

THE MEASUREMENT OF DROPLET SIZE AND VELOCITY IN AN ATOMISED FILM-COATING SPRAY

G.C. Cole, P.J. Neale, J.S. Wilde, Merck Sharp and Dohme Research Laboratories, Hertford Road, Hoddesdon, Herts., and K. Ridgway, The School of Pharmacy, University of London, Brunswick Square, WC1N 1AX.

The photographic assessment of the droplet size and velocity distribution in an atomized spray presents no great problems when the droplet size is 50 μm or larger. Below this, however, in-flight photography becomes more difficult, and most previous workers (Roth & Porterfield 1965; Groeneweg et al 1967; See & Johnston 1978) have found that 10-20 μm represented the lower limit of size that could be photographed. We have used a 300ns Argon Jet double flash unit (Pulse Ltd., Fareham) to obtain pictures of the droplets produced by a Pilot WA/XV atomizing nozzle (R.C. Walther, Wuppertal, W. Germany) of the type currently used to spray ALDOMET and DOLOBID aqueous film-coating suspensions. The flash unit contains two pairs of electrodes. Gaseous argon is continuously fed through one electrode of each pair to stabilize conditions so that a uniform spark discharge occurs. In addition to giving photographs of the droplets in flight, the flash unit can be fired twice, with an adjustable delay between the flashes, to give double-image photographs from which droplet velocities can be deduced. Photography was by back illumination of the spray through a condensing lens and diffusing screen, the camera having a 90 mm Super Angulon lens, arranged to produce an aerial image which was magnified by a 20 mm Olympus Macro lens and focussed onto the film. This gave a magnification of x20 whilst keeping the focussing plane at some 5-7 cm in front of the object lens; such a large distance must be maintained in order to ensure that the spray plume is not disturbed by the camera.

This method, supplemented by the collection of droplets by impingement on to microscope slides, was used to give size and velocity distributions for sprays produced at different atomizing pressures and coating suspension flowrates. Droplets smaller than 5 μm could readily be observed.

At flowrates in the range 10-50 g/min, the median size of the droplets is reduced on increasing the air pressure, from about 30 μm at 275 kN/m^2 (40 psi) to 18 μm at 550 kN/m^2 (80 psi). For the coating suspensions used, which contain 10 per cent solids, mainly lake pigments and opacifiers, in aqueous vehicles having about 6.7 per cent dissolved hydroxypropylmethylcellulose with 0.1 per cent propylene glycol (ALDOMET) or 3 per cent HPMC and 3 per cent hydroxypropylcellulose (DOLOBID) there is a fairly well-defined region at about 30 cm from the nozzle, in which the droplets change from liquid to at least semi-solid. Beyond this zone particles can be collected on slides held in the spray plume: before it, droplets are impacted on the slide so that size distribution measurement is an uncertain procedure. The transition distance is dependent upon the ambient temperature; at 40 C it appears to be at the empirically-determined best operating distance for good coating performance in a 48-inch Accela-Cota, and so is correspondingly too close for optimality in the 24-inch model.

Roth, L.O., Porterfield, J.G. *Trans. Am. Soc. Agric. Engrs* (1965) 8: 493-6
Groeneweg, J. et al *Brit. J. Appl. Phys.* (1967) 18: 1317-20
See, J.B., Johnston, G.H. *Powder Tech.* (1978) 21: 119-133

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