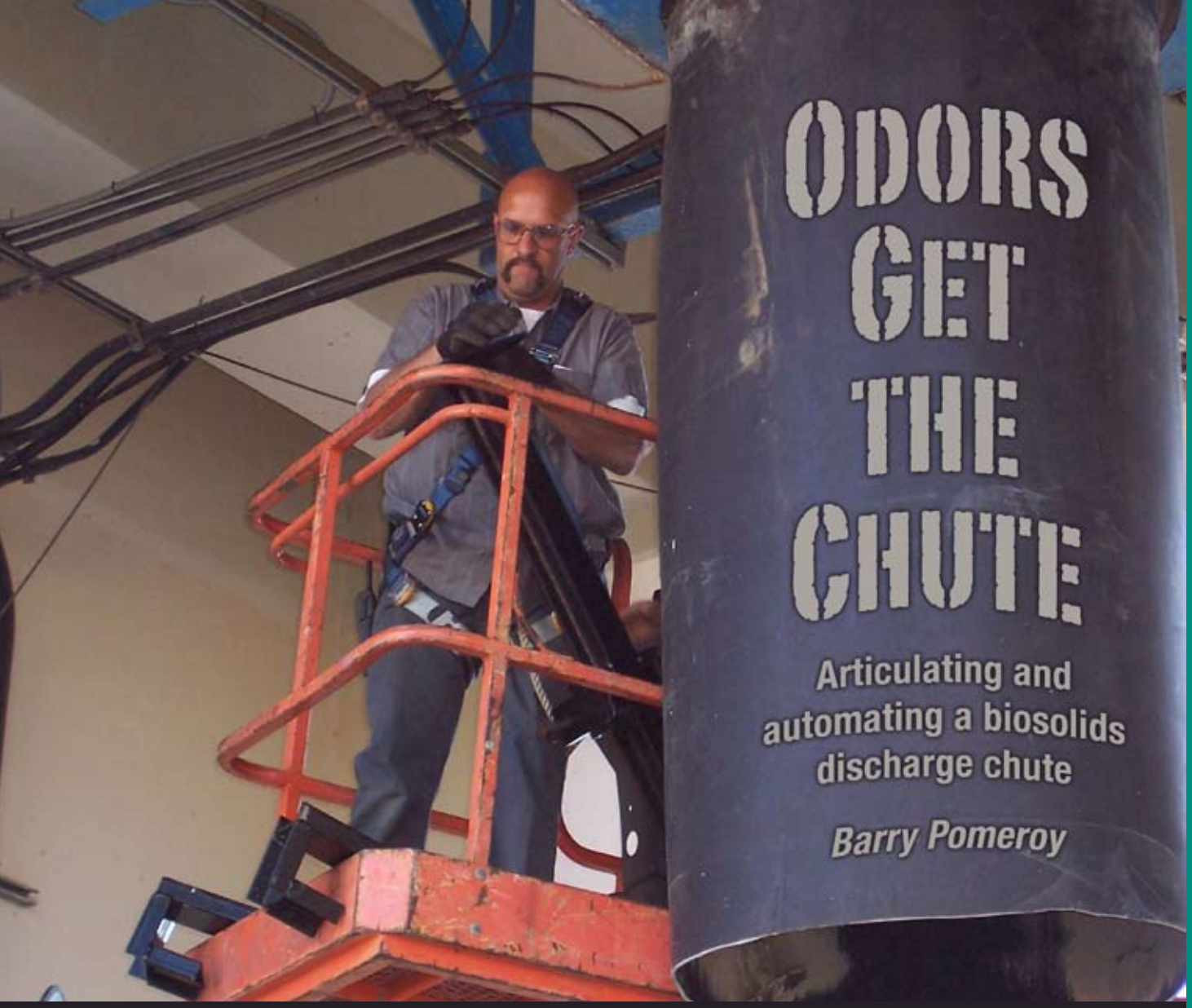

ODORS GET THE CHUTE

Articulating and automating a biosolids discharge chute

Barry Pomeroy

Tom Chalmers of the Vallejo (Calif.) Sanitation and Flood Control District begins installation of a pivoting hinge on the district's biosolids-loading chute. The hinged chute enabled the district to evenly load its solids-hauling trucks and control odors with an odor hood.

PHOTOS: VALLEJO (CALIF.) SANITATION AND FLOOD CONTROL DISTRICT STAFF

Operators at the Vallejo (Calif.) Sanitation and Flood Control District used a do-it-yourself approach to build an articulated chute that would be the solution to evenly loading their biosolids transfer trucks and controlling odors. The district dewaters its solids using belt filter presses and then conveys the material to a 95-ton (86-Mg) storage hopper. The solids are transferred by a rotary discharger into the solids-hauling trucks, which carry the material to a land application farm.

As part of a plantwide odor-control project, the district needed to find the most cost-effective solution to controlling odors while filling its hauling trucks from the biosolids storage hopper.

The most expensive solution would involve constructing a building long enough for trucks to traverse under the hopper to fill both the tractor and trailer. The estimated cost for this building was approximately $1.2 million in 1994. This configuration also would have required new, larger odor fans and odor scrubbers.

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Craig Lundgren gives Tom Chalmers a lift to complete installation of the hinge that allows the chute to pivot.

On the other end of the spectrum, the least expensive solution proposed was to build a hood with nearly the same outside dimensions as the truck beds, in which a feed-screw conveyor would deliver the solids to the truck while the truck remained stationary during filling. The concept of the hood was not only cost-effective, it also utilized existing odor fans and scrubbers.

Although the hood concept seemed to be the most cost-effective solution, it presented the challenges of how to maintain the filling operation if the screw conveyor assembly failed and how to deliver the solids to the trucks during the repair.

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The district's mechanical maintenance staff designed and built the hinges for both the trial period and the permanent installation.

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To automate the chute, the district's electrical and instrumentation staff tied the feedback from the weight cells on the solids hopper to the plant's distributed-control system. The discharge chute moves based on time and weight to get a fairly even and complete filling of the truck beds.

After some consideration, district staff realized that solids discharged from the hopper would be interrupted during repair and replacement. This was not an acceptable solution, so staff looked for a method that would enable the hopper to remain in operation, control the odors, and be able to be repaired and serviced while continuing to deliver product to the trucks.

The final solution also had to fill the truck completely and evenly while the truck remained stationary. This process had to be automated, as the hood would obstruct the view of the solids level in the truck bed as it filled.

Ideas for a solution included using a camera under the odor hood with a screen in the truck cab and installing a screw conveyor with multiple discharge points and air-operated valves controlled by sonic level sensors. After many discussions, it was suggested that the discharge chute could be hinged and automatically articulate back and forth, directing the solids all the way to the front and back of the truck bed.

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With the air ram in its relaxed state, the solids fill the front of the truck bed.

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When the weight sensors in the hopper indicate enough solids have been loaded into the front of the truck, the air ram activates and moves the loading chute to the rear.

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For the 26 months from its first trial through permanent installation, the Vallejo (Calif.) Sanitation and Flood Control District's articulated solids chute has operated without problems.

Test Run

Before the odor-control project design could be finalized, the district had 3 months to build and test the chute concept. Tasked with the design and construction of an articulating discharge chute, the district's in-house mechanical maintenance staff designed and fabricated a hinge with two pivot points. The test hinge was constructed with mild steel and used normal bolts for the pivots.

This design enabled the chute to deliver the solids far enough in both directions to fill the entire 20-ft-long (6-m-long) truck bed. As a trial, the hinge was mounted, and the chute was moved back and forth using a rope tied to the chute and pulled by a forklift.

Once this operation appeared to be successful, an air ram, used in assembly automation, was purchased and installed. By using a joystick control and temporary air lines to control the movement of the discharge chute, the concept was tested. It was a complete success. The chute could be articulated far enough to fill the entire truck bed completely and evenly.

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Installing an articulated and automated solids-loading chute enabled trucks from the Vallejo (Calif.) Sanitation and Flood Control District to remain stationary during loading. This also enabled use of a smaller odor hood, which saved the district money on its odor-control project.

Automating the Arm

Next, the district's electrical and instrumentation staff set out to determine if the operation could be automated using the treatment plant's distributed-control system (DCS) computer. A temporary control board was designed with solenoid-operated air valves. Running temporary wiring, the control board was connected to the DCS. Using the feedback from the weight cells on the solids hopper, the DCS was programmed to articulate the discharge chute based on time and weight to get a fairly even and complete filling of the truck bed. This operation was tested for a month with great success.

Final Installation

With successful testing under their belts, district staff members rebuilt the hinge and controls using more durable materials. The initial design was adopted without further modification. The hinge was removed, and the mild steel was coated for corrosion control. The hinge bolts were replaced with hardened steel bolts. The district's electrical and instrumentation staff constructed and installed the permanent control panel and did all DCS programming, including developing graphic display screens that show the chute position and the odor-damper valve's open–closed indication.

The automated articulating discharge chute was completely built in-house and has been successful at automatically and evenly filling the solids trucks. This project is a great demonstration of the technological achievement made possible by relying on the knowledge and experience of the district staff. This hinge has now been in use for more than 2 years with no problems.

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