A multiphase SPH method with the application on hydrate-bearing sediment

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Abstract

Marine gas hydrate is one of the important targets for the energy development in the future. Phase change characteristics, gas and water transport mechanism, heat and mass transfer mechanism and other physical phenomena in hydrate decomposition process have important effects on the decomposition rate of hydrate, permeability of hydrate-bearing sediments and mechanical properties of hydrate reservoir, which directly affect the production efficiency of hydrate gas and the safety of production process. In order to better protect the marine environment and develop hydrate resources, it is necessary to study the characteristics of hydrate decomposition and sediment migration[1].

With the development of computer, numerical simulation has been an important tool for the study of scientific and engineering problems. SPH (smoothed particle hydrodynamics) method is a meshless Lagrangian particle method[2]. It has special advantages in simulating multi-phase flow and fluid-solid coupling problems, and has been widely used in the field of marine engineering fluid dynamics[3]. Based on the original SPH method, a multi-phase SPH algorithm is developed to study the migration characteristics of hydrate-bearing sediment. Gas, liquid and solid phases are considered simultaneously in this study in order to better capture some special physical phenomenon. Different soil structure and saturation are simulated by present multi-phase SPH, and their effects on transport of air, water and soil are investigated.

Keywords: Smoothed particle hydrodynamics; Multi-phase flow; Fluid-solid coupling; Meshless method

References

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