Geophysical Research Abstracts
Vol. 19, EGU2017-17719, 2017
EGU General Assembly 2017

Effect of roughness and porosity on geometry and kinematics of lock-exchange gravity currents

Elena Gatto (1), Claudia Adduce (1), and Rui M L Ferreira (2)

(1) Department of Engineering, University Roma Tre, Rome, Italy, (2) CERIS - Instituto Superior Técnico, Universidade de Lisboa, Lisboa, Portugal

Gravity currents generated by lock-exchange are an important research tool to understand key features of flows driven by a density may be naturally caused by interaction of geophysical nature but may also be triggered by adverse anthropic actions, from oil spills to pollution related turbidity. Research on the fundamental geometrical and kinematic features of these currents is still necessary, especially when they propagate on complex geometries.

The purpose of this work is to investigate the shape and the velocity of propagation of gravity currents over rough beds and over rough-porous beds. To attain this objective, different initial conditions were specified, namely smooth bed, rough bed composed of a single layer of 2 mm glass beads and rough and porous bed composed of 4 layers of the same beads.

The dimensions of the channel are $300 \times 19,6 \times 40$ cm in which a steel gate is inserted to define the lock. Two initial mixtures were tested: 1015 and $1030\ \mathrm{kgm}^{-3}$. The density is measured with a pycnometer on a high precision balance. The mixture is composed of fresh water, salt and rhodamine, to allow for visualization and measurements based on image analysis.

A high-speed video system camera was used to record the motion of the current. The camera has a 50 mm lens and a sampling frequency of 100 fps. Gray-level images were obtained with 8 bit depth. Calibration of gray-levels was performed pixel by pixel to mixture concentrations. The current is examined in three positions: immediately after the gate ($(x-x_0)/x_0 = 0\ \mathrm{to}\ 3$), in the middle ($(x-x_0)/x_0 = 5\ \mathrm{to}\ 8$) and at the end of the channel($(x-x_0)/x_0 = 10\ \mathrm{to}\ 13$).

It is shown that the celerity of the gravity current wave front varies with the different boundary conditions. Indeed, the current is faster for the smooth bed and slower for the rough bed conditions. No appreciable effects of porosity were registered on the wave celerity. The shape of the current varied slightly between the rough and the porous-rough tests, indicating a minor loss of mass to the porous bed.

Acknowledgements

This research was partially supported by Portuguese and European funds, within programs COMPETE2020 and PORL-FEDER, through project PTDC/ECM-HID/6387/2014 and Doctoral Grant SFRH/BD/97933/2013 granted by the National Foundation for Science and Technology (FCT).