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# CRB
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# Repair and Protection of a 1950s-era Wastewater Digester Tank Structure: Gold Bar Digester No. 3

## EDMONTON, ALBERTA, CANADA

SUBMITTED BY RJC ENGINEERS

Wastewater Treatment Plant: Gold Bar Digester No. 3

Wastewater Treatment Plant (WWTP) repair and restoration projects can present uniquely challenging environments and the Gold Bar Digester No. 3 was no exception. At the Gold Bar WWTP, the plant completed process improvements to Digester No. 3 during one of the maintenance and facility upgrade programs, which required the digester to be taken out of service for an extended time. Although no sewage leakage had been previously observed, after the process upgrades were completed, the digester had to pass a hydrostatic tightness test using treated water before it could be returned to active service with sewage.

Unexpectedly, the digester did not meet this water tightness criteria (Fig. 1). To ensure that the digester met all regulatory and American Concrete Institute (ACI) requirements, the WWTP management immediately implemented a plan to investigate, design, and undertake a suitable concrete and leakage repair program that would serve the facility into the future.

One of the original structures at the Gold Bar WWTP, Digester No. 3 (circa 1955) is constructed of reinforced concrete and is approximately 100 ft (30 m) in diameter. It has a sloped conical-shaped floor, a circular perimeter wall approximately 31 ft (9.3 m) high and is enclosed with a roof slab. The bottom two-thirds of the digester are buried below-grade, while the remaining wall portions are either exposed to the exterior or shared with other buildings or interior access tunnels serving the plant. Along with the perimeter wall, twelve concrete columns support the roof structure from inside the digester's interior.

### DIAGNOSIS PHASE

As part of recent upgrades, a High-Density Polyethylene (HDPE) liner assembly had been installed on the upper portions of the interior wall surfaces and the underside of the roof structure. The HDPE liner was thoroughly tested during installation; therefore, it was generally assumed that the leakage was not occurring through this new liner, and the investigation and leakage repair program targeted solely the 1950s-era concrete wall and floor surfaces below.

To establish the potential sources of water leakage and the extent of any associated concrete repair required prior to waterproofing, an inspection of the digester's interior surfaces uncovered numerous concrete issues including cracking, cold joints, loose form-tie hole plugs, large areas of poorly consolidated and non-encapsulated aggregate (honeycombing), and void-ridden pour joints with debris embedded at the interface (Fig. 2). None of these conditions were determined to be the sole source of leakage, but all were considered during the design of the new coating.

Prior to specifying and developing details for the coating, structural analysis determined that the as-constructed reinforcing steel in the digester wall was close to "on-par" with current concrete reinforcement provisions. However, thermal and structural modelling determined that the digester wall was prone to significant temperature-related stresses and cyclical/seasonal movements, due to both the internal process and exterior environment.

Additionally, based upon the interior inspection and assessment, it was considered that the pre-existing coal tar coating (Fig. 3) was likely providing some level of waterproofing and concrete protection; however, the hydrostatic water tightness testing demonstrated that the coal tar assembly was no longer providing full waterproofing or containment, which was likely the consequence of its extended service life. The observed conditions substantiated the baseline water tightness testing results and aided in defining the potential sources of leakage and repair objectives.

## REPAIR EXECUTION

The structural repair and protection program was implemented in two phases. During the first phase, scaffolding was constructed inside the digester for the cleaning, concrete repair, substrate preparation, and coating application on the lower 21 ft (6.3 m) of interior vertical wall surfaces, up to the underside of the recently installed HDPE liner (Fig. 4).

Once the wall coating application was completed, reviewed, and tested for conformance with project specifications, the scaffolding was deconstructed and floor surface cleaning, repair, preparation, and coating application proceeded into the second phase.

Surface preparation was performed by heavy abrasive blasting to fully remove the existing coal tar coating. This surface preparation method resulted in a rough substrate with a Concrete Surface Profile (CSP) greater than 5 for the 23,600 sf (2,200 sm) of coating application area. Concrete surface pH testing was performed to confirm that the concrete substrates had been adequately cleaned of bond-inhibiting contaminants before proceeding with concrete repair and resurfacing (Fig. 5).

A pre-packaged mortar mix was applied to resurface and reprofile the substrate, effectively filling all the "peaks and valleys" of the abrasively blasted concrete and provided a uniformly textured substrate similar to CSP 3, which was the required surface profile for the coating application.

After priming the resurfaced substrate, a flexible polyurethane coating was applied using a heated, plural component

Fig. 1: Original construction of bridge and ramp in 1972

Fig. 2: Wood debris embedded at pour joint interface

Fig. 3: Partially removed pre-existing coal tar coating

sprayer to the specified dry film thickness, 100 mils (2.5 mm). As a safety consideration for future maintenance and cleaning work, granular quartz was seeded into the wet floor coating for slip-resistance on the sloped surface, with a subsequent tie-coat application to encapsulate the quartz.

Fig. 4: Access scaffolding set up inside the digester

Fig. 5: Determining substrate concrete surface profile (CSP) and pH testing

Fig. 6: Failure in original substrate during adhesion strength pull-off testing

In addition to the contractor's Quality Control and the on-site technical review and support from the material suppliers, Quality Assurance (QA) testing included thickness, adhesion strength pull-off testing, and holiday/spark testing (Fig. 6 and 7).

Upon completion of the interior coating program, hydrostatic testing was again performed using treated water, and the digester passed with no measurable water loss.

## CONCLUSION

The Gold Bar Digester No. 3 repair solution prevented leakage, protected, and extended the life of the existing concrete structure, and provided the facility management and operations team with confidence that their asset's operational performance will meet all regulatory and plant requirements.

Fig. 7: Holiday/spark testing

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