

The Effect of Air Throttle on Combustion Process and Emission Formation in Marine Lean-Burn Gas Engines

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Abstract - Enhancing the marine propulsion system's performance is one of the crucial issues that has received noteworthy attention due to the current strict emission legislation. A fundamental improvement without an additional after-treatment system is employing natural gas fuel in lean-burn combustion. Lean combustion may improve the thermal efficiency in a stable condition, but a real ship works in a time-varying inflow on the propeller, and the engine must afford high-efficiency combustion against the fluctuating load. Stable combustion in a lean-burn marine gas engine is guaranteed by installing controllers on the air and the fuel pipes to regulate air-fuel ratio and engine speed.

The present study aimed to investigate the influence of adding an air throttle during the engine's lower loads and its effectiveness during a time-varying load. A thermodynamics model of spark ignition engine with an imposed constant and transient load is presented. The results revealed that using a throttle in the lower loads may improve the engine fuel consumption and emission formation during steady-state, but, in transient condition, it showed a negligible impact on the brake specific fuel consumption and unburned hydrocarbon emission formation.

Keywords: Natural gas engine, Dynamic load, Marine propulsion system, Throttle valve