Laminar flow of constant-flux released gravity currents: Friction factor-Reynolds number relationship  
FIRAT TESTIK, NAZLI YILMAZ, MIJANUR CHOWDHURY, Clemson University — This study aims to provide a relationship for the friction factor, \( C_f \), in terms of the Reynolds number, \( Re \), for two-dimensional constant-flux release gravity currents during viscous-buoyancy propagation phase. Motivation of this study was related to the pipeline disposal of high-concentration dredged fluid-mud. Such disposal operations form non-Newtonian gravity currents that propagate over the coastal seafloor. Our theoretical and experimental analysis resulted in \( C_f-Re \) relationships for both Newtonian (e.g. saline solution) and power-law (e.g. non-Newtonian fluid mud) fluids. A large number of experiments were conducted with different concentrations of both fluid mud mixtures (Kaolinite clay mixed with tap water) and saline solutions in a laboratory tank [dimensions: 4.3\( m \times 0.25m \times 0.5m \)]. In the experiments, different depths of ambient fluid (tap water) were considered. To determine the experimental \( C_f \) values for the viscous-buoyancy propagation phase, theoretical analysis was conducted to relate \( C_f \) to the experimental measurables. Based upon experimental observations, \( C_f \) is shown to relate to \( Re \) of the gravity currents inversely for both Newtonian and power-law fluids. While Newtonian gravity currents revealed a single value of the constant of proportionality for the \( C_f-Re \) relationship, power-law gravity currents revealed multiple values of the constant of proportionality that depends on the fluid-mud concentration.

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