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Effects of Yield Stress and Viscosity on Debris Flow Behaviors by Flume Experiment and Numerical Analysis

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Debris flows are serious hazard on the slope areas. Rheological properties including yield stress and viscosity are major parameters in prediction of intensities and deposition on fans of debris flows. In this study, the effect of rheological properties on debris flow intensities and deposition on fans of natural clay was investigated using large scale flume experiments. The flume experimental device employed in the tests consists of a tilting flume with an inclination 17°, on which a steel tank with a removable gate was installed. A final horizontal plane works as the deposition area. Rheological properties of natural soil samples at different water contents were obtained from vane-rheometer tests. A non-linear regression analysis was used to assess the effect of yield stress and viscosity on debris flow velocity, runout distance, deposited area and deposited volume. It can be found that surface velocity profile versus horizontal distance behaved complicated and expressed by a sixth order polynomial function. Mean velocity, runout distance, deposited area and deposited volume decreased following power law with an increase in the yield stress and viscosity. The empirical equations were proposed to estimate these properties. The results of laboratory tests compared well with the results from a numerical analysis. The results indicated that the yield stress and viscosity play a significant role in the behavior of debris flow.