CASE HISTORY

MULTILAYER GEOGRID FOR CLAY REINFORCEMENT BLAIR, NEBRASKA

PROJECT NAME	Lagoon Clay Liner Reinforcement
LOCATION	Blair, Nebraska
PRODUCTS	MS500
OWNER	Cargill Corn Milling, Inc.
ENGINEER	Terracon Consultants

Problem

The project consists of constructing a single lagoon cell as a liquid pond at Cargill Corn Milling Incorporated in Blair, Nebraska. The lagoon site is located in the alluvial plain 200 meters west of the Missouri River. The lagoon has plan dimensions of 180m by 107m (600 by 350ft). The top of the lagoon liner was constructed at an elevation of 2.4m (8ft) below existing grade, with the dikes being built up 0.6m (2ft) above existing grade.

The lagoon dikes have a maximum 3 to 1 slope. The lagoon liner was at least 0.6m (2ft) thick. The liner extended over the entire lagoon bottom and up to the lagoon sides at least 0.3m (1ft) above the maximum water surface elevation. Construction of the bottom 0.6m (2ft) thick lagoon liner resulted in excavations extending within several feet of groundwater level in relatively wet clays and fine sands. These soils were anticipated to be inadequate for support of repetitive loads from heavy-wheeled or traced excavation and liner construction equipment. An effective measure of subgrade stabilization was necessary to support proper placement and compaction of the clay liner materials. The liner soils were required to be compacted to be compacted to at least 93% of the material's maximum standard Proctor dry density. The engineer recommended a geogrid solution to provide adequate stabilization and support careful placement of soil liner. Areas requiring stabilization are expected to include the entire lagoon bottom and the lower portion of the side slopes.

Two Possible Geogrid Solutions Were Considered:

1. Excavate an additional 0.3m (1ft) below the liner base elevations, import a 3.0m (1ft) layer of crushed limestone in conjunction with a single-layer biaxial geogrid. The crushed limestone was to be composed of 38mm (1 ½ inch) minus well graded material containing less than 8 percent fines.
2. A multi-layer biaxial geogrid (MS500) in conjunction with the on-site clay material. The multi-layer geogrid solution was based on laboratory tests, and project experience with similar conditions, and more importantly a trail section outlined in the next section. Eliminating 0.3m (1 ft) of crushed stone resulted in a significant cost savings in both material and excavation. The multi-layer biaxially oriented polypropylene geogrid was manufactured by a continuous extrusion and orientation processing.

Field tests were conducted to evaluate the proposed solution for weak subgrade stabilization with a multi-layer geogrid. The testing section was at depth of 2.4m below the ground surface. The geogrid was placed in an area approximately 4.6m wide and 30m long. This area was determined to be one of the most unstable locations at the job site in reference to soil testing. The first 1.8m of soil was cut by scrapers and the final 0.6m of excavation was done using a smooth-edged backhoe bucket. When the test depth was reached, the soils were very soft, wet and sensitive to disturbance. Foot traffic on the weak subgrade caused pumping of soil moisture and left deep footprints. The above photo shows a compactor in the area that sank to the drum while attempting to compact a 0.3m lift of clay liner material placed on the weak subgrade.

A 0.3m layer of non-processed on-site clay fill material was spread directly on top of the geogrid. The above figure shows the installation of the geogrid. A Caterpillar CP563 compactor was used to compact the fill soil. This unit has a single drum in front, driven by rubber tires on back. The compactor made 6 passes across the test area. A pass consists of a compactor travel over the area in one direction; the return to the original location was considered the second pass. The test revealed at this point we had an 89% compaction with a water content of 29.3%. After running 4 more passes over the same area, for a total of ten. The test revealed a 97% compaction with 27% water content. To verify this, a second test was done in an adjacent location, still in the test area, this test revealed a 98% compaction with 27% water content. Both tests exceeded 93% required compaction.

To provide a control for the test, an adjacent unreinforced section was also tested and subjected to the same test conditions. After 6 passes over the test area, where 0.3m of fill had been added, the test showed a compaction of 89% with 27.9% water content, with 4 more passes to take the total to 10, a second test was run, this test showed 86% compaction with water content of 39.6%. It was noted that the fill surface in the test area had sunk about 0.15m from the original elevation, and the soil was pumping bearing failure under the weight of the compactor.

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