ABSTRACT

The Characterization of Tensile Fracture and Crack Propagation in Trinidad Soils of Varying Peat Content with Applications in Tillage

Robert Anderson Garfield Birch

An investigation into the tensile failure of soils was performed on two distinct Trinidadian soil types at varying water states (status), percentage peat content and forcing frequencies that were factors related to the initial conditions of the soil. The mechanical process of tillage was examined and an energy model that described crack propagation was developed. Further development led to the hypotheses that the tensile strength and resilience were related to the initial conditions of the soil. A full examination on tensile failure was performed on the soils at a constant compaction level of 404 kPa under three different loading conditions, namely, quasi-static tensile, constant tensile (creep) test and dynamic (vibratory) test. Specialized experimental jigs and moulds were designed and fabricated for the constant tensile test and the dynamic test. Image acquisition and processing techniques were employed to analyze crack propagation. Results on each loading condition included time to failure, maximum tensile strength, resilience, tensile strain and other engineering properties depending on the loading condition. A regression model was developed for tensile strength. The model was a function of percentage peat and water content and had a multiple correlation R value of 53 % (N = 384). This model was validated using four other soils from around Trinidad and tested at varying peat and moisture content and a correlation r value of 78.5% (N=24) was obtained. This model is useful as it mathematically characterizes the influence of water and peat in the tensile failure of soils and thus soil pulverization. Further it allows engineers the ability to calculate the yield strength of soils, which is much needed data in the design of tillage implements.

Keywords: Robert Anderson Garfield Birch; Trinidad soils; fracture; crack propagation; tensile; peat; tillage.