The Influence of Hydrogen Addition on the Combustor Thermal State

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One way to reduce combustion chamber emissions is to use hydrogen additives to hydrocarbon fuels, such as using a methane-hydrogen mixture. However, hydrogen has a high flame speed, a high combustion specific heat and, as a result, a high thermal load on the combustion chamber components. Therefore, the use of hydrogen additives leads to a revision of the setting of operating parameters in order to comply with technical requirements.

The aim of this study is to determine the effect of hydrogen additives in the fuel on the thermal state of the combustor.

The study was carried out on a model combustion chamber by experimental and computational methods. The combustion chamber includes two fuel supply circuits: main and pilot. There is also an air supply circuit that goes to cool the flame tube with the ability to adjust the flow rate. Seven thermocouples were installed along combustor length on the outer surface of the flame tube in order to experimentally determine the thermal state.

Conjugate thermal simulation was carried out using the Ansys Fluent software package in a steady state. A three-dimensional geometric model of the combustion chamber was built, a finite element mesh was generated with a conformal interface between the fluid and solid.

The calculation and experiment were carried out under standard atmospheric conditions with a pressure drop of 3%, an air/fuel ratio of 1.5, and various additions of hydrogen to methane.

As a result of the study, a comparison of the temperature along the length of the combustor wall, obtained by calculation and experimental methods, was obtained. The influence of the proportion of hydrogen addition on the thermal state of the combustor was obtained.