

Environmental & Science Engineering

www.esemag.com

ES&E's annual Spring Conference Previews

**Geosynthetics solve
chronic lagoon system
slope failure**

**Retrofitting vintage
pumping station in
Sudbury**

**New poultry plant
wastewater facility
reduces costs**



With the Geoweb® sections secured by integral tendons over an impermeable geomembrane, workers distribute aggregate infill in the cells.

strength tendons were secured to the pipe and threaded through the 4-inch deep geocell sections, then secured through the use of ATRA® restraint clips. The large cell size (18.7 in x 20.0 in), allowed installers to work efficiently on the 3H:1V slope, expanding, orienting, and then securing the geocell sections in place.

Installation of the geotextile fabric, flexible geomembrane liner and place-

ment of the geocells system was performed by subcontractor Colorado Lining International, Inc.

The last step in the construction process was infilling the cells with crushed stone to provide the final cover for the protected slope. The contractor developed a conveyor system to expedite the infilling process. Over 1,500,000 ft² of geosynthetic materials were installed on this project.

During the various stages of design and construction, the Geoweb system representative, Soil Stabilization Products Co. (SSPCo), provided technical support to four consulting engineering firms involved in the project: Camp, Dresser & McKee Inc., Intersol Engineering Inc., Lockwood, Andrews & Newnam Inc., and Terra Mar Inc.

Results

The geocell system was uniquely suited to this application - restraining sliding forces of the protective stone without staking through the liner system. The perforated geocells allow heavy water flows accumulating above the liner to move quickly down-slope without migration of the stone infill. This composite geosynthetics slope protection system gave the City of Dallas Water Utilities a long-term, low maintenance solution for this challenging problem.

Photographs courtesy of Colorado Lining International, Inc.

Contact: Patricia Stelter, e-mail: patricia.stelter@alcoa.com.

Geosynthetic solution applied for chronic slope failure at water treatment lagoon system

Consulting engineers for the City of Dallas were asked to develop a solution to chronic sliding failures on the outer slopes of the City's Eastside Water Treatment Lagoon system. The Dallas Water Utilities facility consists of five water retention lagoons enclosed within a large perimeter levee.

Identifying the Problem

The individual lagoons are lined with geomembrane and the tops of all levees are capped with paved access roads. The 3H:1V exterior slopes were constructed of highly expansive clay soils with a PI (Plasticity Index) ranging from 21 to 75. Because of the nature of expansive soils, the exposed levee embankment slope suffered from severe soil shrinkage and result-

ing surface cracking during the dry summer months. During the rainy season, water flowed into these deep cracks causing saturation and instability of underlying soils.

By maintaining proper soil moisture, the sliding failures, which were triggered by the drying-cracking-rain-saturation cycle, could be eliminated by controlling soil moisture fluctuations with a liner cover.

Since the lagoon side of the levee embankment was protected by the liner and the top by the paved road, it was determined that only the outer exposed embankment surface needed protection. An impermeable geomembrane cover could provide a barrier, preventing the drying-saturation cycle which was causing the instabilities

within the levee.

A geotechnical engineering firm was retained to evaluate the problem soils and develop alternative solutions to the sliding issues. After considering a wide range of approaches, a composite geosynthetic solution was developed. It included two layers of 28oz. nonwoven geotextile, a 40-mil impermeable HDPE geomembrane liner, the Geoweb® (geocell) cellular confinement system with integral tendons and restraint clips, and aggregate infill within the geocell to stabilize and protect the geomembrane.

Evaluating the Solution

The engineered composite geosynthetic solution has a flexibility that conforms to surface deformations in the embankment soil while resisting down-slope sliding at the various interfaces without the use of penetrating ground anchors. The protected geomembrane layer forms a permanent impermeable barrier that prevents infiltration of water into the embankment soils. The aggregate-infilled geocell slope cover prevents major surface erosion and creates a permeable protective layer that allows rain water to flow through the stabilized aggregate and drain off naturally over the geomembrane without penetrating down to the problematic soil layer.

Anchored internal high-strength tendons and load transfer clips within the cellular structure create a suspended protective cover over the geomembrane, maintaining the liner's integrity by preventing puncture and natural degradation.

Installing the Geosynthetic Components

The installation began by stripping the slopes of vegetative cover and finish grading. An anchor trench for the geosynthetic layers was excavated along the outside perimeter of the access road at the top of the slope. The geomembrane, sandwiched between the protective cushion of two geotextile fabrics, was then installed.

With the composite protective liner system in place, a 4-inch diameter, schedule 40 PVC pipe was placed in the trench at the top of the slope for the dead man anchor system. High-



High-strength tendons, tied to a PVC pipe, allow the Geoweb® sections to be suspended over the containment lagoon's outside embankment.