Current characteristics of perforated culture tank aboard an aquaculture vessel in various incidence angles

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ABSTRACT

An aquaculture vessel with perforated sideboards is a new piece of equipment suitable for the offshore fish farm. Present study preliminarily evaluated the performance of an aquaculture vessel with perforated sideboards, which was transformed from an international benchmark ship, Japan Bulk Carrier (JBC). Firstly, the numerical model is verified by comparing the CFD simulation and PIV measurements of JBC's stern flow fields. Then, a three-dimensional numerical model was established to investigate the hydrodynamic coefficient of the aquaculture vessel and flow field characteristics of the perforated culture tank in various incidence angles. Incidence angles ranging from 0◦ to 90◦ with an interval of 10◦ are considered. The variation trend of the aquaculture vessel's hydrodynamic coefficient with the incidence angles is exactly the same as that of the normal ship model with the incidence angles. Results show that the current characteristics are persistently enhanced as the incidence angles increases in the perforated culture tank. Unlike a left-right symmetric pattern at zero incidence angles, the flow field of the tank in oblique flow conditions shows a strong asymmetry. The vorticity pattern behind the perforations of face flow sideboard were dipole-type, regardless of incidence angles, consisting of one or two pairs of high-vorticity but opposite rotation direction clouds formed. This study aims to reveal the flow field characteristics in the perforated culture tank aboard an aquaculture vessel and fills the gap of existing research.

Keywords: Aquaculture vessel, Perforated culture tank, Incidence angles, Turbulence field, Computational fluid dynamics (CFD)