C. R. Mecanique 330 (2002) 865–870

Micromechanical computational modeling of expansive porous media

Márcio A. Murad [a], Christian Moyne [b]

[a] **Laboratório Nacional de Computação Científica, LNCC/MCT, Av Getúlio Vargas 333, 25651–070 Petrópolis, RJ, Brazil**

[b] **LEMTA–CNRS–INPL–UHP (UMR 7563), 2, avenue de la Forêt de Haye, 54504 Vandœuvre lès Nancy cedex, France**

Received 28 June 2002; accepted after revision 25 October 2002

Note presented by Pierre Suquet.

Abstract A modified Terzaghi principle is proposed to describe the influence of locally coupled electro-chemo-mechanical processes in highly compacted swelling clays upon the form of the macroscopic modified effective stress principle. The two-scale model is derived using the homogenization procedure to upscale the microscopic behavior of a two-phase system composed of clay particles saturated by a completely dissociated electrolyte aqueous solution. Numerical experiments are performed to illustrate the results in a particular cell geometry. ***To cite this article: M.A. Murad, C. Moyne, C. R. Mecanique 330 (2002) 865–870.***

porous media / expansive clays / effective stress / homogenization / Poisson–Boltzmann / swelling (disjoining) pressure

Modélisation micromécanique des milieux poreux déformables

Résumé Un principe de Terzaghi modifié est proposé pour décrire les phénomènes électro-chimico-mécaniques couplés dans des argiles gonflantes fortement compactées. Le modèle à deux échelles utilise la méthode de l'homogénéisation pour un système diphasique composé de particules d'argile saturées par une solution aqueuse d'un sel complètement dissocié. Quelques résultats numériques illustrent les résultats dans un cas particulier. ***Pour citer cet article : M.A. Murad, C. Moyne, C. R. Mecanique 330 (2002) 865–870.***

milieux poreux / argiles expansives / contrainte effective / homogénéisation / Poisson–Boltzmann / pression de (disjonction) gonflement

1. Introduction

The swelling of clay minerals, particularly montmorillonites is of widespread importance in geotechnical and geoenvironmental fields. It is of concern to the civil engineer because of the severe structural damage caused by collapsible and expansive soils. In petroleum engineering, borehole instability in expansive shales is a technical problem in oil and gas drilling in particular using water-based drilling muds. Compacted swelling clays (bentonites) have received great attention because of their use as sealing materials to impede the leakage of radioactive materials from waste repositories into the groundwater supply.

E-mail addresses: murad@lncc.br (M.A. Murad); Christian.Moyne@ensem.inpl-nancy.fr (C. Moyne).

S1631-0721(02)01543-7/FLA