DIRECT MEASUREMENT OF CONCENTRATION AT MIXING IN THE HOT-SHOT FACILITY

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Effective mixing of fuel and air is important for the ignition and combustion in any system, especially at the combustion in supersonic flow because of short residence times of fuel in the channel. Direct sampling, its preservation in the closed sealed volume and the subsequent analysis by means of the stationary gas analyzer is preferable under conditions of facilities with short time of operating.

Experimental investigations have been carried out in hot shot wind tunnel IT-302M of ITAM SB RAS on model of the combustion chamber in the mode of the attached pipe with following parameters at the channel entrance: M = 3, P_0 = 30-50 bar, T_0 = 2000-2300 K. System of sampling consists of the total pressure rake, which was installed in the channel, the cylinder for preservation of sample, the fast-acting valve, sealing system, and pressure gauges. The principle of definition of quantity of kerosene in the sample has been based upon the assumption that, behind normal shock wave, kerosene burns down with combustion efficiency close to 1. Accordingly, full fuel oxidation should occur in gas sample and concentration of kerosene can be calculated in the section of the channel, if residual oxygen in sample has been determined.

As a result of the fulfilled tests it has been revealed that at the initial part there is an essential non-uniformity of distribution of fuel concentration across height of the channel. In the bottom part of the channel (opposite to injection zone) the kerosene concentration is no more than 18% of stoichiometric ratio. High concentration of kerosene is reached in the middle part of the channel and, especially, in the region of a cavity. So, the kerosene concentration nearby a cavity exceeds concentration at an opposite wall in five times. At a distance of approximately 4.5 entrance channel heights downstream the kerosene concentration was leveled across channel and had a little maximum in the middle part of channel.