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Numerical simulation of sediment erosion by submerged jets using an Eulerian model. (English) Zbl 1278.76012

Sci. China, Technol. Sci. 53, No. 12, 3324-3330 (2010).

Summary: The erosion of loose beds by submerged circular impinging vertical turbulent jets is simulated using an Eulerian two-phase model which implements Euler-Euler coupled governing equations for fluid and solid phases, and a modified k-ε turbulence closure for the fluid phase. Both flow-particle and particle-particle interactions are considered in this model. The predictions of eroded bed profiles agree well with previous laboratory measurements and self-designed experiments. Analysis of the simulated results reveals that the velocity field of the jet water varies with various scouring intensities, that the scour depth and shape are mainly influenced by the driving force of the water when the density, diameter and porosity of the sand are the same, and that the porosity is an important contributor to sediment erosion. In this study, the scour depth, the height of dune and the velocity of the pore water increase with increasing porosity.

MSC:

76B10 Jets and cavities, cavitation, free-streamline theory, water-entry problems, airfoil and hydrofoil theory, sloshing
76F60 k-ε modeling in turbulence
76T99 Multiphase and multicomponent flows

Keywords:

sediment erosion; jet flow; Eulerian model; numerical simulation

Full Text: DOI

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