Editorial

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Advances in modern society coincide with the use and reuse of materials, consumption of resources and innovation in engineering applications. Commiserate with technical advances comes environmental- and energy depletion-related concerns, which must be balanced with the need to develop industrial and agricultural activities. Environmental geotechnics attempts to span the gap between environmental-related problems and geotechnical considerations for construction and design of infrastructure, but particularly in designing controls for contaminants. Controlling pollutants goes beyond in situ subsurface containment or destruction to novel reuses of industrial byproducts, new uses for natural geomaterials, energy generation or capture from industrial activities, to understanding osmotic suction caused by pore fluids interacting with hazardous chemicals in clays.

Within this issue of *Environmental Geotechnics*, control and destruction of contaminants and sustainable design are the overarching objective. In recent years, waste barriers have been examined not just for physical but also chemical properties in order to reduce external exposure. The first paper of this issue 'Waste barriers in geotechnics' (Vardon and Heimivaara, 2017), provides an overview of waste barriers for radioactive and municipal wastes. The unique aspects of each waste type requires in-depth scrutiny in order to design the waste barrier for a given material, environment, host material, groundwater, etc. Generation of waste byproducts from containment of the specific contaminant over the evolution of the life cycle of the waste barrier technology are also considered in this manuscript.

Environmental concerns are a complex situation that must balance the need for industrial advancement in order to increase the standard of living of a society, with the need for solutions to the threats produced during industrialisation. This apparent dichotomy in society is the thin line that we walk in industrialised countries. Pouya (2017) examines the role that environmental-related considerations play in geotechnical applications in our second paper 'Environmental geotechnics in modern societies'. As societies evolve and progress, we will also need to address more complicated environmental needs with a steady stream of innovation, techniques and investigative methods.

As societies advance, the remnants and debris produced during industrialisation can provide unique opportunities for product recovery. In the paper by Hytiris *et al.* (2017), heat recovery is examined as it is generated from mineworkings in Glasgow, UK. The geological setting of Glasgow combined with the large-scale

mineral exploitation in the area has given rise to an ideal setting for extracting geothermal heat. Indeed, Hytiris *et al.* explore the intricate relationship of temperature and chemical profiles in abandoned mineworkings in and around Glasgow in order to establish suitability as potential geothermal source. Shallow mineworkings as geothermal heat sources may assist Scotland in balancing the legislative requirements for reductions in carbon dioxide emissions and Scotland's commitment to generate 100% of its electrical needs from renewable sources.

Balancing the need for fuels and the emissions of carbon dioxide are also a concern in Northern Alberta, Canada, where the translocation of 'lean' oil sands (LOS; sands containing less than 7% petroleum hydrocarbon content) is performed in order to excavate and extract oil sands below. LOS that have been translocated is uneconomical to process but does still contain petroleum hydrocarbons that potentially pose an environmental risk to disposal facilities (Scale *et al.*, 2017). Using field and laboratory studies, Scale *et al.* examined the spatial and temporal gas fluxes present in LOS and found a potential negative effect on plant life and soil as degradation of hydrocarbons from LOS materials occurs at slow rates.

Life cycle assessment of geotechnical constructs in waste containment and environmental assessment is a robust tool for evaluating the impact of design on sustainability. The stages of life cycle assessment, as applied to traditional geotechnical structures such as mechanical stabilised earthen walls, can quantifiably distinguish between differing wall configurations and provide a tool for designers to utilise (Damians *et al.*, 2017). When comparing geotechnical solutions using life cycle analysis, Damians *et al.* contend that a score-based tool for design considerations can help designers who are unfamiliar with recent developments in life cycle analysis compare geotechnical solutions for mechanical properties but also assess sustainability. The fourth manuscript in this issue provides a technical toolbox and steps for performing a life cycle analysis on geotechnical structures.

In environmental geotechnics, waste barriers or compacted fills contact hazardous chemicals that may transform the physical and chemical properties of geomaterials. Alterations in geomaterial mechanical properties is a concern for those utilising waste barriers, as chemical alteration may lead to potential degradation of geomaterial performance and impact the design. In our fifth paper in this issue, Das and Thyagaraj (2017) assess the impact of salt solution on remoulded clayey sand performance by comparing the macrostructural and microstructural pores. In this paper, salt

solution interacting with clayey sand causes the development of larger macropores, which leads to increases in osmotic suction and ultimately to collapse of clayey sand materials. This phenomenon is associated with clays under salt flux in other applications that include osmosis and reverse osmosis (Hart *et al.*, 2008; Meier and Schackelford, 2017) and may impact the design of barriers.

Other compacted geomaterials that are used for construction works include the addition of external materials to increase the physical and mechanical performance properties. Preceding the papers of this issue is a Briefing by Okonkwo (2017), who examines the performance of lateritic soils treated with increasing proportions of calcined kaolin and measures the engineering performance standards by utilising the British standard light and West African standard compactive efforts. Shear strength drastically increased when the geomaterials were treated with calcined kaolin, with maximum strength gained at the upper extents of kaolin incorporation. Lateric soils that did not experience this treatment exhibited much lower compressive strength gain and could not satisfy the requirements for some earthen embankments.

The content of this issue can be utilised as a reference for future environmental geotechnical applications and for geomechanical property changes induced by chemical alterations. As development drives innovation, so will innovation drive the state of environmental geotechnics.

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