Numerical Simulation of Methane Slip in Dual Fuel Marine Engines

The methane slip is the problematic issue for the engines using natural gas (NG). Because methane is more powerful greenhouse gas (GHG) than CO$_2$, understanding the methane slip during gas exchange process of the engines is essential. In this study, the influence of the gas pipe geometry and the valve timings on the methane slip was investigated. MAN L28/32DF engine was modeled to simulate the gas exchange process of the four stroke NG-diesel dual fuel engines. The mesh size of the model was decided based on the sensitivity study on the peak pressure of the cylinder and the fuel mass estimations. The simulations with various gas pipe geometries were conducted. It seemed that the effect of the change in injection direction is more dominant than the change in the gas hole configuration. The favorable injection direction for minimum amount of methane slip was discovered as the direction which helps developing the flow of methane far from the exhaust ports. The effects of various valve timing settings were also simulated. The advancement of the exhaust valve closing was more efficient than the retardation of the intake valve opening. A little retardation of the intake valve opening even resulted in the increase of the amount of methane slip.

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