted only 18 months.

Each line failure required a shutdown. Inspecting elbows became a frequent task while maintenance personnel became expert at replacing elbows to keep the silos in service. Each time an elbow required replacement, it consumed many hours and incurred unexpected costs. "It's very difficult for us to replace an elbow," said Forgione. "The elbows at ground level are not easily accessed and the ones on top of the silos are four stories up. It's a safety concern as well as a cost concern." Meanwhile, operations personnel were being diverted from their formal responsibilities to help with the cleanups. "We hit a brick wall," said Forgione. "We needed to make the elbows last longer and we needed it done fast."

Forgione became aware of a deflection elbow from HammerTek Corp. that had been installed at a nearby wastewater treatment plant in Alexandria, VA to solve an identical lime handling problem. Under Forgione's direction, a UOSA process control engineer and the mechanical manager toured the Alexandria facility. "They were very happy and hadn't had a single blowout since installing the manufacturer's Smart Elbow® design," the process control engineer said, also noting the cleanliness of their facility. "You could see they weren't having any of the problems with leaks that we were having."

The elbow is characterized by a spherical chamber that protrudes slightly beyond the desired 90 or 45 degree flow path, causing a loose ball of material to rotate slowly in the same direction as the air stream that powers it, gently deflecting incoming material around the bend. Self-renewing, the ball gradually releases material in a first-in, first-out progression, promoting directional change without affecting system pressure.

Forgione tested the Smart Elbow design for more than a year and, after finding no signs of wear, replaced all pebble lime elbows at the facility. Five



*The Upper Occoquan Water Reclamation plant has gone 16 years without an elbow failure after installing short radius Smart Elbow® deflection elbows.*



*Installing short-radius deflection elbows put an end to leaks, spills, replacements and associated costs encountered with other type elbows.*



45-degree, four-inch diameter elbows were installed where the trucks off-load their lime and twelve 90-degree, four-inch diameter elbows were installed at the tops of the silos. A custom alloy was specified based on characteristics of the pebble lime and the length and velocity of the pneumatic conveying system.

More than 16 years have elapsed since the installation of the deflection elbows at UOSA's facilities without a blowout. "With the Smart Elbow deflection elbow, we've eliminated the primary source of lime dust along with the hazardous conditions it creates," Forgione said. Maintenance and labor costs have been reduced, safety and air quality have been upgraded, and the buildings are visibly cleaner. He added, "The delivery was fast and our mechanics were able to install them quickly without complaints. If we ever get wear in an elbow anywhere in the plant, we'll replace it with one of these elbows."



*The Smart Elbow® deflection elbow features a spherical chamber in which incoming particles swirl in a slowly rotating ball, gently deflecting incoming material around the bend without impacting or abrading the elbow wall.*



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