Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

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: $4.3m$ x $0.25m$ x $0.5m$]. 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.

Firat Testik
Clemson University

Date submitted: 01 Aug 2012 Electronic form version 1.4