

Study of Gravity-Inertial Phase of Spreading of Oil on a Calm Sea employing the Lagrangian Particle Method Smoothed Particle Hydrodynamics

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Abstract

Oil spill on the sea is considered a serious environmental problem. It can occur during oil well drilling, repair and transport operations. The spreading of oil is due to the tendency of the pollutant to flow over itself. Knowledge of oil physical properties during the spreading, like velocities and positions allows the adoption of environmental protection actions. The modelling of the physical process, due to a balance between gravitational, inertial, viscous and interfacial tension forces, started during the mid-twentieth century, when Fay adjusted curves to experimental data, considering a calm sea condition. These adjusted curves, defined for idealized theoretical conditions are still used, with some modifications. This Thesis presents the development and implementation of a purely Lagrangian meshless model, considering the fundamentals of the Smoothed Particle Hydrodynamics (SPH) method for the study of the spreading of oil. A model for the collisions between the particles and boundary was implemented, with the definition of a coefficient of restitution of kinetic energy. The model was validated by using results, from the literature, for classical problems: heat diffusion on a flat plate, static tank containing an incompressible fluid and dam breaking. After model validation, it was performed the numerical simulation of the spreading of oil on calm sea conditions, in its first phase (gravitational-inertial). There was agreement between the numerical results obtained with the use of an appropriate coefficient of restitution of kinetic energy and those provided by the adjusted curve proposed by Fay, for the diameter of the oil slick at the end of the studied phase.