GCL PANEL SHRINKAGE LAB AND FIELD TRIALS

INTRODUCTION

CETCO GCL products were tested in the field and laboratory to determine if any shrinkage occurs from cyclical wetting and drying.

Lab Trials
Two types of GCL samples; Bentomat DN (with two nonwoven geotextiles) and Bentomat ST (with a woven and a nonwoven geotextile) were hydrated and placed at their as-manufactured moisture levels under heat lamps (Figure 1).

Figure 1. Laboratory Heat Lamp Room

GCL samples were measured for moisture content and dimensional changes as shown in Table 1. Moisture Data showed that the GCL samples dried from their initial moisture content of 25 - 27.8% down to 1.8 - 3.3% moisture. Measurements indicated that the nonwoven-nonwoven GCL decreased slightly (0.4%) in width and 0.9% in length. The woven-nonwoven GCL did not change in width, but its length decreased by 1.1%.

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Table 1. Heat Lamp Trial Results.

Sample	Width (XM)	Length (MD)	Moisture (% dry wt.)
Nonwoven- nonwoven Bentomat	Initial: 244 cm Final: 243 cm Shrinkage: 0.4%	Initial: 108 cm Final: 107 cm Shrinkage: 0.9%	Initial: 25.0 Final: 3.3
Woven- nonwoven Bentomat	Initial: 245 cm Final: 245 cm Shrinkage: 0.0%	Initial: 107 cm Final: 106 cm Shrinkage: 1.1%	Initial: 27.8 Final: 1.8

Field Trial

CETCO constructed field test plots in late July 2004 in Northwestern Wyoming. Full-width GCL panels were laid on 3:1 northerly-facing slopes over compacted subgrade. The soil subgrade classification was CL, a silty clay with a little fine sand, and had ~5% moisture content as measured per ASTM D4643. Dielectric moisture sensors (ECH_2O by Decagon Inc.) were installed at the top, middle east, middle west and bottom of the GCL panel (Figure 2). Movement telltales (as described by Koerner et al., 1996) were installed near the moisture sensors. The GCL was then sprayed with water to increase its moisture content and covered with a smooth geomembrane (Figure 3). Both the sensor wire end plugs and telltales were attached to wooden monitoring stations set in concrete (Figure 4).

Figure 2. Dielectric Moisture Sensor Installation

Figure 3. Smooth Geomembrane Cover

Figure 4. Monitoring Station

Climatic data indicated that during August 2004, the hottest full-month period during the field study, the area had an average maximum temperature of 81°F and average minimum temperature of 47°F (University of Wyoming, 2004; Young et al. 2000). Daytime temperature measurements of the geomembrane surface in the summer showed temperatures of up to 140°F. The Bentomat DN moisture content dropped from over 40% to as low as 11% on the GCL plots (Figure 5). The data was collected at different times of day (between morning and late afternoon) and it appears that there was some migration of moisture downhill and that there was only one wet-dry cycle during the study.

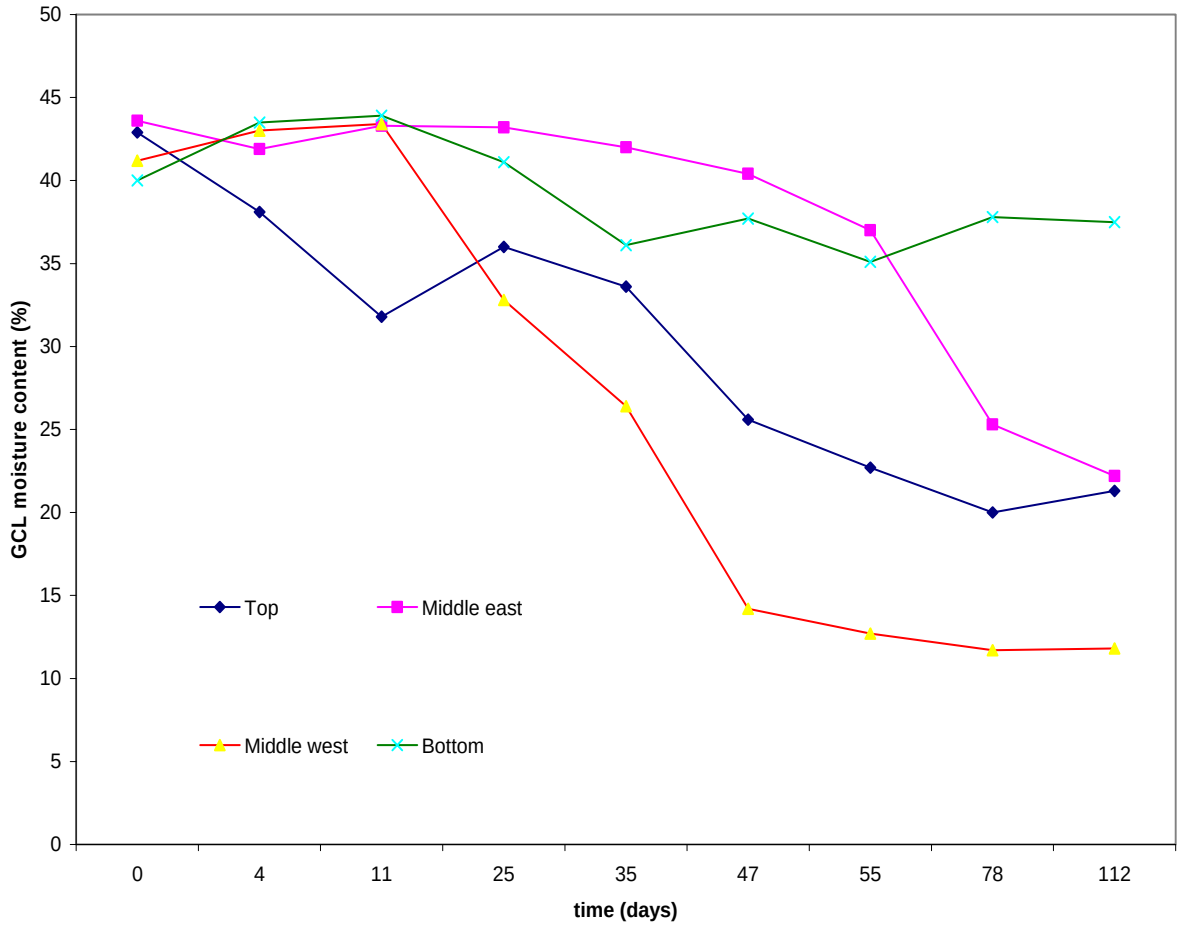

Figure 5. Bentomat DN sensor moisture content versus time.

In May 2005 the smooth geomembrane was removed. Table 2 shows the GCL panel moisture content and width change between the time the panels were covered with the geomembrane and when they were uncovered. Bentonite samples were taken adjacent to the dielectric moisture sensors and taken to the laboratory for moisture content testing per ASTM D4643. The moisture contents between the two correlated very well (Figure 6).

Product	Moisture (from sensor)	Midslope Width Shrinkage
Woven-nonwoven GCL	Initial: 41% Last: 15%	1” (0.6%)
Nonwoven-nonwoven GCL	Initial: 42% Last: 13%	1” (0.6%)
Nonwoven-light nonwoven GCL	Initial: 44% Last: 19%	1.5” (0.9%)

Table 2. Field Plot Measurements

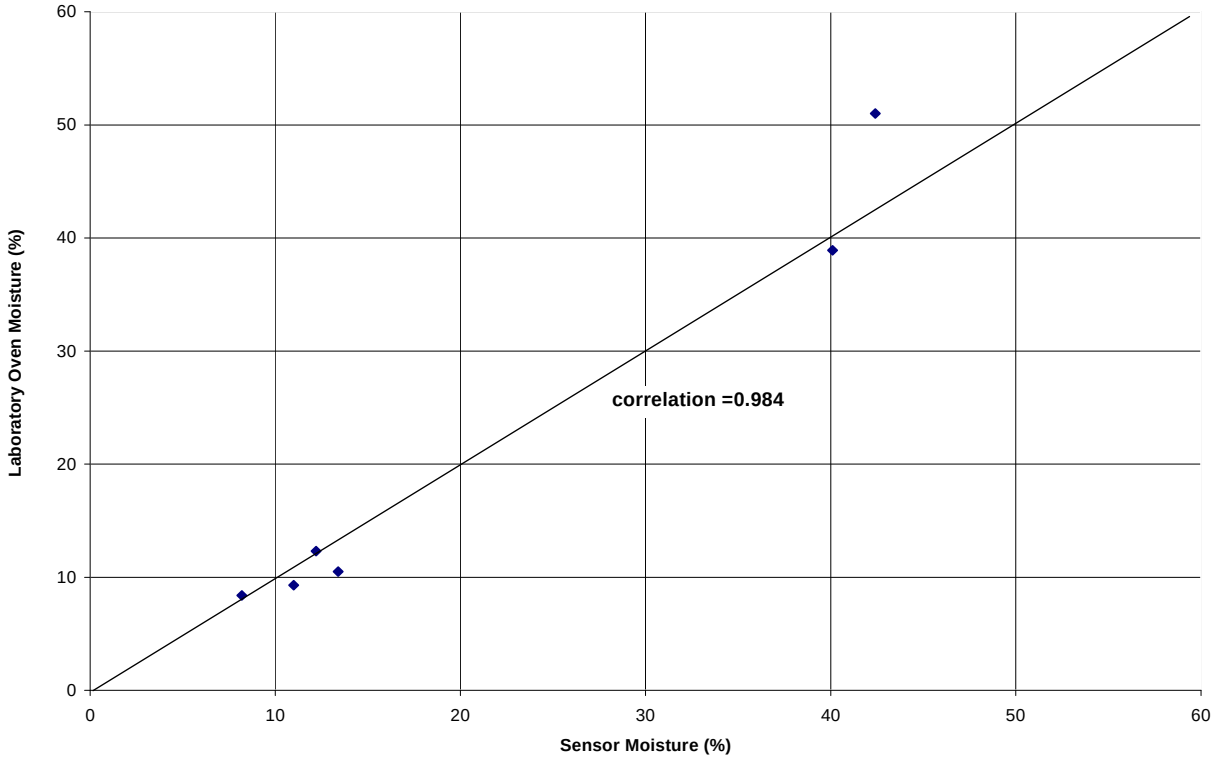

Figure 6. Dielectric sensor soil moisture content versus laboratory moisture content per ASTM D4643.

Conclusion

Field tests indicate that GCL panels undergo only one wet-dry cycle from one year of northerly exposure. Field tests indicate that GCL panels do not undergo significant dimensional change from one year of northerly exposure under a smooth geomembrane. This agrees with lab tests that indicate that GCLs do not undergo significant dimensional change from one wet-dry cycle.

Side-to-side overlaps of 6" and end-of-roll overlaps of 24" appear to be sufficient under these conditions. It appears that multiple wet-dry cycling and/or textured geomembrane expansion are responsible for the few cases of panel separation reported in the 20 years of GCL usage in landfill containment.

References:

Koerner, G., Bowders, J. and Scranton, H., "Installation for Monitoring Field Performance of the Cincinnati GCL Test Plots", *Proceedings of the 10th GRI Conference*, 1996.

University of Wyoming, Wyoming State Climatologist, "Departure from Normal Temperature (°F) 8/1/2004 – 8/31/2004", www.wrds.uwyo.edu/images/wrds/wsc/monthsum/2004Aug/Aug_temp.gif.

Young, J., Vance, G. and Zhang, R., "Climatic Patterns in the Big Horn Basin, WY", Publication B-1089, University of Wyoming College of Agriculture Cooperative Extension Service, Oct. 2000.