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Numerical Simulation of the Flowing of Ice Slurry in Seawater Pipe of Polar Ships

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Abstract : In recent years, as global warming, the sea-ice extent of North Arctic undergoes an evident decrease and Arctic channel has attracted the attention of shipping industry. Ice crystals existing in the seawater of Arctic channel which enter the seawater system of the ship with the seawater were found blocking the seawater pipe. The appearance of cooler paralysis, auxiliary machine error and even ship power system paralysis may be happened if seriously. In order to reduce the effect of high temperature in auxiliary equipment, seawater system will use external ice-water to participate in the cooling cycle and achieve the state of its flow. The distribution of ice crystals in seawater pipe can be achieved. As the ice slurry system is solid liquid two-phase system, the flow process of ice-water mixture is very complex and diverse. In this paper, the flow process in seawater pipe of ice slurry is simulated with fluid dynamics simulation software based on k-ε turbulence model. As the ice packing fraction is a key factor effecting the distribution of ice crystals, the influence of ice packing fraction on the flowing process of ice slurry is analyzed. In this work, the simulation results show that as the ice packing fraction is relatively large, the distribution of ice crystals is uneven in the flowing process of the seawater which has such disadvantage as increase the possibility of blocking, that will provide scientific forecasting methods for the forming of ice block in seawater piping system. It has important significance for the reliability of the operating of polar ships in the future.

Keywords : ice slurry, seawater pipe, ice packing fraction, numerical simulation
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