

METHOD OF PRODUCING SPRAY PARTICLES

This invention relates to a method of producing spray particles and is concerned with a method of producing a powder or particles by spray drying or spray cooling.

5 Many powder products are produced by a spray drying process, such as domestic detergent powder and powder foods, e.g. milk and coffee. In this process a slurry of the material is sprayed through one or more
10 nozzles into a heated air flow, either in a counter-current spray dryer or a co-current spray dryer, depending on the desired quantity of production and the thermal stability of the material. When spray cooling, higher alcohols, waxes or the like, which may be used as industrial materials are powdered by
15 spraying molten material and causing the spray to solidify.

When producing powder by spray drying or spray cooling, it is regarded by the industry as of crucial importance to increase the production per unit time
20 without increasing the production of coarse particles and fine powders, that is to say particles which are too large or too small.

In order to increase production per unit time when spray drying, it has been the general practice to
25 increase the rate at which the slurry is sprayed, generally in a tower, and, at the same time, to increase the supply or temperature of the hot air. In a specific process using a nozzle, the diameter of the nozzle and the spraying pressure were increased to
30 increase the rate of spraying of the slurry. In

another known process a plurality of nozzles are used through which slurry is sprayed simultaneously. When a plurality of nozzles is used in the known process they are spaced apart sufficiently so that undried particles will not contact one another and agglomerate. In spray cooling as in spray drying, it is general practice to increase the quantity of spraying slurry to increase the production per unit time.

However, when the diameter of the nozzle(s) and the spraying pressure are increased, the problem arises that the particle size distribution becomes large and the powder obtained has a poor external appearance. Moreover, since the initial rate of spraying is relatively large, unless the tower in which the spraying takes place has a sufficiently large diameter, undried droplets contact the tower wall and become deposited thereon. When a plurality of nozzles are arranged within the tower, it is necessary that they be spaced from the centre of the tower and thus the distance between them and the wall of the tower becomes relatively small. As a result, in a comparatively small tower, undried droplets tend to deposit on the tower wall. This deposit subsequently drops as coarse particles or a mass and is mixed into the product. Such coarse particles or mass not only spoil the outer appearance of the product but also diminish the quality of the product.

Thus in the known processes, production was limited due to the size of the apparatus (tower), the effect of which increases as the size of the apparatus decreases.

It is therefore an object of the present invention to provide a process for producing spray particles in

which the rate of production of coarse particles is reduced and the yield is increased.

After lengthy experimentation it has been found that when the nozzles are arranged at a small spacing
5 instead of a large spacing, as in the conventional process, the production of coarse particles is reduced, contrary to expectations.

According to the present invention there is provided a method of producing a spray powder in which
10 a starting slurry or liquid is sprayed simultaneously through a plurality of nozzles and subsequently dried or cooled to form a powder, the nozzles each producing a substantially conical spray pattern of droplets and being arranged so that the spray patterns overlap and
15 so that no nozzle is within the spray patterns of any other nozzle.

When producing spray particles each spray droplet initially moves substantially linearly under the action of its own momentum but its speed then soon decreases
20 due to the frictional effect of the air and it then progressively drops naturally under the influence of gravity. The distance moved by the droplet under the action of its own momentum depends on the size, weight and initial speed of the particles. When the droplets
25 sprayed from the nozzles are observed conical areas or spray patterns are formed with the orifices of the nozzles at the apexes and ahead or downstream of the conical areas there are areas where the particles are moved by the flow of drying or cooling air and thus
30 appear to move randomly. The process of the present invention is carried out with the nozzles being arranged so that the conical areas overlap and further so that none of the nozzles is situated within the conical area of any other nozzle.

The method according to the invention is found to result in a substantially reduced rate of production of coarse particles, even when the apparatus or tower is relatively small. Even when the process of the present invention is applied to an otherwise conventional apparatus having two or more nozzles the productivity is improved without generating substantial quantities of coarse particles or spoiling the external appearance of the product. Thus in the apparatus with which the method of the present invention is performed the nozzles are closer to one another and thus to the central axis of the tower than in the known apparatus and thus the generation of coarse particles caused by coalescing of the droplets on the tower wall is minimized. The method of the present invention also permits the number of nozzles in any particular apparatus to be increased and thus the rate of production to be increased also. The particles and the heating or cooling air come into intimate contact and thus the thermal efficiency is improved also.

Further features and details of the invention will be apparent from the following description of two embodiments of the invention and one known embodiment which is given with reference to the accompanying diagrammatic drawings, in which:-

Figure 1 is a side view of two spraying nozzles of the first embodiment of the present invention;

Figure 2 is a similar view of the second embodiment; and

Figure 3 is a similar view of a known apparatus.

With reference firstly to Figures 1 and 2 two or more nozzles 1,1' are arranged with their spraying directions parallel, as shown in Figure 1, or inclined

towards one another, as shown in Figure 2. The nozzles are provided with respective slurry feed pipes 2,2'. The distance ℓ between the nozzles 1,1' is preferably 50cm, and more preferably 30cm or less. The lower limit of the distance ℓ is determined by their ^{of the nozzles} size and is achieved when they contact one another. A metallic connector (not shown) may be used to fix the relative positions of such nozzles. Alternatively, the nozzles may be carried at the ends of a single bifurcated slurry feed pipe.

In use, the droplets sprayed from the respective nozzles 1,1' occupy conical areas 3,3'. The nozzles are constructed and positioned such that the areas 3,3' overlap at an area 4. Once the initial speed of the droplets has decayed they drop naturally under the influence of gravity, as indicated by the exemplary lines 5,5'.

In use, slurry is simultaneously sprayed from the plurality of nozzles described above and the resulting droplets are dried or cooled to produce a powder. The drying or cooling of the droplets of the slurry is performed by passing hot or cool air into a drying or cooling tower, in which each nozzle is arranged as in the known method. The rate of production of coarse particles is extremely low in the method according to the present invention. In the known process, in which a plurality of nozzles is used in order to improve the productivity, the distance ℓ between the nozzles 1,1' as shown in Figure 3, is made significantly greater than 50cm so that the conical areas 3,3' do not overlap (the reason for which is probably to prevent the droplets from agglomerating). Contrary to expectations, however, the powders produced according

to the method of the present invention is of higher quality. Although the reason for this is not clear, it is presumed that the amount of movement of the droplets is large in the conical areas formed ahead of the nozzles and, in addition, the droplets are not yet hardened by drying or cooling and, therefore, although droplets sprayed from the nozzles collide in the overlapping portion of the conical areas, they do not combine to form large droplets but scatter and, as a result, the droplets are uniformly distributed in space thereby achieving an effective contact between the droplets and air.

It is preferable to set the parameters of the nozzles, the spacing between the nozzles and the parameters of the spraying in dependence on the type, viscosity, etc. of the slurry so that the conical areas have an apex angle of about 40 to 90 degrees and a generating line of about 50 to 300 cm long, the generating line being the hypotenuse of the right angled triangle which is rotated to generate the cone. The conditions of spraying are preferably such that the conical areas overlap at points which are within 60%, preferably within 40%, of the length of the generating line from the apexes of the conical areas along the generating line.

The parameters of the drying or cooling air may be established in the conventional manner.

The arrangement of the nozzles according to the present invention is also effective in the case where it is applied to only some of the nozzles of an apparatus for producing spray particles.

Certain specific processes will now be described with reference to the following examples of which Examples 1 and 2 are in accordance with the invention and the comparative Examples are not.

Example 1

The apparatus and slurry (spray liquid) described below were used to produce a powder under the drying conditions described in Table 1. The results are shown in Table 1.

As may be seen from Table 1 and by comparison with the comparative examples which will be described below, the generation of coarse particles is very limited and the production yield using the process of the present invention is improved.

The apparatus comprised a counter-current spray dryer of 3m diameter and 12m height from the hot air inlet to the spray nozzles which comprised two pressure nozzles of type SDX1/4 manufactured by U.S. Delavan Inc. each of which is provided with an orifice having an opening of 1.6mm diameter and a swirl chamber of 5mm diameter. The nozzles were located 10cm apart with their axes parallel.

The slurry had a 40% water content and contained solid matter comprising 20 wt.% of a sodium linear alkylbenzene sulphonate, 15 wt.% of 4A type zeolite, 10 wt.% of sodium silicate, 10 wt.% of sodium carbonate and 40 wt.% sodium sulphate. The slurry was sprayed at a temperature of 60°C.

Example 2

The method of Example 1 was repeated with the difference that the space between the nozzles was 30cm. The results are shown in Table 1 from which it may be seen that the rate of production of the powder was again high and that the rate of production of coarse particles was again very low.

Comparative Example 1

5 The method of Example 1 was repeated with the difference that only one nozzle was used. The results are shown in Table 1 from which it can be seen that the production of coarse particles was even lower but that the production of the powder, which had an excellent external appearance was halved. The productivity of this method was thus very poor.

Comparative Example 2

10 The method of Example 1 was again repeated with the difference that the spacing between the nozzles was 100cm.

15 As may be seen from Table 1, the generation of coarse particles was very high and the particles obtained were of extremely poor outer appearance. Furthermore, the resulting particle mixture required sieving which represents an additional method step which increases the cost of the method.

TABLE 1

	Example 1	Example 2	Comparative Example 1	Comparative Example 2
No. of nozzles	2	2	1	2
Nozzle spacing (cm)	10	30	-	100
Spraying pressure (Kg/cm ²)	20	20	20	20
Inlet temperature of hot air (°C)	280	280	280	280
Exhaust air temperature (°C)	97	95	96	94
Production (t/Hr)	0.4	0.4	0.2	0.4
Coarse particles (%) (2mm and more in diameter)	1.1	1.3	0.3	18
Average particle diameter (mm) (excluding coarse particles)	0.3	0.3	0.3	0.4

CLAIMS

1. A method of producing a spray powder in which a starting slurry or liquid is sprayed simultaneously through a plurality of nozzles and subsequently dried or cooled to form the powder, the nozzles each producing a substantially conical spray pattern of droplets and being arranged so that the spray patterns overlap and so that no nozzle is within the spray pattern of any other nozzle.
 2. A method as claimed in Claim 1, in which the spacing between adjacent nozzles is 50cm or less.
 3. A method as claimed in Claim 1 or Claim 2 in which the nozzles are of pressure type.
 4. A method of producing a spray particle substantially as specifically herein described with reference to Figures 1 or 2 of the accompanying drawings and Example 1 or Example 2.
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