2014 Honorable Mention

Long Prairie Digester Rehabilitation Project

By David Graham

The Long Prairie Digester is a wastewater treatment facility constructed in 2012 to process wastewater generated by food processing operations. The facility includes four reinforced concrete process tanks and one open-top receiving tank.

The enclosed process tanks vary in size. Two of the tanks measure 282 x 39 ft (86 x 12 m); one is 59 x 24 ft (18 x 7.3 m); and the other is 87 x 24 ft (26 x 7.3 m). The wall height of the enclosed tanks is 22 ft (6.7 m). The open-top receiving tank is 21 x 21 ft (6.4 x 6.4 m) with a wall height of 12 ft (3.7 m).

Fig. 1: Tank before repair

The tanks were originally constructed with cast-in-place concrete slab-on-ground floors, 18 in. (450 mm) thick insulated concrete form (ICF) walls, and topped with a precast concrete roof system. A polyurea lining material was sprayed over the interior wall insulation and the underside of the precast roof (Fig. 1).

The Problem

After original construction, the tanks were tested for watertightness. During the testing phase, the tank walls exhibited extensive leaking (Fig. 2 and 3).

The insulated form wall system made it impossible to determine where the leaks originated. It was immediately evident that removal of all interior insulation would be necessary to properly inspect tank walls, expansion, and construction joints.

After removal of interior insulation, the exposed walls revealed extreme honeycombed areas resulting from poor consolidation during original construction. Also, the ICF wall ties used consisted of a hollow tie without a waterstop feature; thus, water could be leaking from anywhere in the walls through existing voids or through any of the thousands of hollow ties.

The Repair Solution

The plan provided for repair of structurally deficient areas and protection of carbon steel wall ties while providing a smooth, level surface to receive a final protective lining system.

Due to the high volume and severity of poorly consolidated areas, it was determined that the tank walls required repair prior to final lining application. Honeycomb areas were chipped back to sound concrete and brought back with shotcrete to original wall plane using King Packaged Materials MS-W1 with poly fibers. These areas were not troweled and were left with a natural gun finish.

After repair of honeycombed areas, 6 x 6 in. W1.4 x W1.4 (152 x 152 mm W9.1 x 9.1) welded wire reinforcement was securely anchored to all wall surfaces. Wall surfaces were washed with

clean water and allowed to reach saturated surface-dry condition. A minimum of 1-1/2 in. (38 mm) of King Packaged Materials MS-W1 with poly fibers was applied to the wall surfaces and finished with steel trowel to provide a tight, level surface. All newly placed concrete was water cured for 7 days.

Site Conditions

The site provided many challenges during the life of the project. The existing tanks were constructed with the finished floor elevation 8 ft (2.4 m) below grade. The water table in this location was higher than the existing floor elevation, causing groundwater to seep into the tank through floor sumps and at the floor-to-wall construction joint. A dewatering plan was implemented that included installing dewatering wells around the tank perimeter to draw down groundwater elevation. This dewatering system was operated and monitored 24/7 to provide dry working conditions during shotcrete and protective lining operations.

The only access available to each of the tanks was from the roof, through existing 42 x 42 in. (1.1 x 1.1 m) roof hatches. No additional openings were allowed, thus limiting the size of access equipment that could be used to complete the work. Electric scissor lifts were selected to access the walls. Due to the small roof openings, the lifts were disassembled and lowered into the structure in pieces and reassembled inside the tank. The smaller tanks and areas with limited work area required scaffolding to reach all repair areas.

Fig. 2: Poorly consolidated concrete

Fig. 3: Honeycomb at cold joint

Fig. 4: Shotcrete placement

Fig. 5: Shotcrete placement at weir

Fig. 6: Completed repair

The construction schedule was compressed and required multiple operations to run concurrently in multiple tanks at the same time. Concrete demolition, abrasive blasting, welded wire reinforcement installation, and shotcrete application were all tasks which were required to take place at the same time.

Shotcrete Placement

To complete this project, 640 bulk bags of King Packaged Materials MS-W1 with synthetic fiber were used. The prepackaged dry material was placed into a Cemen-Tech MCD 10-150 mobile concrete dispenser, where it was mixed to the proper slump and conveyed into an Allentown Powercreter 20S shotcrete pump. Pumping distances varied from 200 to 300 ft (61 to 91 m) in length. Shooting wires were installed and shotcrete was placed by ACI-certified nozzlemen. The final finish was with steel trowel to provide a uniform surface to receive the final protective lining system (Fig. 4 through 6).

***David Graham**, Project Manager for PCiRoads, LLC, since 2007, is an ACI Certified Nozzleman for both dry- and wet-mix shotcrete. With over 30 years of experience in the shotcrete industry, he has managed numerous projects nationwide that include the use of shotcrete on buildings, bridges, tunnels, dams, silos, tanks, and soil stabilization.*

Honorable Mention

Project Name
Long Prairie Packing-Digester Rehabilitation

Project Location
Long Prairie, MN

Shotcrete Contractor
PCiRoads, LLC*

General Contractor
PCiRoads, LLC*

Architect/Engineer
BKBM Engineers

Material Supplier/Manufacturer
King Shotcrete Solutions*

Project Owner
Long Prairie Packing Co.

*Corporate Member of the
American Shotcrete Association