CALCULATION FEATURES OF THE COMBUSTION PRODUCTS COMPONENTS HEAT CAPACITIES OF THE GTE FUELING ON HYDROGEN

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High-energy characteristics and the product of the oxidation reaction as water vapor are some of the main benefits of hydrogen. Those and other advantages of using hydrogen as a fuel make it attractive to use for developed gas turbine engines (GTEs) and the existing ones (fleet of stationary GTEs) [1]. At the development and conversion of GTEs, when thermochemically calculating the combustion process, it is necessary to consider that water vapor dissociates noticeably at temperatures starting from 1000 °C [2].

Thermal dissociation can be taken into account in two ways. The classical method: a system of equations, which is based on the constants of chemical equilibrium as functions of the composition, temperature and (partial) pressure of not only water vapor H_2O and its derivatives (H^+; OH^-), and other combustion products components (N_2, O_2, CO_2, Ar) are compiled and solved [3]. The alternative method: the dissociation can be taken into account indirectly through the value of the heat capacity of the substance. It is possible because dissociation leads to an increase in heat capacity, insofar as part of the heat is spent on the breakdown of chemical compounds and these costs are deterministic, being functions of the composition, temperature and pressure of the combustion products. At the same time, the calculations are significantly simplified, insofar as the non-dissociated gas is calculated, and the dissociation is implicitly considered in the value of the heat capacity, which is a function of temperature and pressure for each component of the combustion products. As part of the second method, based on tabular data for dissociated gas, the polynomial dependences of the heat capacities of the main components of air and combustion products were obtained by authors [2]. Using the alternative method, the amount of calculations has decreased significantly and the accuracy of the calculation is not inferior to the classical method [3].

Based on the obtained polynomial dependences of the heat capacities of air and combustion products components, which consider thermal dissociation, a mathematical model of the GTE's combustor working process fuelling on hydrogen was developed, and the temperature of combustion products depending on the oxidant excess factor and the GTE's combustor pressure was calculated.

References:

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