Coated, fabricated geomembrane modernizes Tempe's water infrastructure

By John Heap

Introduction

The primary water treatment system in the city of Tempe, Ariz., serves about 160,000 residents and includes two main facilities: the South Tempe Water Treatment Plant (opened in the 1980s) and the Johnny G. Martinez Water Treatment Plant (built in 1967). The Martinez plant is a 50-million gallon per day (MGD) facility named for a 41-year veteran of the city's water department.

The Martinez plant was selected for a significant overhaul to support the city's growing population and water security needs. This article describes the project, including the use of coated, fabricated geomembranes in its completion.

Modernizing Martinez

Both of Tempe's water treatment facilities are supplied by an ever-changing combination of water from the Salt River, Verde River, and the Central Arizona Project (CAP) canal system, which is part of the Colorado River network.

Additional well capacity along the canal systems also adds to the water supply. The water is delivered to Tempe's facilities via the Salt River Project (SRP) canal system.

The SRP system manages how water is distributed into the treatment infrastructure, based on precipitation and watershed conditions. Depending on the dominant source of the delivery, the water will possess slightly different characteristics. The Salt River's waters are higher in chlorides and total dissolved solids. Verde River water is higher in hardness.

In modernizing the Martinez facility, the city sought both an expansion-minded facility and one capable of greater operational efficiency. And, as with most public projects, considerable scrutiny was placed on keeping the facility's upgrades within budget.

The design engineering for the facility changes included increasing the capacity to 50 MGD, revamping an existing concrete clear well, replacing the aging pipes, and recontouring the entry flows to alleviate water loss that had become significant as the Martinez plant aged. The construction was implemented in a design-build scheme to optimize the project economics, with the general contractor working closely with city of Tempe employees on the works.

Stopping water loss

Halting the historical water loss was one of the main objectives in improving the facility, but recontouring entries and replacing pipes would not fully complete this goal.

The site's necessary design solutions would accomplish a great deal of the containment and efficiency goals; but the construction itself would introduce new points of potential risk.

PROJECT HIGHLIGHTS

OWNER
City of Tempe, Ariz.

DESIGN
Jacobs Engineering Group Inc.

GENERAL CONTRACTOR
PCL Construction Inc.

DESIGN-BUILD PARTNER (LINER)
Colorado Lining Intl. Inc. (CLI)

GM FABRICATION & INSTALLATION
CLI

GEOMEMBRANE
45-mil reinforced polypropylene from Carlisle Syntec

GEOTEXTILE CUSHION
12 ounce from SKAPS Industries

GEOTEXTILE COATING
Ecodur 201 from Castagra

John Heap is the owner and president of Colorado Lining Intl. Inc., based in Parker, Colo.

Photos courtesy of Colorado Lining

PHOTO 1 Blackouts, baffle wall section.

For example, the addition of three concrete baffle walls would provide significant control over dwell time as water moved through the system. Yet to add these baffle walls, the existing concrete required cutting, with a new foundation poured under the baffle walls to support the weight. This process would introduce numerous control joints that could increase the leakage potential in the system **(Photo 1).**

The lining company reviewed the design and proposed a cost-effective, fabricated geomembrane system that was further enhanced with an all-natural coating product. The addition of a targeted coating served to provide better leakage protection, notably at the mechanical joints where the geomembrane and concrete were connected.

Achieving optimal performance

The liner used in this project was a 45-mil reinforced polypropylene geomembrane.

Polypropylene geomembranes provide flexibility to meet the varying geometry of water treatment plants, which may include narrow chutes, vertical walls, steep and rough slopes, and large tanks or reservoirs. Polypropylene is also known for its longevity and is commonly selected for use in water storage infrastructure.

The concrete baffle system in Tempe, as in many other water and wastewater facilities, introduced many angles to the construction. Geomembrane flexibility was required, and reinforced polypropylene was the choice **(Photo 2).**

This geomembrane also offered a cost advantage in the project because the material was fabricated prior to installation. This enabled the fabricator/installer to use the site's precise measurements for seaming geomembrane panels ahead of site delivery. So once on-site, the larger panels were then moved into exact positions and secured, expediting installation, with some on-site seaming still required.

The selection of the coating was also key to achieving optimal performance in the containment system. This materials, made of an all-natural "veggie plastic," was originally developed in the 1990s for coating the decks of ferryboats in

PHOTO 2 Coating is applied along the baffle wall.

PHOTOS 3 AND 4 Aerial manlift—extrusion patching from tray.

Vancouver, B.C. The product exhibits a strong adhesion to steel and concrete, as well as to other products, which was excellent for the geomembrane-concrete security in this project.

The use of coatings to enhance the characteristics and performance of steel, concrete, and geosynthetics is increasing through the civil engineering sector. This movement has been aided by innovations in how the coatings are applied. The coating utilized in Tempe may have been used in the field for close to 20 years, but it was only in 2011 that a spray-applied version was developed to deliver the same quality. (Secondary containment has become a growth sector for these coatings, as has interior and exterior tank coating, canal coating, and coating of manholes, sewer pipes, and other elements of water infrastructure.)

The coating's high performance combined with the time and cost savings of spray application also added value to the project for the city of Tempe.

Additional geosynthetics used in the project included 12-oz cushioning geotextile installed under the liner, except on the rougher slopes; for those rougher zones, a geocomposite underlay was selected.

Meeting the challenges

The liner phase of the facility work began with the installation of epoxy-set bolts at the top of the wall structure. This was a challenging installation, because the wall was 25 ft. high and sloped at 1:1. Manlifts and harnesses were used so the installation technicians could access the upper bolting sections **(see photos 3 and 4).**

All mechanical attachments were designed flat-attached to the concrete so the best possible seal was achieved. Once the bolting operations were completed, the polypropylene geomembrane wall panels were installed. Due to the site layout, a stringent job safety analysis was required to make sure deployment and

mechanical operation could be accomplished safely. Two manlifts were used as the crew pulled up 24ft × 36ft prefabricated panels to cover the wall sections. They attached the liner the upper bolt run, leaving 4ft off the ends of the panels to allow for field welding.

Certified welding technicians (CWTs)* provided the expertise of the welding along the 1:1 slope zones. The CWTs worked out of the manlift while a separate operator controlled the movement down the slope. Prefabricating the panels saved time on this installation and also added an extra element of QA/QC to the panel connections with so many of the welds finalized in the fabrication facility.

Once the wall sections were installed in the first bay and north wall, the installation crew proceeded with the floor panels. The geomembrane was attached at the toe of slope to the wall panels. The other side of the run was flat attached along the edge of the baffle wall. Here, the addition of the coating to the mechanical system provided a strong secondary leakage prevention strategy at a critical point.

The batten stripping system was 0.25in. × 2in. punched at 6in. on-center for all underwater attachments. Wherever attachments would be less than 25ft of head pressure, all exposed concrete and batten were coated to fully secure the connection points.

As the civil contractor completed each section of baffle wall construction, the lining crew followed, with both teams moving from west to east. It proved an efficient process, exemplifying design-build strategy and how fabricated geomembranes are used successfully in them.

The last phase of this project required close coordination and planning. To apply the spray-coating to the critical connection points—such as at the waterstops and all other underwater connections—a 400ft hose was brought into the facility. Only small sections of the roof could be taken back in phases to allow the hose in. To make the process more efficient, the spray system followed the same path of construction as the concrete work and geomembrane installation **(Photo 5).**

The project was completed on time and on budget. It demonstrated the exciting opportunity in how coating products combined with geomembranes can alleviate leakage risks in difficult-to-access areas. The use of design-build strategies and fabricated geomembranes helped the city of Tempe meet all of its goals for cost, time, and performance.

Tempe's watertight storage and system capacity are now secured for decades.

* *The CWT program is administered by the International Association of Geosynthetic Installers, www.iagi.org*

PHOTO 5 Column attachments—wall and floor with column sections.

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