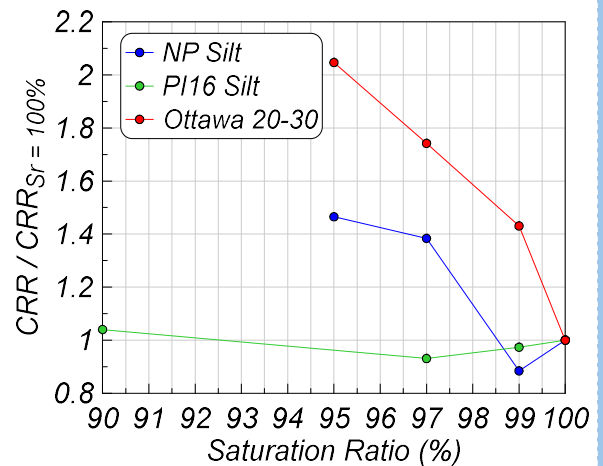
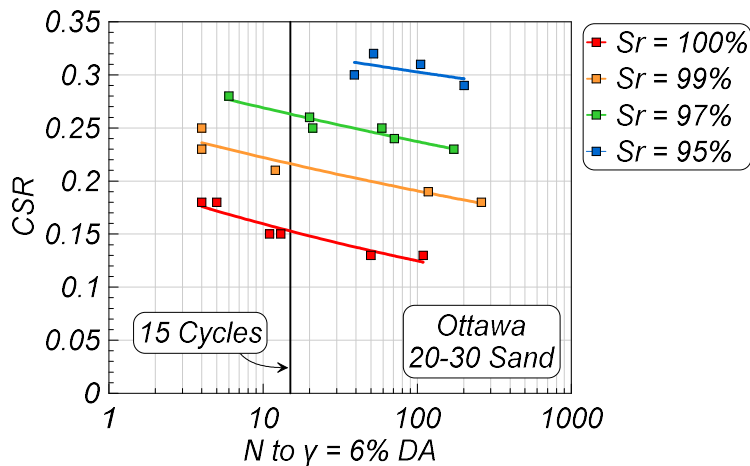


The Effect of the Degree of Saturation on the Liquefaction Resistance of Non-Plastic and Low-Plastic Soils



PhD Defense

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Date: Friday, January 9th, 2026

Time: 10:00 – 11:00am

Location: Engineering Building Rm 315 or via Zoom: <https://pdx.zoom.us/j/4158027704?omn=81029806682>

Abstract

Liquefaction is a phenomenon caused by earthquake shaking that leads to porewater pressure buildup followed by significant strength loss. Although it is often associated with clean sands, liquefaction has also been documented in fine-grained soils such as low-plasticity silts. These soils are common in the Pacific Northwest and are widespread in Portland, Oregon. Most existing ground improvement methods are ineffective and often cost-prohibitive in silts, especially beneath existing structures. This creates a need for mitigation techniques that work well in fine-grained soils under existing structures. Microbially Induced Desaturation (MID) is an emerging method that reduces the saturation ratio (Sr) by introducing gas bubbles into the pore fluid and thus increases cyclic resistance against liquefaction. Previous tests on sands show that reducing Sr from 100% to 97% can increase the cyclic resistance ratio (CRR) by roughly 40%. This research examines how the introduction of gas into the pore fluid affects the cyclic response of non-plastic and low-plasticity silts across varying Sr values. A cyclic direct simple shear device was modified to allow truly undrained testing with controlled saturation using a standpipe system. Validation tests on fully saturated Ottawa 20–30 sand matched published results. In the modified system, Ottawa 20–30 sand showed a 40% increase in CRR when Sr was reduced from 100% to 99% and a 75% increase when Sr was reduced from 100% to 97%. Non-plastic silt showed a 40% increase when Sr was reduced from 100% to 97%. Silt with a plasticity index of 16 showed almost no change in CRR with varying Sr. This work improves the understanding of how MID influence the cyclic behavior of non-plastic and low-plasticity silts and provides insights into which soil types are more amenable to improvement using MID.