NUMERICAL SIMULATION OF THE OPERATION PROCESS IN A DIESEL ENGINE WITH THE REAL-GAS EQUATION OF STATE

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Abstract: Comparative three-dimensional gasdynamic calculations of the operation process in the combustion chamber (CC) of a diesel engine using the thermal and caloric equations of state (EoS) of real and ideal gases are performed. The significant influence of real-gas effects on the indicating diagram and on the emissions of nitrogen oxides and soot is demonstrated. Thus, the account for the real gas properties leads to (i) a decrease in the maximum pressure and the mass-averaged temperature in the diesel engine by approximately 7 atm (6%) and 150 K (9%), respectively; (ii) an increase in the self-ignition delay by 1.6 crank angle degree; (iii) a 20 percent increase in the maximum heat release rate; and (iv) a decrease in the NO and soot emissions by factors of 2 and 4, respectively. The maximum values of the relative excessive specific heat ($\sim 2.5\%$) and relative excessive pressure ($\sim 4\%$) are reached near the "cold" walls of the CC and in the area of the fuel spray with a high concentration of fuel vapor and a relatively low temperature, i. e., in the areas of the CC with high density.

Keywords: diesel engine; operation process; numerical simulation; real-gas equation of state; indicating diagram; nitrogen oxides; soot

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