

# Micro-explosive dispersion of gel fuel composition ignited in a high-temperature air medium

K.K. Paushkina, D.O. Glushkov, A.G. Nigay, A.O. Pleshko

National Research Tomsk Polytechnic University, 30 Lenin Avenue, Tomsk, Russia, 634050

[kkp1@tpu.ru](mailto:kkp1@tpu.ru)

At present, investigations into the ignition and combustion of gel fuels are relevant for the development of the combustion theory of condensed substances [1]. By their state of matter, gel fuels take an intermediate position between the common liquid and solid fuels, combining their advantages in terms of relatively high energy and environmental characteristics, as well as safety indicators for storage and practical application [2]. Due to the multi-component structure of gel fuels, their combustion mechanism differs greatly from that of widespread liquid fuels [3]. When oil-filled cryogels are melted, the liquid components of the fuel separate. A film of molten gellant is formed on the droplet surface with a combustible liquid beneath it. Due to such structure of the gel fuel melt droplet, its heating is accompanied by the processes not typical of the ignition of a single-component combustible liquid droplet: a great number of bubbles emerge in the near-surface layer of the droplet; bubbles increase in number and size, significantly changing the droplet shape; bubbles collapse, and the initial droplet is dispersed to produce a group of much smaller droplets (with a size 1–2 orders of magnitude smaller than the initial fuel particle size); the previous process occurs with a release of combustible liquid vapors into the oxidizer medium through the thickener layer (external envelope) when the droplet breaks up; under threshold conditions, the gas-phase ignition takes place in the vicinity of the droplet.

Unlike it is with liquid single-component fuels, combustion is initiated not in the immediate vicinity of the droplet but in a rather large area. At the moment of the gel fuel ignition, the flaming starts around one or several small fragments which separated and moved away from the droplet surface as a result of a micro-explosion. The temperature of these fine droplets is quite low. When they move around the initial droplet, evaporation proceeds at a relatively low rate. In this area, the temperature of the emerging gas-vapor mixture is lower than that of the ambient hot air. As the fine droplets are moving away from the initial droplet surface, the ambient temperature increases to the initial temperature of heated air, enhancing evaporation. Under critical conditions, the fuel vapors are ignited around the moving fine droplet or a group of droplets. Then, the exothermic reaction is spread from this area all over the volume of the combustible gas-vapor mixture that was formed during the induction period around the gel fuel melt droplet from the outer boundary into the deep layers. Micro-explosions, accompanied by the droplet dispersion, intensify both the ignition and burnout of the fuel due to considerable growth of the surface area of liquid component evaporation [4, 5].

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## References

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