Editorial

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Since geotechnical engineers first began to deal with environmental issues concerning the design of new waste containment facilities and the remediation of sites contaminated by past industrial practices, they have had to face new theoretical problems that go beyond the field of traditional soil mechanics, and to develop innovative technologies for the control of pollutants in the subsoil (Daniel, 1993; Rowe *et al.*, 2004).

Although this list is far from complete, among the theoretical problems that are still nowadays the subject of specific studies, mention can be made to the role of diffusion on pollutant transport through low permeability barriers (Shackelford, 2014), the ability of bentonites to exhibit semipermeable membrane behaviour (Dominijanni *et al.*, 2013; Shackelford, 2013), and the effect of vacuum application on the speed of volatile pollutant extraction from the subsoil (Manassero *et al.*, 2009).

As far as technological innovation is concerned, again without being complete, the following can be pointed out: the chemical and physical treatments of bentonites that are aimed at maintaining the low hydraulic conductivity of bentonite to water, even in the case of permeation with aggressive solutions that have a high salt concentration (Puma *et al.*, 2015; Scalia *et al.*, 2011), biological processes for the improvement of soil engineering properties (DeJong *et al.*, 2013; Mitchell and Santamarina, 2005), and thermo-active geotechnical structures that provide an efficient heat source for the heating and cooling of buildings (Laloui *et al.*, 2013).

The eight papers that are included in the present issue of *Environmental Geotechnics* are all representative of the innovative studies that geotechnical engineers are presently conducting in order to face environmental problems. These papers deal with both theoretical and applicative topics, such as landfill liner design, the reuse of materials commonly considered as waste, laboratory testing, modeling techniques for land subsidence, and the osmotic behaviour of high-density concrete barriers for radioactive waste.

In the first paper, Johnston and O'Kelly (2016) describe the importance of the discipline of environmental geotechnics, whose multidisciplinary nature has given rise to new studies concerning time-dependent chemical and biological processes, and has contributed towards engineers becoming aware of the relevance of sustainability in geotechnical projects.

In a briefing, O'Kelly (2016) analyses the opportunity and significance of Atterberg limits for peat and other highly organic soils. Among other issues, O'Kelly mentions the disparity problem in sample preparation for fibrous peat, which can be influenced by

operator subjectivity. Broadly speaking, the author concludes that Atterberg limit concepts are inappropriate for peat, and suggests more suitable laboratory index tests, such as tests on the natural water content, organic content, fibre content and the degree of humification. On the basis of Dutch organic soil practice, the water content and bulk density are usually sufficient for correlations with strength and compressibility parameters.

In the second paper, Stipceovich *et al.* (2016) assess the possibility of substituting traditional clay soils in landfill liners with coal composites in order to address Australia's scarcity of and the cost of the use of such clay soils. The studied coal composites consist of brown coal (lignite) mixed with either polyacrylamide (PAM) or sodium bentonite. The main hydraulic and swelling properties of coal composites, such as the liquid limit, hydraulic conductivity and swell index, have been investigated in laboratory. According to the authors, the hydraulic and swelling performances of coal composites increase with the addition of PAM, and do not deteriorate significantly in the presence of highly concentrated electrolyte solutions. This latter property is particularly advantageous considering the expected performances of the currently used landfill liner materials (included natural sodium bentonite).

In the third paper, Costa *et al.* (2016) provide a set of experimental data concerning the elastoplastic fracture mechanic parameter, J -integral, for two clay soils. This parameter quantifies the change in potential energy (both elastic and plastic) during crack growth and, for this reason, is suitable for assessing the fracture behaviour of clays during desiccation. The authors describe the laboratory ring tests carried out on specimens with different initial water contents and provide J -integral values calculated during specimen desiccation. The authors discuss the interpretation of these data and outline the need to obtain more detailed knowledge on the mechanics of crack propagation in soils through further investigations.

In the fourth paper, Bannour *et al.* (2016) present a numerical simulation of the flow through a composite liner that consists of a damaged geomembrane, stacked on a geosynthetic clay liner (GCL), which in turn is placed on a compacted clay liner (CCL). The numerical simulation describes the advective flow through the unsaturated GCL and CCL when a constant hydraulic head is applied above a circular membrane discontinuity. The model reproduces a flow rate that is influenced by the hydraulic conductivities of the GCL geotextile and bentonite, both of which vary with the degree of saturation.

In the sixth paper, Baù *et al.* (2016) investigate the feasibility of an inverse modelling technique to calibrate gas/oil reservoir

geomechanical parameters (such as soil compressibility, Young's modulus and Poisson ratio), by assimilation of surface displacement data, in order to model land subsidence. In fact, geomechanical parameters are usually derived from laboratory tests or in situ measurements, whose reliability may be limited in some cases. This is the reason why a data-assimilation algorithm is considered in order to reduce the uncertainty on geomechanical parameters by assimilating a number of surface displacements. The results obtained by the authors show that the algorithm constitutes a quite promising tool that could be used to reduce the uncertainty in modelling land subsidence.

In the seventh paper, Missaoui *et al.* (2016) assess the feasibility of substituting sand in paving blocks with dredged marine sediments in order to recycle a part of the large quantities of sediments that are commonly considered as waste. The authors preliminarily describe the physical, chemical and environmental characterisation of marine sediments dredged from one of the most important harbours in Tunisia. Moreover, a laboratory-scale production method, inspired by a factory-making process, was used to investigate the optimal mixing of marine sediments with sand, cement and water for reuse in paving blocks. According to the authors, the partial replacement of sand with dredged sediment provides paving blocks that can be considered comparable with standard ones.

In the last paper, Hart *et al.* (2016) examined the physico-chemical properties of high-density concrete in order to evaluate its use in low-level radioactive wastes containers. These radioactive waste barrier systems have the aim of preventing the ingress of groundwater into waste and also of retarding or temporarily mitigating the migration of radionuclides from the waste to the surrounding environment. The ability of the high-density/low-permeability concrete barrier to act as an osmotic semipermeable membrane could play a significant role on the containment of the migration of solutes, such as radionuclides, from the waste to the environment. However, the osmotic behaviour of concrete barriers also leads to the formation of a polarisation layer, adjacent to the high pressure side of the barrier, which can cause rapid deterioration of the leading edge-reinforcing members due to their greater exposure to chloride, sulfate and other ionic solutes. Laboratory tests conducted by Hart *et al.* (2016) to investigate the ability of high-density/low-permeability concrete to hyperfiltrate chloride solutions show that, once steady state conditions have been established, diffusion, driven by the high gradient that occurs due to the formation of the polarization layer, can determine the penetration of salt into the barrier and the consequent corrosion of the reinforcing rebar.

All the aforementioned papers are of great interest and are representative of the various environmental issues that face geotechnical engineers. The topics of these papers point out that the environmental issues currently dealt with by geotechnical engineers are related to both theoretical and applicative problems, and stimulate an extremely active field of scientific research.

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