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Stress-Strain Relation in Debris Flow Analysis

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Abstract

In debris flow analysis, the generalized viscoplastic fluid (GVF) model can be used as the constitutive equations. When the yield stress is negligible, the shear expression in the GVF model for simple shear flow reduces to $\tau = \mu_1 (du/dz)^{\eta}$, where τ is the shear stress, μ_1 is the consistency index, du/dz is the shear rate, and η is the flow behavior index. In this paper the τ versus du/dz relation is studied by running experiments with 14 mm dry glass spheres in a conveyor-belt flume. A comparison of the estimated τ with the measured du/dz across the flow depth indicates that μ_1 is a strong function of the concentration that changes across the flow depth and thus, must be included in the analysis of the τ versus du/dz relation. An analysis of experimental results indicates that a relation between τ/μ_1 and du/dz is more meaningful; therefore, concentration data across the flow depth is needed. In this paper a viable method based on a Van Der Waals type equation of state is developed from experimental results, thereby assessing the applicability of τ/μ_1 versus du/dz relation in debris flow analysis.

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