Geophysical Research Abstracts
Vol. 12, EGU2010-3117-1, 2010
EGU General Assembly 2010

Numerical simulations of negatively buoyant jets in an immiscible fluid using the Particle Finite Element Method

Monica Mier-Torrecilla (1), Adelina Geyer (1), Jeremy C. Phillips (2), Sergio R. Idelsohn (1), and Eugenio Oñate (1)

(1) CIMNE International Center for Numerical Models in Engineering, Spain (mdemier@cimne.upc.edu/ageyer@cimne.upc.edu), (2) Department of Earth Sciences, University of Bristol, UK

In this work we investigate numerically the injection of a negatively buoyant jet into a homogenous immiscible ambient fluid using the Particle Finite Element Method (PFEM), a newly developed tool that combines the flexibility of particle-based methods with the accuracy of the finite element discretization. In order to test the applicability of PFEM to the study of negatively buoyant jets, we have compared the two-dimensional numerical results with experiments investigating the injection of a jet of dyed water through a nozzle in the base of a cylindrical tank containing rapeseed oil. In both simulations and experiments, the fountain inlet flow velocity and nozzle diameter were varied to cover a wide range of Reynolds *Re* and Froude numbers *Fr*, such that $0.1 < Fr < 30$, reproducing both weak and strong fountains in a laminar regime ($8 < Re < 1350$). Numerical results, together with the experimental observations, allow us to describe three different fountain behaviors that have not been previously reported. Based on the *Re* and *Fr* values for the numerical and experimental simulations, we have built a regime map to define how these values may control the occurrence of each of the observed flow types. Whereas the Fr number itself provides a prediction of the maximum penetration height of the jet, its combination with the Re number provides a prediction of the flow behavior for a specific nozzle diameter and injection velocity. Conclusive remarks concerning the dynamics of negatively buoyant jets may be applied later on to several geological situations, e.g. the flow structure of a fully submerged subaqueous eruptive vent discharging magma or the replenishment of magma chambers in the Earth's crust.