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Experiments with water and slurries in hanging geotextile bags: A further appraisal

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ABSTRACT

Dewatering experiments with hanging geotextile bags filled with water and slurries are described. The theory for draining bags filled with water was presented in an earlier paper (Weggel et al., 2010). A procedure suggested in that paper was used to analyze data on water and slurry-filled bags which was compared with the theory presented therein. Experiments with only water draining from the bag confirm the validity of the theory. Earlier experiments by one of the authors (Merida) conducted with soil slurries are reanalyzed using the procedures proposed in the earlier paper. Asymptotic (long-term) dewatering values are determined for the slurry-filled bags. The effect of a non-circular bag cross-section is considered for low water/slurry levels near the seam at the bottom of the bag. New equations are presented that consider the non-circular (elliptical) bag cross-section. Experimental values of a k factor which relates the measured results to those from a circular cross-section are determined.

1. Introduction

Large geotextile tubes can be used to dewater dredged material, mine tailings and chemical plant wastes (Lawson, 2008; Huang and Luo, 2007). The hanging bag test has been proposed as a measure of how well a given geotextile will facilitate dewatering a given slurry (Fowler, 1995; GRI, 2004; Koerner and Koerner, 2006, 2010).

A number of investigators have studied geotextiles for filtration. Lawson (2008) presented an overview of geotextile containment systems for hydraulic and environmental engineering applications. Aydilek and Edil, (2003) and Yaman et al. (2006) looked at their use for filtering wastewater. Geotextile tubes for dewatering have been studied both in the laboratory and field. Field studies include those by Shin and Oh (2003) who conducted two field model tests, one with sandy soil and one with silty clay at a land reclamation site in Korea, and Koerner and Koerner (2005, 2006) who contrasted the performance of three geotextile tube field case histories with results from hanging bag tests and pressure filtration tests. They found that the hanging bag and pressure filtration tests were good indicators of field performance. Liao and Bhatia (2006) investigated soil retention in woven and non-woven geotextiles and the results of pressure filtration tests on Cayuga Lake sediments.

Laboratory investigations include those by Kutay and Aydilek (2004, 2005) who investigated the retention of fly ash slurries in the laboratory using a composite of woven and non-woven geotextiles. They found that a double layer system performed better than a single layer system for sediment retention. Muthukumaran and Ilampanuthi (2006) conducted 42 dewatering tests using geotextiles with four different opening sizes with harbor sediments and fly ash. Huang and Luo (2007) conducted falling head dewatering tests and recorded the characteristics of the filter cake including its compression index and thickness.

More recently, Myers and Elton (2011) studied the dewatering of rock crushing fines using geotextile tubes and the effectiveness of various chemical flocculants and found that the filter cake rather than the geotextile dominates the dewatering process. Satyamurthy et al. (2011) investigated three woven, one non-woven and one composite geotextile for dewatering high water-content lake sediments using the hanging bag and pressure filtration tests.

Grzelak et al. (2011) discuss the need to establish industry-wide standards to assess dewatering methods and to estimate dewatering times. They propose a theoretical model using Darcy's law and the Kozeny–Carman equation to estimate dewatering time.

Weggel et al. (2010) presented a theory for the flow of water through a geotextile bag and suggested a method to evaluate a bag's overall suitability for dewatering slurry. The theory for a water-filled bag was verified by conducting experiments with 15- to 18-cm-wide specially constructed bags. Since the bags could not

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