NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

CUS Biogeotechnics Online Seminar Series

Ground Improvement by Microbially Induced Desaturation

Date: 16 August 2023 (Wednesday)

Time: 3:00 pm to 4:30 pm (Singapore Time)

Platform: MS TEAMS (The "Join event" link will be in the confirmation email.)

Organised By: Centre for Urban Solutions (CUS), School of Civil and Environmental Engineering (CEE), Nanyang Technological University, Singapore

Registration (Free): Please click the link below to register.

https://events.teams.microsoft.com/event/57077997-4f46-417a-99d4-0401703dffbf@15ce9348-be2a-462b-8fc0-e1765a9b204a

PDUs: Pending from Professional Engineers Board Singapore

About the Online Seminar

Biogenic gas in soils has been studied for many geotechnical and geo-environmental applications. Micro-organisms can produce gas through their metabolism, which displaces the water and desaturates the soil. Microbially induced desaturation (MID) increases the compressibility of the pore fluid, dampens pore pressure build up during undrained (cyclic) loading of loosely packed sands, and therefor MID has been considered as a ground improvement method to mitigate earthquake-induced liquefaction. Lab tests demonstrated that only a 10% reduction in degree of saturation is sufficient to significantly increase the undrained cyclic shear resistance of loose sands, while field tests demonstrated that sediments with occluded gas remained desaturated for more than 3 years. Alternatively, MID has been considered as a method to improve the efficiency of dynamic compaction methods, since desaturation brings the water content closer to its optimal water content, which would improve its compactibility. The buoyant effect of trapped biogenic gas in the pores in soft fine-grained soils or in sand layers above fine-grained soils, lowers the effective unit weight and reduces the rate and amount of consolidation. Venting of trapped biogenic gas can cause a major hazard for offshore installations and the increased escape of natural trapped methane gas, in response to global warming, forms a significant hazard further aggravating climate change. How the presence of biogenic gas affects the undrained shear strength, cyclic resistance ratio at varying relative density, buoyancy or whether it can be used as ground improvement method or forms a potential hazard will depend on the distribution, migration and permanence of biogenically formed gas, which are affected by the reaction rate, the grain- or pore size distribution, pore connectivity, and at a larger scale by the overburden pressure and soil stratification. Large scale experimental studies have been performed, in which the distribution of gas has been monitored and numerical reactive transport models have been developed and used to simulate the biochemical conversions that result in biogenic gas and predict its effect on the hydraulic and mechanical properties. The models have been fitted to the experimental data and the comparison suggests that in order to predict changes in hydromechanical properties properly the model need to be fully coupled, allow for multi-phase flow, and needs to consider other metabolic products like organic biomass and biominerals.

About the Speaker

Leon van Paassen, Ph.D. M.ASCE, is a biogeotechnics expert with Hydronamic, the in-house engineering department of Boskalis, an international dredging contractor and offshore service provider based in Papendrecht, Netherlands, where he is involved in tenders and provides project support for large land reclamation projects and is involved in research on novel bio-based ground improvement methods. Next to his job at Boskalis, he is Adjunct Research Professor at Arizona State University and serves as senior investigator at the NSF Engineering Research Center for Bio-Mediated and Bio-inspired Geotechnics. He received his MSc and PhD from Delft University of Technology and is one of the pioneering researchers in the field of biogeotechnics, managed the scale up several bio-based ground improvement from lab to full field-scale applications, and has published over 75 peer-reviewed articles and numerous conference contributions.