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Thermal and Caloric Imperfections Effect on the Supersonic Flow Parameters with Application for Air in Nozzles

Authors : Merouane Salhi, Toufik Zebbiche, Omar Abada

Abstract : When the stagnation pressure of perfect gas increases, the specific heat and their ratio do not remain constant anymore and start to vary with this pressure. The gas does not remain perfect. Its state equation change and it becomes a real gas. In this case, the effects of molecular size and inter molecular attraction forces intervene to correct the state equation. The aim of this work is to show and discuss the effect of stagnation pressure on supersonic thermo dynamical, physical and geometrical flow parameters, to find a general case for real gas. With the assumptions that Berthelot's state equation accounts for molecular size and inter molecular force effects, expressions are developed for analyzing supersonic flow for thermally and calorically imperfect gas lower than the dissociation molecules threshold. The designs parameters for supersonic nozzle like thrust coefficient depend directly on stagnation parameters of the combustion chamber. The application is for air. A computation of error is made in this case to give a limit of perfect gas model compared to real gas model.

Keywords : supersonic flow, real gas model, Berthelot's state equation, Simpson's method, condensation function, stagnation pressure
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