THE SIMULATION OF LIQUID-DROP AEROSOLS SYSTEMS GRAVITATIONAL SEDIMENTATION

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The process of gravitational sedimentation of liquid-drop aerosols cloud plays an important role in meteorology (formation of particles sizes spectrum of atmospheric sediments) and also in a number practical and ecological problems (aviation methods for fire quench by liquid drain, aviation fuel drain before emergency landing of plane, propagation of liquid-droplet components of the rocket propellant in areas of falling the launcher separated units).

In the present report the results of complex experimental and theoretical study of the liquid-drop aerosols systems propagation in the atmosphere taking into account the gravitational sedimentation, turbulent diffusion, wind force, drops coagulation, breaking up and evaporation are presented.

The series of experimental studies were carried out for determine the characteristics of drops dynamic interaction with a gas flow and at mutual drops collisions. These results allow obtain the necessary criterion dependences taking into account the next processes.

- Rayleigh-Taylor (Bond criterion) and Kelvin-Helmholtz (Weber criterion) instability of drops in a flow.
- Coagulation and breaking up of drops at mutual collisions.
- Decrease of the drag coefficient at the sedimentation of high-concentrated drops systems.

The results of experimental studies were used for development of physical-mathematical model for propagation of liquid-droplet aerosols cloud in an atmosphere. To solving concrete problems the full database must include the thermal dependences for drops thermo physical characteristics, parameters of atmosphere and dominant wind velocity vector in the whole of height range, and also the initial conditions for drops cloud – particles sizes distribution function, concentration and temperature of drops.

The developed physical-mathematical model, algorithm and software product were approved in a number of practical problems.

- Propagation of liquid-droplet toxic component (heptil) of the rocket propellant formed at the second stage of “Proton-K” launcher separation above the Tomsk Region and Republic of Mountain Altai.

- The emergency kerosene drain by USA fuel-filler plane above the Kyrgyz Republic.

Keywords: Aerosol cloud, drop, gravitational sedimentation, mathematical simulation, experimental study.