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Editorial

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Chemical transport through the ground is a major concern in groundwater pollution, waste disposal and storage, remediation of contaminated sites, corrosion, and leaching phenomena. The strong dependency of the soil permeability on the pore-fluid chemistry can cause changes in geotechnical properties due to changes in the soil fabric (Mitchell & Soga, 2005). Having worked on micro-mechanics of soil for over 10 years, I became accustomed to looking into particle morphologies, the relative particle positions and the mechanisms that lead them to evolve and alter the pore space.

The impact of pore space changes on the conduction phenomena of the flow through geomaterials of fluids and chemicals is the common theme across the five papers presented in this issue of *Environmental Geotechnics*. I found it fascinating to learn about the micro-mechanisms described in these papers and the tremendous significance of these new findings for the development of sustainable and environmental friendly solutions for soil and groundwater remediation. It is my hope that the readers will find this issue as interesting as I did and will be able to discover useful information and inspiration for their own work.

Heavy metals released into the groundwater from industrial activities are harmful to human health. Permeable reactive barriers, acting by immobilising the contaminants or transforming them into less toxic compounds, are a sustainable in situ technology for groundwater remediation. The key challenge for the design of these barriers is to prevent reactivity loss and the reduction hydraulic conductivity due to the clogging of the barrier pores. Bilardi *et al.* (2020) address this issue by experimentally comparing the suitability of two volcanic porous rocks, pumice and lapillus, as admixing agents for the granular zero-valent iron. The results show a better sorption capacity of lapillus attributed to the presence of pores with a greater average diameter, which allows better access to the inner surface by contaminated water. The authors conclude that thanks to its removal capacity, lapillus enables reducing the barrier thickness the treatment time, and can thus be used as an effective and inexpensive reactive medium.

The long term permeability is also critical for the containment barriers for storage of oil derivatives, the challenge here is on how to prevent it from increasing over time. To this end, adequate parameters, such as shrinkage-swelling susceptibility, and the compatibility between the contained and the barrier materials are required. Machado *et al*. (2020) presents a comprehensive laboratory and field testing campaign to fine-tune the optimal ranges of soil index properties for compacted soil liners for non-aqueous phase fluids. Soils with high clay contents tend to present poor long-term performance due to wetting-drying cycles and the consequent appearance of cracks and fissures. The authors propose the use of less active clay minerals that act mainly as a filler material, reducing the size of the soil pores, rather than an active surface for particle-fluid interaction. Machado *et al*. (2020) also emphasise the need for the design and construction of these barriers to be based not on the permeability of water, but of the fluids to be contained.

We direct now the focus on hydraulic barriers to the issues arising when construction on old landfills and waste deposits leads to the damage of these barriers. The iron released from corrosion of the piles can react with the clay minerals changing the clay pore structure and locally increasing its permeability, thus, creating preferential paths for contaminant transport. Minder *et al*. (2020) investigate whether the corrosion-induced increase in clay permeability could facilitate contaminant transport through a barrier separating polluted ground from deeper aquifers. Based on the results of experimental tests, a constitutive model for the coupled chemo-mechanical behaviour was modified to account for a different pore-fluid chemistry and incorporated into a finite-element code. The authors show that once the hydraulic barrier is perforated with foundation piles subjected to corrosion, small concentrations can arrive in the aquifer up to four times earlier, which should be of utmost concern for the case of drinking water wells.

An attractive alternative to the compacted clay liners for migration or waste containment is the geosynthetic clay liners. The long-term performance of these liners can be affected by the significant increase in permeability due desiccation resultant from thermal dehydration. Ghorbani *et al.* (2020) investigate this problem using a thermo-elasto-plastic model and highlight the different elasto-plastic response of the liner to thermal gradients, when compared with a commonly used elastic approach. The authors also identify the mechanical parameters with a pronounced effect on the risk of desiccation to inform future experimental investigations.

Moving on to a different application of synthetic membranes, Cen *et al.* (2020) presents an analytical investigation into the stability of slopes with impervious geomembranes during rapid drawdown of an earth-rock dam. The authors investigate the influence of membrane defects and the permeability of dam materials on the seepage behaviour. The paper demonstrates the influence of membrane defects and their location, on the integrity of the impervious barrier and the stability of the dam slope.

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