ISSUES OF ENDOTHERMIC FUELS USAGE IN HIGH-VELOCITY ENGINES OF ATMOSPHERIC VEHICLES

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Abstract

Heat absorption at thermal decomposition of endothermic hydrocarbon fuels makes possible to use these fuels for cooling the engines for high-velocity flight vehicles. In addition, gaseous products of decomposed fuel can be used for fuel pump drive before supply to combustion chamber. Fuel decomposition products contain hydrogen and light hydrocarbons gases which are able to combustion in high speed air flow. The paper represents the results of experimental research and modeling of heat and mass transfer at turbulent flow of hydrocarbon fuels at supercritical pressure. To predict heat transfer at turbulent flow of liquid hydrocarbon fuels under supercritical pressures new equations have been proposed. These equations are intended for more accurate account of the thermal property variability as a function of temperature and pressure. A new kinetic model has been developed for description of coke deposit formation. This model includes three mechanisms of coke formation: coke from soluble gum which consist in hydrocarbon fuel, coke from fuel oxidation by solved oxygen, and coke from High Molecular Products (HMP). The model with equations of hydrodynamics, and heat and mass transfer gives accurate prediction of the coke deposit in channels at turbulent flow of endothermic hydrocarbon fuels. A new kinetic model of fuel pyrolysis for prediction of heat and mass transfer at turbulent flow of endothermic fuel under supercritical pressure in pseudo-vapor phase (T > 500°C) has been developed. The model accounts an effect of high fuel pressure and change of catalytic activity of wall surface on gas and coke formation.

Keywords: Endothermic hydrocarbon fuels