THE MEASUREMENT OF SPRAY DROPLET SIZE DISTRIBUTIONS

M.E.Aulton and M.Banks*, School of Pharmacy, Leicester Polytechnic, Leicester, UK. *Present address: IDDC, Abbott Laboratories, Queenborough, Kent, UK.

A study of fluidised-bed granulation led to a desire to quantify, as accurately as possible, spray droplet size characteristics in order to relate them to the granulation process. One of the major problems with this type of work has been the difficulty in obtaining an accurate, easy and quick size and number distribution. In this present study the Malvern Instruments ST.1800 Particle and Droplet Size Distribution Analyser has been used. With this apparatus, the spray is fired through a parallel laser beam of monochromatic (red) light. The light, on hitting a droplet, is deflected by an angle which is a function of the size of the droplet. After passing through a lens the light hits a multi-element detector, the output from which passes through a small computer which produces a hardcopy print-out of a 15-part size distribution covering a 100-fold size range. The data is fitted to a Rosin-Rammler distribution; this is defined such that the weight or volume fraction of particles or droplets larger than size x is given by R, where

$$R = e^{-(x/\bar{x})^w}$$

w is a measure of the spread of the distribution and $\bar{x}$ is the Rosin-Rammler mean. These two coefficients are also outputted.

The effect of atomising air pressure on the spray characteristics of a granulating solution was examined by spraying a 5 / aqueous PVP solution from a binary nozzle through the beam. After allowing a few seconds for the spray to stabilise, a particle size analysis was made. Changing atomisating air pressure had the following effect on $\bar{x}$: 95μm at 2.5 psig , 59μm at 5 psig , 30μm at 10 psig and 15μm at 15 psig. There was little change in the width of the distribution.

The influence of seven process variables on the properties of granules produced in a fluidised-bed has been examined previously; four of these factors related to the spray (Aulton and Banks 1978). Changes in droplet size distribution and spray rate, which resulted from changes in these four process variables, were examined using the size analyser. An experiment of 2^4 factorial design was performed and the degree of significance that any one factor had in altering the character of the spray was assessed by the statistical method of Yates. The process variable having the most significant effect on droplet size was i) atomising air pressure, followed by ii) the spray nozzle used and iii) the temperature of the granulating solution. The factors having an effect on spray rate decreased in significance in the following order i) the spray nozzle ii) atomising air pressure iii) concentration of granulating solution and iv) temperature of granulating solution.

The addition of sodium lauryl sulphate (SLS) to the granulating solution has been shown to have an influence on fluidised-bed granulation (Aulton et al 1977). The size analyser has also been used to examine the effects of its addition on the characteristics of the spray. A decrease in $\bar{x}$ from 43μm to 31μm was observed as the SLS concentration was increased from 0 to 2.5 / w/v under otherwise identical conditions. Between 2.5 / and 6.25 / $\bar{x}$ remained approximately constant, but increased slightly to 34μm at 7.5 / .

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