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[54] **PROCESS FOR COATING PHARMACEUTICAL
 SOLID FORMS**
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ABSTRACT: The invention concerns a coating process for coating a pharmaceutical solid form, which comprises applying a foamed coating medium to the solid form surface, and then urging the coating medium against the solid form surface to break down the foam and produce an even coat of the coating medium on the solid form surface.

PROCESS FOR COATING PHARMACEUTICAL SOLID FORMS

IMPROVED PROCESS FOR COATING OF PHARMACEUTICAL SOLID FORMS

This invention relates to an improved process for coating of pharmaceutical solid forms, such as pharmaceutical tablets, granules, and pellets. The process of the invention may be generally applied and is suitable for most types of coating medium.

Known methods of coating pharmaceutical solid forms include spraying, pouring and dipping. A factor which normally needs to be considered in coating pharmaceutical solid forms is that the coating should be of an even thickness over the entire surface of a solid form. In coating a pharmaceutical tablet by conventional means, coating medium often tends to collect at the corners defined between the cylindrical surface and opposing faces of the tablet, forming so-called "railroad edges." This phenomenon is likely to occur in any coating process in which liquid coating medium is applied to the tablet.

Spray coating of pharmaceutical solid forms is widely employed in the pharmaceutical industry, and automatic spray coating systems suitable for coating tablets, granules and pellets have been developed over the years. Factors which play an important role in spray coating methods, include fineness of spray, solid content of coating medium and volatility of coating medium solvent or dispersant. Thus, for example, the spray must be sufficiently fine in order to obtain a thin and even coat. On the other hand, high pressures are required in order to sufficiently atomize a coating medium. In a pneumatically produced spray, that is one in which atomization of the coating medium may be effected by directing a gaseous stream across a stream of coating medium, the gaseous stream must move at high speed across the stream of coating medium which is in turn moving at a relatively low speed. Similarly, in a hydraulically produced spray, that is one in which atomization of the coating medium may be effected by directing a stream of coating medium against a spreader plate, the stream of coating medium must move at high speed into contact with the spreader plate. Therefore, a high gas pressure is required in the case of a pneumatically produced spray, and a high coating medium pressure is required in the case of a hydraulically produced spray.

Inherent features in employing a pneumatically produced spray in coating pharmaceutical solid forms, may include such disadvantages as:

- a. a large amount of air moving at high speed is required to sufficiently atomize the coating medium, resulting in a low ratio of coating medium volume to air volume;
- b. air drafts about the desired area of application, tending to transport away amounts of the spray, may result in a substantial loss of coating medium; and
- c. air required to atomize and transport the coating medium may have a cooling effect on the coating medium, resulting in uneven distribution of the coating medium and an adverse effect on the crystallization process of sugar contained in the coating medium.

The main disadvantage in employing a hydraulically produced spray is that high cost pumps are required in order to achieve the necessary high coating medium pressure. However, there are a number of features of pumps and hydraulic spray nozzles which may cause difficulties in employing a hydraulically produced spray in coating pharmaceutical solid forms. These difficulties include:

1. The reciprocating action of a reciprocating pump may cause uneven flow resulting in unevenly distributed spray and different droplet sizes;
2. Insolubles which may be contained in the coating medium may cause blockage and wear in a hydraulic spray nozzle, and the functioning of check valves may be impaired.

It is an object of the invention to reduce or eliminate the difficulties encountered in evenly coating pharmaceutical solid

forms. It is a further object of the invention to overcome the disadvantages of features inherent in conventional spray devices.

Now, in accordance with the invention, there is provided a coating process for coating a pharmaceutical solid form, which comprises applying a foamed coating medium to the solid form surface, and then destroying the foam to produce an even coat of the coating medium on the solid form surface. The foamed coating medium may conveniently be applied to the solid form surface, by atomizing the foamed coating medium and spraying onto the solid form surface.

Foaming of coating medium may be carried out by any convenient means. For example, a gaseous medium, such as air, may be mechanically dispersed in the coating medium. Alternatively, a gaseous medium may be introduced under pressure into the coating medium, and the pressure then reduced to allow the gaseous medium to expand in discrete volumes within the coating medium. Further, a gaseous medium may be injected into the coating medium, which gaseous medium may be injected at high speed to cause a state of turbulence in the coating medium.

In that the coating medium may be of such a form that the foamed coating medium is not stable for any appreciable length of time, foaming of the coating medium may conveniently be carried out immediately prior to application of the foamed coating medium to the solid form surface. Thus, for example, when the foamed coating medium is to be sprayed onto a pharmaceutical solid form, foaming of the coating medium may be carried out immediately prior to atomization thereof.

Urging of the coating medium against the solid form surface may be effected by tumbling the solid form on a tumbler surface, such as provided by a conventional coating pan. The high standard of coating achieved in this conventional apparatus is attributed to a simultaneous spreading and breaking down of the foamed coating medium as the solid form tumbles on the tumbler surface.

By foaming the coating medium prior to atomization and spraying, many of the disadvantages and difficulties in employing pneumatically and hydraulically produced sprays are reduced or eliminated. The above-mentioned disadvantages mentioned in connection with employment of a pneumatically produced spray are substantially reduced. As the foamed coating medium is much more readily atomized a lower airspeed is required, so that the ratio of coating medium volume to air volume is increased. Further, by virtue of the lower airspeed, the intensity of air drafts about the desired area of application are reduced so that loss of coating medium is also reduced. Still further, the cooling effect which the air may have on the coating medium will clearly be reduced by virtue of the lower airspeed. In the same way, the main disadvantage in employing a hydraulically produced spray is reduced in that the foamed coating medium is more readily atomized and the previous high coating medium pressure required is reduced. Also, it has been found that the previous difficulties encountered with pumps and hydraulic spray nozzles are considerably reduced.

As follows from above, the coating process of the invention lends itself particularly well to spray coating methods. In this connection, it has been found that the coating process of the invention is also suitable in the automatic spray coating systems which have been developed.

The coating medium employed in the process may be of almost any type. For example, coating solutions such as those described by T. H. Rowell [Rowell, T. M., "The Art of Coating Tablets," Baudette, Minn., (1949)] and R. Clarkson [Clarkson, R., "Tablet Coating," Drug and Cosmetic Industry, N.Y., N.Y. (1954)].

It will be appreciated that the process of the invention has a great number of practical advantages apart from those already discussed. Particularly noteworthy is the shortening of dwelling and drying times required in conventional coating processes.

Without limiting the invention in any way, the process of the invention is illustrated in the following Examples.

Example 1

Components of the coating medium were as follows, and in the percentages by weight indicated;

Components:	% w/w
F.D. & C. Dye	q.s.
Sugar	35.0
Gelatin	0.3
Acacia gum	0.9
Talc	15.0
Terra Alba	25.0
S.D.A. 30 Alcohol	1.0
Distilled Water	21.3
Pluronic F-68 (nonionic surfactant manufactured by Wyandotte Chemical Corp.)	1.5

The Pluronic F-68, Gelatin, Acacia gum, sugar F. D. & C. Dye and Alcohol were dissolved in the water. The Terra Alba and Talc were suspended in the so-formed syrup and the resulting slurry was homogenized by means of a suitable colloid mill.

The homogenized slurry was poured into a modified DeVilbiss QMR-530 pressurized tank. A known amount of carbon dioxide gas was then sparged through the slurry until a 80-90 p.s.i. pressure was reached inside the tank. During saturation of the slurry, the baffled mixer of the pressurized vessel was employed constantly. The temperature of the slurry was maintained at about 50-55°C.

100,000 Placebo tablet cores, 7 mm. in diameter and having an average weight of 180 mg., were placed in a CP-2 Manesty coating bench, provided with an automatic system as described by D. S. Mody [Mody, D. S., Scott, M. W. & Lieberman, H. A., J. Pharm. Sci. 53, 949 (1964)], which regulates the spraying, dwelling and drying cycles of the coating process.

The foamed slurry was sprayed using automatic DeVilbiss AGB-504 spray guns equipped with an internal mixing nozzle 0491. Information concerning the coating operation is set out below:

Spraying Time	45 seconds
Dwelling Time	4 minutes
Drying Time	5 minutes
Liquid Pressure	80-90 p.s.i.
Air Pressure	10 p.s.i.

15 coats were applied to the tablets which was sufficient to produce elegant coated tablets which were then finished and polished.

Only 90 minutes were necessary to produce the elegant coat.

Example 2

Components of the coating medium were as follows, and in the percentages by weight indicated:

Components:	% w/w
F. D. & C. Dye	q.s.
Sugar	55.0
Talc	5.0
Calcium Carbonate	10.0
Gelatin	0.3
Acacia gum	0.9
Pluronic F-68	1.5
Distilled Water	27.3

The F. D. & C. dye, Pluronic F-68, gelatin, acacia gum and sugar were dissolved in the water. The calcium carbonate and

talc were suspended in the so-formed syrup, and the resulting slurry was homogenized by means of a colloid mill.

Foaming of the homogenized slurry was carried out by passing it through a Graco Hydra-Clean foamer. Basically, this apparatus consists of a mixing nozzle which employs air injected into a solution and then through a 60 mesh screen to produce a foam consisting of tiny, long lasting bubbles.

The foam obtained was applied to tablets as described in Example No. 1.

10 In this case, less than 20 applications were required to obtain elegant coated tablets.

Example 3

15 Components of the coating medium were as follows, and in the percentages by weight indicated:

Components	% w/w
F. D. & C. Dye	q.s.
65 % Sugar Syrup	81.5
C.M.C. Low Viscosity	2.0
Wheat Flour	15
Pluronic F-68	1.5

The procedure employed was precisely as described under Example 1, excepting that air was introduced into the modified DeVilbiss QMR-530 pressurized tank instead of carbon dioxide.

20 Less than 20 coats were required in order to obtain elegant coated tablets.

What we claim is:

1. A coating process for coating a pharmaceutical solid form, which comprises applying a foamed viscous sugar medium to the solid surface, and then urging the coating medium against the solid form surface to break down the foam and produce an even coat of the coating medium on the solid form surface.

2. A coating process according to claim 1, in which the foamed coating medium is atomized and sprayed onto the solid form surface.

3. A coating process according to claim 1, in which foaming of the coating medium is carried out by mechanically dispersing a gaseous medium in the coating medium.

4. A coating process according to claim 1, in which foaming of the coating medium is carried out by introducing a gaseous medium under pressure into the coating medium, and then reducing the pressure to allow the gaseous medium to expand in discrete volumes within the coating medium.

5. A coating process according to claim 1, in which foaming of the coating medium is carried out by injecting a gaseous medium into the coating medium.

6. A coating process according to claim 5, in which the gaseous medium is injected into the coating medium at high speed to create a state of turbulence in the coating medium.

7. A coating process according to claim 1, in which foaming of the coating medium is carried out immediately prior to application of the foamed coating medium to the solid form surface.

8. A coating process according to claim 2, in which foaming of the coating medium is carried out immediately prior to atomization of the foamed coating medium.

9. A coating process according to claim 1, in which the coating medium is urged against the solid form surface by tumbling the solid form on a tumbler surface.