VELOCITY OF DROPLETS IN THE JET FROM A VORTEX-TYPE SPRAYER

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Results are shown of velocity measurements in a jet from a vertically oriented sprayer during atomization of water into still air.

A vortex-type sprayer (Fig. 1) represents a simplified version of a centrifugal sprayer and produces fine droplets under small pressure heads.

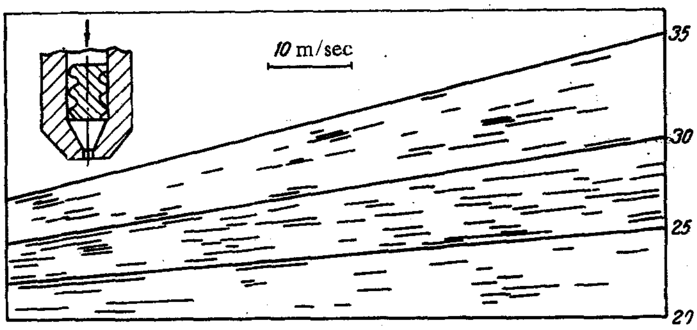

Fig. 1. Trajectories of droplets in one region of the jet from a sprayer (pressure drop 0.9 bar, orifice diameter 1.5 mm).

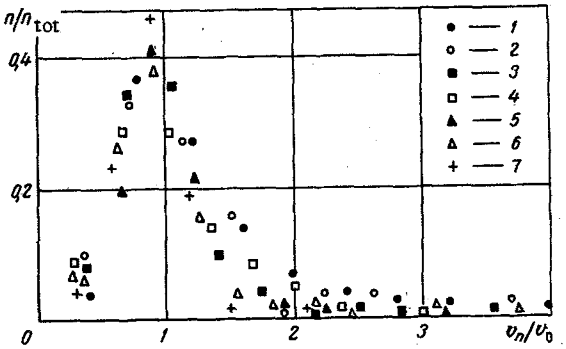

Fig. 2

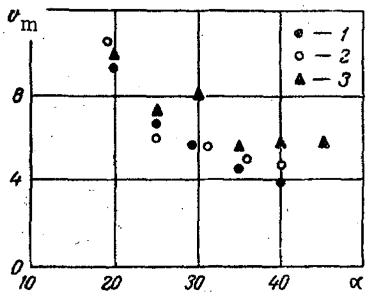

Fig. 3

Fig. 2. Droplet distribution with respect to the relative velocities (number of droplets moving at velocity v_n is n, total number of droplets in the given portion of the jet is n_{tot}, drop velocity is v_n, mean velocity of droplets at the outlet orifice of the sprayer is v_0): pressure drop for atomization $\Delta p = 0.7$ bar (1), 0.8 bar (2), 0.9 bar (3), 1.0 bar (4), 1.1 bar (5), 1.2 (6), 1.3 bar (7).

Fig. 3. Angular distribution of relative mean velocities of droplets in a jet (sprayer orifice diameter 1.5 mm): pressure drop $\Delta p = 0.7$ bar (1), 1.0 bar (2), 1.2 bar (3). Angle α in degrees.

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In order to measure the droplet velocity, one of the important sprayer performance parameters, a narrow flat portion of liquid mist (in the plane of the sprayer axis) was isolated within the conical jet by means of a special device and the droplets here were photographed in parallel light beams from a condenser lens. The traces of droplets were thus recorded on photographic film and from their dimensions, with a given scale factor and a known exposure time, one could calculate the velocities of these droplets. Part of the jet with droplet traces is shown in Fig. 1 for one of the flow modes. The numbers next to the respective lines indicate the angles of the latter with the sprayer axis in degrees. The photographs taken under all test conditions (diameter of outlet orifice 1.5 or 1.0 mm, pressure drop varying from 0.7 to 1.3 bar) indicate that the minimum and the maximum droplet velocity in one jet may differ by one order of magnitude or more.

The calculated relative velocity distribution of droplets is shown in Fig. 2 for the sprayer with the 1.5 mm outlet orifice (the peak of the distribution curve for the other sprayer with the 1.0 mm orifice is shifted slightly toward lower velocities).

Calculated were also the mean velocities of droplets at the transverse sections along a jet at various distances from the sprayer (up to 160 mm). These data have shown that along the given flow path the droplets move at a 30-50% lower velocity and then continue much faster than in the soaring mode.

The mean velocity of droplets within the angular sectors (at various angular distances from the sprayer axis) varies, which agrees with prevailing concepts about the jet from centrifugal sprayers. In Fig. 3 are shown some results but, on the whole, the angular distribution of droplet velocities cannot be generalized.