By Patricia Stelter, Gary Austerman, and Andrew Lister

Pittsburgh International Airport Institutes Innovative Fuel-Containment Solution

Environmental responsibility takes top priority for the air force reserve station at the Pittsburgh International Airport fuel facility. Thousands of gallons of jet fuel are stored and pumped each year, posing a significant environmental threat if the fuel was to reach groundwater levels. In an effort to minimize stormwater damage and environmental impact, engineers designed a detention pond that serves as the collection area for the facility's stormwater and for potential contaminated runoff or spills.

Photos: ADF Environmental

Normally, the detention-pond slopes would consist of a series of poured concrete slabs, but over time, water works its way underneath the slabs, eroding the subgrade. The underscour of the subgrade robs the slabs of needed support, and they began cracking under their own weight. This cracking diminishes the detention pond's ability to withstand erosion, leaving the structure open for containment problems.

"The detention pond area was located in an area of unconsolidated random fill that would cause cracking of the concrete slabs and fail," explains Gary Austerman of Burns & McDonnell (Kansas City, MO), consulting engineer for the Army Corps of Engineers. "The soil requirements necessitated a stable material for the sideslopes and bottom that would allow some settlement without failure."

The Facility's Challenge

"The facility needed a detention pond with a system that could withstand erosive forces on a long-term basis and provide a higher degree of containment," continues Austerman. "We needed something that wasn't going to fail."

Several options were discussed, but in the end a combination of a geosynthetic clay liner (GCL) and a cellular confinement system was specified. The combination offered engineers a double-layered defense, guarding against containment and the erosive effects from runoff. Presto Products (Appleton, WI) was selected to provide the cellular confinement system because of its experience in working with similar types of applications and the ability to securely protect the GCL with its tendoned system.

Presto's representative, Andrew Lister, explains, "In order for the GCL to become impermeable, it must become hydrated. It is critical to provide a cover with a uniform thickness and weight to prevent uncontrolled expansion of the liner, which could eventually cause a failure."

"Although this was the first time that I had specified this particular solution, all the data pointed to it as the best possible alternative." explains Austerman.

The Geocell Solution

Presto's Geoweb cellular confinement system is an engineered expandable, honeycomb-like polyethylene cellular structure that provides a wide variety of flexible erosion control treatments for slopes, channels, and earth-retention structures. A geocell lining system can use a variety of infill materials, depending on variations in hydrologic and hydraulic conditions as well as aesthetic requirements. In this case, 4,000-psi concrete was specified with the perforated cellular confinement system. The perforated system contains holes specific in size, quantity, and spacing, providing increased frictional interlock with the concrete infill.

Poured concrete provides hard, durable protection for slopes that are exposed to hydraulic or mechanical stresses. Concrete quantities and costs can be controlled because there is a defined, uniform thickness to the sections. Additionally, special compacted granular-bedding layers necessary with conventional poured concrete slabs can be omitted.

Embankments armored with the Geoweb system retain flexibility and are able to conform to potential subgrade movement. The system also prevents uncontrolled cracking of the concrete and reduces the

chances of piping or undermining.

The addition of the GCL provides the barrier needed between the contaminated runoff and the environment. However, its presence changes the way the system is anchored. Traditional earth-anchoring systems could not be used because the integrity of the GCL would be jeopardized if penetrated. This system offers alternative protection over the impermeable clay lining system through the addition of internal polyethylene-coated polymeric tendons and ATRA clip load-transfer restraint pins. The entire system uses a deadman anchor at the crest of the four sideslopes to provide resistance to downward sliding.

Integral polymeric tendons provide an effective means of supplying the required restraint on slopes where the downslope component of the cover's self-weight exceeds the available frictional resistance. Polyethylene-coated polyester tendons offer superior creep resistance and better overall durability. The coating also provides resistance to the concrete's high pH content and fuel from any potential spillage.

"The use of the tendons allowed us to ensure the integrity of the clay liner," recounts Austerman. "Any staking or puncturing of the liner would have defeated the purpose of the project."

Detention Pond Installation

Construction began on the detention pond in late October 1997 and was completed in five days on a tight timetable.

"With this installation coming late in the year, there was no time for false starts," notes Greg Kramer of ACF Environmental, Presto's local distributor. "Cold weather could have thrown a real wrench into the works."

The process began with the demolition and removal of debris, rock, and unstable soils. Once removed, the subgrade was inspected and any depressions were filled with compacted native soils.

A nonwoven geotextile was first installed throughout the containment pond. Next, 40-ft.-long by 15-ft.-wide Bentofix GCL liner sections were placed from a spreader-bar assembly over the complete surface.

With the sections expanded on the stretcher frames, the clips were secured to the tendon, acting as restraint clips to transfer sliding-load forces from the cell wall to the tendon. Thirty-five clips were used per section, spaced every 6 ft. Five laborers inserted the tendons and clips at a rate of 10 minutes per section. Assembled sections were removed from the frames, collapsed, and positioned at the crest of the sideslopes for anchoring and expansion.

Excess tendon lengths were secured to a 4-in. pipe deadman anchor laid in a 2.5-ft.-deep perimeter trench at the crest of the slope. When all sections were secured to the pipe, the anchor trench was backfilled and compacted. The Geoweb sections were expanded down the slope and adjoining sections fastened with a pneumatic stapler. Special cuts were made for corner sections and to compensate for a 3-ft.-diameter pipe protrusion.

Once several sections of the system were secured on the sideslopes, infilling with concrete began. Expansion of geocell sections and placement of concrete were performed simultaneously. Five laborers placed 130 yd.^{3} of 4,000-psi concrete in two days with a 1-yd.^{3} backhoe. The concrete was struck off level and a raked finish was applied.

Completing the installation and infilling with concrete immediately is critical to protecting GCLs that can become damaged through moisture when exposed or unprotected. Crews worked late into the night to finish the project and completely protect the liner.

Conclusion

The entire detention pond measures 65 ft. by 115 ft. with 21-ft.-long sideslopes with angles of 1.5:1 (H:V). Over 10,000 ft.^{2} of the perforated Geoweb system was installed, and the project was completed by November 1, 1997.

"We consider it a success when you can install a product for the first time and still make a profit while, at the same time, making the owner happy," remarks Susan McDowell, project manager for the Associated Construction Company, the general contractor on the job. "This installation was definitely a success. Everyone involved is happy." **EC**

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