**Evaluating shear strength and brittleness in mine tailings using variable rate shear vane apparatus.**

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# ABSTRACT

Field vane shear testing (VST) is a widely used in situ test method for assessing undrained shear strength in fine-grained plastic soils, including mine tailings. However, when applied to non-plastic and coarse-grained materials, partial drainage can occur due to increased permeability, leading to elevated shear strength measurements. It has become common practice to undertake the VST at variable rotation rates, outside of the ASTM D2573 standard 6 deg/min, to ensure undrained shearing during the test. This paper presents advancements in VST testing in tailings through two complementary studies; one material specific and one driven by large diverse data sets.

The first study reviews variable rate digital vane shear testing (VR-eVST™) conducted across coal mine tailings in Australia since 2019. The case studies presented focus on the impact that a change of rotation rate has on peak and remoulded shear stress. This allows for site-specific consideration of partial drainage effects and viscosity effects when testing silty and non-plastic materials.

In parallel, this paper explores brittleness obtained from standard-rate eVST through a large-scale data-driven approach. To isolate undrained conditions, data is screened to only include eVST paired with a cone penetration test (CPTu) and soil behaviour index Ic>3.0. Brittleness explored through assessing the shear strength at varying degrees of rotation and strength degradation from 60 degrees of rotation to the final remoulded value. This approach aims to explore the for a quantitative evaluation of the strength degradation behaviour across various sensitivities and materials.

Together these studies aim to demonstrate the application of the vane shear test in tailings and refine the understanding of the post peak behaviour when compared to the remoulded strength. When combined this can contribute to improving geotechnical characterization of mine tailings and our understanding of stress strain response of mine tailings.