

ADDRESSING ION EXCHANGE IN GCLs

Research from Meer and Benson (2004) suggests that GCLs in landfill caps are susceptible to increased permeability resulting from the combined processes of ion exchange and desiccation. Ion exchange involves the replacement of sodium ions with other ions (typically calcium) in the bentonite component of GCLs. Desiccation is the drying out of the bentonite to the extent where non-healing cracks may form. In this study, exhumed field samples of GCLs from four landfill final cover systems showed laboratory permeability values ranging from 5×10^{-9} cm/s to 2×10^{-4} cm/s, and moisture contents ranging from 30% to 200%.

The wide variation in lab permeability values appears to have been caused by several factors, most importantly desiccation combined with ion exchange. The samples experiencing ion exchange in addition to desiccation exhibited a higher increase in permeability than those that underwent ion exchange only. Other factors such as the sampling and testing methodologies may also have contributed to the very wide range in permeability values observed in the Meer and Benson research.

The effects of ion exchange are less severe if desiccation does not occur. Egloffstein (2002) and Olsta and Mackey (2004) showed only modest permeability increases in samples exhumed from several landfill cover systems in humid climates where desiccation is less likely to have occurred. Based on the Meer and Benson Report, CETCO believes that GCLs should not be exposed to conditions which could allow a combination of ion exchange and desiccation. In practical terms, it appears that landfill final cover systems are a common application where such conditions may occur. Consequently, the use of membrane-laminated ("CL") GCLs, or composite liner systems including both GCL and an overlying geomembrane, should be considered in landfill final cover applications. The membrane components of these systems will serve to deter both desiccation and ion exchange.

References:

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Mackey, R. E. and Olsta, J. T., "Performance of Geosynthetic Clay Liners used in two Landfill Closures in a Coastal Area of Florida", *Advances in Geosynthetic Clay Liner Technology: 2nd Symposium*, ASTM STP 1456, R. E. Mackey and K. von Maubeuge, Eds., American Society for Testing and Materials, West Conshohocken, PA 2003, pp. 53-71.