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# LIQUID DROPLET COMBUSTION IN WEIGHTLESSNESS: DOUBLE FLAME MATHEMATICAL MODEL AND EXPERIMENTAL RESULTS

**Abstract**

The development of many processes in weightlessness differs significantly from their course on Earth in the presence of gravity. In conditions of "weightlessness" when spacecraft move in near-earth orbits, these spacecraft carry multidirectional microaccelerations, which form a special environment called "microgravity". The mechanisms of development of many hydrogasdynamic and physicochemical processes under microgravity conditions require a separate special study. This paper is devoted to the burning of an isolated n-heptane droplet in microgravity and analysis of the experimental data presented by FLEX experiment. Developing the classical analytical research methodology, proposed by Forman A. Williams, and using our obtained analytical solutions for the problem of droplet equilibrium evaporation and combustion, the analytical solutions to solve the problem of two regimes of droplet burning were found. To explain the presence of the radiative flame extinction and further droplet burning in cool flame regime, we assumed that two flame surfaces exist, but the first flame surface can be fixed with observation devices, and the second flame surface is an invisible one. According to this hypothesis, we suggested the analytical formulas for droplet and flame histories. The analytical solutions demonstrate a good coincidence with the experimental and numerical results. The numerical and theoretical study of the experimental results presents the existence of two main regimes of n-heptane droplet burning: high- and low-temperature phase. After radiative extinction of high-temperature droplet burning the transition to low temperature stage with constant burning rate takes place. In this second stage, the droplet continues to burn and evaporate without the presence of a visible flame, which ultimately led to a diffusive extinction at a finite droplet size. The low-temperature diffusion combustion for an isolated droplet has never been proposed or suggested before the FLEX experiments.