Environmental Geotechnics: Past, Present and Future?

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Abstract. Advances over the past 35 years in terms of minimizing impact to the environment by containment, collection, and treatment of contaminants as well as by minimizing the generation of contaminants are highlighted in this keynote lecture. The lecture examines past advances in understanding hydraulic conductivity of soils (both clayey and granular soils) permeated by contaminated fluids. And the lecture considering the present, the substantial use of geomembranes in fluid containment and the advances in construction quality assurance to minimize holes are examined, as well as Looking to the future, the lecture highlights the need for taking a systems approach to environmental geotechnical design.

Keywords: Hydraulic conductivity of soils · Geomembranes
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1 Research Background

As a discipline within the broader context of geotechnical engineering, environmental geotechnics can trace its roots back to the early days of soil mechanics and the work on flow through soil and compaction of soil to achieve low permeability (e.g., in earth dams). However, over about the last 35 years, environmental geotechnics has evolved considerably and one might wonder if it has now matured or if there are still significant challenges to address?

2 Research Content

This lecture highlights some of the advances over the past 35 years in terms of minimizing impact to the environment by containment, collection, and treatment of contaminants as well as by minimizing the generation of contaminants. The effect of clay-leachate interaction on increasing clay liner permeability and of biologically induced processes (clogging) on decreasing the permeability of granular drainage layers are discussed. It then highlights importance of contaminant diffusion in well-designed low leakage, or zero leakage, barriers.

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The leakage that might be expected with good CQA for different types of liner systems and wrinkle networks are touched upon and the role of leak detection surveys in reducing leakage is examined. Since geo-membranes are commonly used as part of a composite liner with a geo-synthetic clay liner (GCL), the lecture touches on some construction issues requiring much more awareness in the industry because of their implications for system performance.

Looking to the future, the lecture highlights the need for taking a systems approach to environmental geotechnical design. It highlights how the optimization of one component of a barrier system (e.g., a drainage layer) can have a negative effect on another component (e.g., a geo-membrane liner) if there is inadequate appreciation of the interactions between the two and how well-intentioned optimization of a component can degrade the overall system performance. The lecture discusses the often underestimated, and sometimes overlooked, interaction between the waste and the barrier system and the impact it can have on the long-term performance of a geo-membrane liner. However, not all interactions are negative! The lecture identifies positive interactions between geo-membranes and adjacent materials that can substantially reduce leakage and discusses the factors still requiring further detailed investigation in this area. Finally, the increasing role being played by geo-membranes as a diffusive-advective barrier used in the containment of hydrocarbon spills and in the remediation of contaminated land is discussed with an emphasis on new geo-membranes being developed for this role and it illustrates their use in Antarctica.

3 Conclusions

By reviewing the state of art in Environmental Geotechnics, this lecture highlights the advances over the past 35 years in terms of minimizing impact to the environment by containment, collection, and treatment of contaminants as well as by minimizing the generation of contaminants.