Freeze/Thaw Effects

# AquaBlok™

## TEST REPORT #8: Freeze/Thaw Effects on AquaBlok

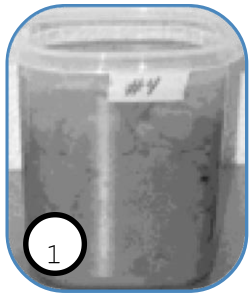
### Background and Purpose of Testing

For some ecosystems, including seasonally exposed wetlands occurring in northern regions, the potential exists for periodic exposure of substrates to climatically induced freeze/thaw effects. The effects of cyclic freeze/thaw on the physical structure and conductive properties of different clay mineral-based landfill capping and lining materials have been investigated by others, both in the laboratory and field. Results of these studies generally indicate that while the physical structure and hydraulic conductivity of many compacted clay materials can be adversely affected by freeze/thaw (e.g. Bowders and McClelland, 1994; Benson and Othman, 1993), that of geosynthetic clay liners, or GCLs, is typically not affected (U.S. EPA, 1996). The relative resilience or "healing" abilities of GCLs is largely attributable to the bentonite component in GCLs; bentonite is a principle component of typical AquaBlok formulations. The purpose of this testing was to qualitatively demonstrate effects of cyclic freeze/thaw on the physical appearance of hydrated samples of typical AquaBlok material.

### Methods

Five samples of hydrated AquaBlok (5050 FW formulation) were prepared in four-inch square, clear-plastic containers. The containers were selected to allow for observation of freeze/thaw effects, and to minimize confining pressure on the samples.

500 mls of municipal tap water and an approximately 2-inch thick layer of dry AquaBlok particles were added to each container. The particles were then hydrated by periodically adding water to achieve material saturation.




Hydrated test sample prior to freezing

The volume of each sample approximately doubled through hydration and expansion, with total hydrated AquaBlok volumes ranging from about 1,100 to 1,200 cubic centimeters (Photograph 1). Each sample was then subjected to a total of five freeze/thaw cycles and the physical condition of the samples after each cycle were observed and documented.

### Results and Observations

Each freezing event produced discrete, open fractures (typically less than 1/4-inch in width) which contained free water that probably migrated from water on top of the sample. None of the observed fractures penetrated entire sample thicknesses. The positions and orientations of these freezing fractures were noted by tracing them with a marker on the containers (Photograph 2). All fractures completely closed, or "healed", upon thawing of the samples. Subsequent freezing events produced new fractures of different position and orientation, implying that planes of weakness do not form in the hydrated product. Again, these newly formed fractures healed upon thawing of the samples. No fracture persisted from one freeze/thaw cycle to the next (Photograph 3)


Representative test sample after third freezing event – Note fractures.


Representative test sample after third thawing event – note healing of fractures.

### Conclusions

Freezing of hydrated AquaBlok samples produces discrete, open fractures, however, the fractures do not penetrate the total sample thickness. Freeze-induced fractures heal, and the mass of hydrated AquaBlok returns to its original, relatively homogeneous state upon thawing. Such an AquaBlok response to cyclic freeze/thaw would generally be expected, based on published literature.

### References


Benson, C. and M. Othman.1993. Hydraulic conductivity of compacted clay frozen and thawed in situ. Journal of Geotechnical Engineering, 119: 276- 294.

Bowders J. and S. McClelland. 1994. The effects of freeze/thaw cycles on the permeability of three compacted soils, pp. 461-481, in D.E. Daniel and S.J. Trautwein (eds.) "Hydraulic Conductivity and Waste Contaminant Transport in Soil," ASTM STP 1142. American Society for Testing and Materials, Philadelphia, PA.

U.S. Environmental Protection Agency (U.S. EPA). 1996. Workshop on geosynthetic clay liners. U.S. EPA Document No. EPA/600/R-96/149.


AquaBlok® Composite Particle System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