

8ICEG Invited Lecture



Prof. Pierre Delage

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Invited Lecture Title

Micro-macro Effects in Bentonite Engineered Barriers for
Radioactive Waste Disposal

[14:10 - 14:40 , Monday 29th Oct. 2018]

Biography

Pierre Delage, Professor of Geotechnical Engineering at Ecole des Ponts ParisTech, contributed to the development of CERMES (the geotechnical group of Ecole des Ponts, now included in Laboratoire Navier), that he directed from 2003 to 2010. He developed researches on the fundamental mechanisms governing the macroscopic response of multi-phase soils and rocks submitted to changes in stress, water content and temperature, with some pioneering contributions on the role of the changes in pore size distribution in the volume change behaviour of soils, the stress-strain and failure behaviour of unsaturated soils or the thermal behaviour of claystones. His researches concerned sensitive clays, deep marine sediments, unsaturated soils, compacted soils, loess, oil reservoir chalks, oil sands, claystones and shales and, more recently, Martian regoliths, in the framework of the NASA mission InSight on Mars (landing planned on 26 November 2018).

He is a corresponding member of the French Academy of Agriculture, has been Chief editor of the “Revue Française de Géotechnique” and “Géotechnique Letters”. He has been or still is member of various editorial panels (Géotechnique, Computers and Geotechnics, Geotechnical Testing Journal, Geomechanics and Geoengineering, Rivista Geotecnica Italiana). He organised, with E. Alonso, the 1st International Conference on Unsaturated Soils in Paris (1995), played an active role in the 18th International Conference on Soil Mechanics and Geotechnical Engineering (Paris 2013) and chaired the 3rd European Conference on Unsaturated Soils (Paris 2016). He serves since 2013 as Chair of the Technical Oversight Committee of the International Society of Soil Mechanics and Geotechnical Engineering, in charge of supervising the activities of the 32 Technical Committees of the ISSMGE, under both Roger Frank and Charles Ng’s Presidential terms.

Abstract

The paper summarizes the findings of various investigations carried out for some time

in the research group on unsaturated soils at Ecole des Ponts ParisTech. It focusses in more details on the links that can be made between nano, micro, and meso scale phenomena, and the macroscopic response of various Engineered Barrier Systems (EBS) made up of bentonite and used in various concepts of radioactive waste disposal at great depth. Meso-scale observations using X-Ray microtomography usefully complete some findings established by using more standard techniques of microstructure investigation, like scanning electron microscopy and mercury intrusion porosimetry. The morphology of sand-bentonite and pellet-bentonite powder mixtures can be better understood, together with their changes during hydration. Also, nano-scale mechanisms that govern the hydration of smectites through the consecutive and ordered placement of layers of water molecules along the faces of the smectite minerals are useful for a better understanding of the macroscopic response of Engineered Barrier Systems submitted to hydration under constrained volume conditions. It appears that the more energetic adsorption levels are those corresponding to 1 and 2 water molecules (1 and 2W hydration) that are still involved during constant volume hydration, whereas the difference between constant and free volume hydration starts at lower suction (between 5 and 10 MPa) during the placement of the third layer (3W). These mechanisms also play a role in the hydration of pellets, and help to better understand the hydration of Engineered Barrier System. Some conclusions drawn should also apply in the case of surface waste disposals based on the use of Geosynthetic Clay Liners.