UNDERWATER AND SHORELINE GEOSYNTHETIC INSTALLATIONS

Underwater and shoreline installations of geosynthetic materials has been accomplished on numerous projects for a variety of reasons. Geotextile fabrics have been placed to provide separation of distinct layers of material, prevent scouring and burrowing of biota. Geomembranes have been placed in underwater applications to provide contain or cap for contaminated sediments, and to repair leaking containment systems. Geosynthetic Clay Liners (GCLs) have been installed in underwater applications for the same purposes as geomembranes. The purpose of this document is to discuss the practical details and construction processes that may be employed to install geosynthetics in underwater applications.

Of primary consideration when designing an underwater installation of geosynthetic materials is the specific gravity of the material to be installed. This when compared to water will give an indication of the materials propensity top float. Proper selection of a material may be dependant on this property and on specific function that the geosynthetic material is expected to perform. These characteristic functions may be divided into the following categories; separation, isolation, filtration, reinforcement. In many applications geotexiles are utilized to perform a combination of these functions.

Installation techniques may also vary greatly depending on the site specific conditions. Conditions to consider include, water depth, current, tidal flux, distance from shore, bottom configuration (bathology), and strength of the underlying materials. Equipment selection for deploying geosynthetics in underwater applications will also vary depending on these site conditions.

Typically geosynthetics are installed in conjunction with other natural materials to provide protection. In many cases the geosynthetics are covered with a minimum of 6 to 12 inches of sand, gravel, concrete, or riprap. Appropriate selection and thickness of the cover material should also be based on many of the site specific conditions.

Figure 1

Example 1: Shoreline Impermeable Sediment Cap

In this project located in New Jersey, an impermeable cap was needed to provide a physical isolation of contaminated sediments. The cap was designed using a Geosynthetic Clay Liner (GCL). The cap designed for physical isolation of the sediments as well as to reduce infiltration into these contaminated sediments. A containment dike was constructed around the perimeter of the contaminated area and extended into the shallow water. The water was then pumped from the containment. The sediment was well consolidated and provided a firm unyielding subgrade for installation of the GCL. The GCL was installed using conventional onshore deployment equipment consisting of a steel pipe inserted through the core of the GCL roll and a steel spreader bar that was used to lift the roll. This was lifted by a low ground pressure tracked excavator, and the GCL was deployed as the excavator moved backwards. The GCL was covered with 12” of clean fill.

Figure 2

Figure 3

Example 2: Underwater Pond Liner Repair

This project located in Florida was a decorative pond that was built in an area with a seasonally high fluctuating water table. The pond, originally lined while empty using a plastic geomembrane, had developed leaks. Because of the need to complete the repair and the high water table, it was determined that draining the pond would be impossible. A GCL was selected to re-line the pond. Because of the pond size a stationary on-shore roll technique was utilized. The rolls were suspended on shore using the core pipe and spreader bar. The leading edge of the material was wrapped around a steel pipe, which was then connected to a cable system. The cable stretched across the pond to a tractor equipped with a heavy duty winch. As the material was winched across the pond, a diver ensured proper material placement, and directed activities through radio communication. It is envisioned that the stationary on-shore roll technique could also be used in situations where the cable system was attached to a barge mounted winch.

Example 3: Reactive Core Mat Sub Aqueous Sediment Cap

10,000 square feet of Reactive Core Mat (RCM) filled with adsorptive media was installed over very soft sediment in the Anacostia River. The RCM geosynthetic material was utilized as a component of an active sediment cap. By incorporating an adsorptive layer into the cap design the cap design can be made thinner, allowing capping of the sediment where it may otherwise not have been possible. The material was deployed using a barge based technique. A barge mounted crane was utilized to suspend the RCM roll over the bottom of the water. The first 10 to 15 feet at the end of the roll was weighed down using sandbags and then a bucket load of sand. The roll was then unrolled 18” over the bottom by swinging the crane. The crane was also used to deploy the sand layer over the RCM.

Figure 4

Figure 5

Many other underwater and shoreline deployments of geosynthetics have been done. Geotextiles have been deployed to provide separation of the overlying clean sand from contaminated sediment in remedial capping. Small scale deployments of RCM have been completed on shoreline applications. Depending on the size and depth of the water of these applications these products, it may be possible to deploy these materials without the use of mechanical equipment.

The deployment of geosynthetics in these underwater and near shore environments illustrates the feasibility of doing such work practically. As capping of contaminated sediment continues to be completed as a practical method of environmental remediation, the use of these types of materials and deployment techniques will continue to develop.