

A study of the delayed regimes of droplet ignition phenomena is presented. Spray ignition is considered as an explosion problem. Physical processes incorporated in the model are evaporation, heat transfer and highly exothermic oxidation reaction. The analysis is spatially homogeneous and adiabatic. Changes of the pressure and gas mixture density are not accounted for. Combustible gas component is deficient. Thermal conductivity of the liquid is much higher than that of the gas. Heat transfer coefficient depends only on the gas thermal properties. Spray is monodisperse. A first-order highly exothermic reaction represents appropriate chemical reaction. Additional connection comes from the Clausius-Clapeyron law. Droplets are regarded as a source of the endothermicity.

The set of governing equations represents a multi-scale, conventional, singularly perturbed system of ODEs. Geometric version of the method of integral manifolds allowing decomposition of the phase space analysis into separate studies of its fast and slow subsystems is used [1].

For the fast gas temperature the delay time increases with increasing droplets number and the ratio between the intensities of the combustion and evaporation processes. It decreases with the increasing dimensionless droplet radius and the ratio of radiative and convective heat transfer coefficients. Radiative heat flow increases the delay time. For the fast droplet radius the delay time decreases with the increasing droplets number and the ratio between the intensities of the combustion and evaporation processes. It increases with the increasing droplet radius and the ratio of radiative and convective heat transfer coefficients. Radiative heat flow decreases the delay time.

REFERENCES

- [1] Gol'dshtein V M and Sobolev V A 1992 Singularity Theory and Some Problems of Functional Analysis (AMS Translations, series 2, vol. 153)(Providence, RI:American Mathematical Society) pp 73-92.