The efficiency of combustor perforated plate

V.M. Anisimov, I.V. Chechet, O.V. Kolomzarov, M.Yu Anisimov, D.R. Bobkova

Samara National Research University, 34, Moskovskoye shosse, Samara, Russia, 443086
vradik@mail.ru

Modern combustion chambers operate at conditions, which are associated with the high temperatures and pressures, so the issue of cooling the walls is relevant. There are different types of cooling systems: film, convective, convective-film, transpiration and perforation, which is the most promising, as it allows for more efficient use of the cooling resource.

To analyze the influence of various geometric parameters on the efficiency of perforation cooling, a sector of the annular combustion chamber with six rows of holes with a diameter of 0.85 mm and a pitch of 8 mm was taken as the initial data. The wall thickness is 1.6 mm, the cold air temperature at the inlet is 957K, the hot air temperature is 1800K, which corresponds to the temperature conditions of modern combustion chambers.

During the work, various geometric parameters of the holes were investigated, which are technologically feasible and can be implemented into the design of the combustion chamber. The following parameters were changed:

1) Angles of inclination of holes;
2) Rotation angles of holes;
3) Recesses on the hot surface;
4) Types of hole geometry;
5) The order of the holes (linear and staggered).

The associated calculation was carried out in the Ansys Fluent program. The wall material was chosen EI868 (XH60BT). When specifying the material, the values of thermal conductivity and heat capacity were taken into account depending on temperature.

The efficiency parameter was taken to be the value η, which is defined as the ratio of the difference in the temperature of the hot air at the inlet and the adiabatic temperature of the wall to the difference between the temperatures of the hot and cold air. A comparison is made of the dependence of cooling efficiency along the length of the wall on geometric parameters. Recommendations are given for the selection of holes for the most effective cooling of the flame tube walls of modern combustion chambers.