Geotextiles and Geomembranes 29 (2011) 381–390

Contents lists available at ScienceDirect

Geotextiles and Geomembranes

journal homepage: www.elsevier.com/locate/geotexmem

Electrokinetic geosynthetics in hydraulic applications

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ARTICLE INFO

Article history:
Received 4 January 2010
Accepted 11 November 2010
Available online 23 December 2010

Keywords:
Electrokinetic geosynthetics
EKG materials
Strengthening slopes
Hydraulic applications

ABSTRACT

In use most geosynthetics play a *passive* role. New applications for geosynthetics have been identified if they can provide an *active* role, initiating biological, chemical or physical change to the matrix in which it is installed as well as providing the established functions. This can be achieved by combining the electrokinetic phenomena of electro-osmosis, electrophoresis and associated electrokinetic functions such as electrolysis with the traditional functions of geosynthetics of drainage, filtration, containment and reinforcement to form electokinetic geosynthetics (EKG). Electrokinetic geosynthetics can be made singly or from combinations of woven, non-woven, needle punched knitted, extruded or laminated materials and can be formed in any 2D or 3D shape.

The majority of the uses of EKG are in hydraulic applications or applications with a significant hydraulic component. These can be grouped in separate engineering categories such as civil, mining, and water engineering. The concept of electrokinetic geosynthetics is described and details of applications and case studies are provided in the paper.

1. Introduction

In use most geosynthetics play a *passive* role, e.g. geomembrane barriers stop the passage of liquids; reinforcement provides tensile resistance, but only after an initial strain has occurred; and drains provide a passage for water but do not cause the water to flow. New applications for geosynthetics have been identified if they can provide an *active* role, initiating biological, chemical or physical change to the matrix in which it is installed as well as providing the established functions. This can be achieved by combining the electrokinetic phenomena of electro-osmosis, electrophoresis and associated electrokinetic functions such as electrolysis with the traditional functions of geosynthetics of drainage, filtration, containment and reinforcement to form electokinetic geosynthetics (EKG) (Nettleton et al., 1998; Hamir et al., 2001).

Electrokinetic geosynthetics (EKG) are a platform technology, which combine a wide variety of materials and processes to perform such diverse functions as dewatering, strengthening and conditioning in materials such as soils, sludges, slurries, tailings and composts. Applications have been identified in a range of industrial sectors including water, mining, civil and environmental engineering, food and sport. Table 1 shows the main technical components which form the backbone of EKG technology. These are explained further in Table 2.

Table 1 shows that electrokinetics and geosynthetics have 14 separate functions between them. By combining the different functions a range of EKG materials can be produced each with unique properties which may be selected and controlled according to:

- Materials and settings in which the EKG is used;
- Physical and chemical design of the EKG;
- Electrical control and operation of the EKG; and
- Management of the boundary conditions associated with the EKG.

2. Electrokinetics

Traditional geosynthetics and industrial textiles are used in the civil, mining, environmental and waste engineering industries to carry out a range of functions which include drainage, reinforcement, filtration, separation, containment, encapsulation and sorption. All of these functions, in one way or another are influenced or limited by the rate at which water is able to flow through the materials with which the geosynthetics are being used to improve or treat.

Water normally flows in response to a difference in pressure identified as hydraulic head. The rate of water flow is determined by the permeability of the material and is directly related to grain

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doi:10.1016/j.geotexmem.2010.11.011