The dynamics of switching to the mode of high-enthalpy flow generators

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The development of high-speed aircraft and power plants requires extensive testing on ground-based high-enthalpy stands, using generators of high-enthalpy quasi-air flows (GWPs) to simulate flight conditions. All the most powerful wind farms in the countries that occupy leading positions in the field of high-speed aircraft and power plants (SU) development use fire-type GWPs. They create a high-temperature quasi-air flow by burning some kind of fuel in the combustion chamber with compensation of burnt oxygen to reproduce its mass or volume content corresponding to atmospheric air. During the start-up of a fire-type GWP, a delay occurs before its parameters (pressure, temperature, flow rate) reach the preset mode, which is undesirable as it consumes resources and affects the facility, making it crucial to minimize this transition time. To do this, it is necessary to determine the factors influencing the dynamics of the launch and the exit time. In this paper, experimental data on the launches of various GWP wind farms are considered and the factors influencing the dynamics and time of the entry of GWP into operation are analyzed. A mathematical model (MM) for describing the dynamics of the GWP behavior during startup is proposed. Based on MM, it is shown that the main factors determining the dynamics of the GWP output to the mode are the volumes of pipelines through which the components are supplied, the combustion chambers of the GWP, the ignition time of the combustion chamber of the GWP and the diameter of the critical section of the aerodynamic nozzle of the stand. The calculated data obtained on the basis of the developed MM are compared with the results of experimental studies.