ON THE PROBLEM OF APPLYING PROTECTIVE COATINGS TO TABLETS IN A CONTINUOUSLY ACTING INSTALLATION

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In the manufacture of protective coatings for tablets, sugar coating in coating kettles is widely used at the present time.

The product in the form of a double convex tablet containing vitamin components is covered with a protective film to exclude the harmful effects of the surrounding medium (moisture, temperature, etc.), thus leading to a reduction in storage time and damage to the product.

Literature data indicate the use of film coatings consisting of film-forming, high-molecular-weight compounds as a protective covering for tablets [1, 2].

Tablets covered with films of polymeric material are the most expedient and economical medicinal forms, since in this way the time for obtaining a protective covering is significantly shortened while retaining the quality of finished product in accordance with pharmacopoeia requirements [3].

For developing protective coverings, the film-forming, high-molecular-weight compounds were dissolved in organic solvents (alcohol and acetone) and the solutions obtained were applied to tablets by spraying through an atomizer.

The process of generating a coating by the method described is accompanied by evaporation of the solvent from the tablet surface. This creates a threat of forming dangerously explosive concentrations and toxic solvent vapor effects in the attendant personnel and must be taken into consideration when setting up the plant for applying protective coatings to tablets.

The equipment described below makes it possible to apply film-forming materials such as certain cellulose ethers, polymeric aliphatic alcohols, and other derivatives to obtain protective coatings on tablets. It provides continuous execution of the process and safe working conditions when applying organic solvents.

Fig. 1. Equipment for obtaining protective coatings on tablets. Explanation in text.

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The equipment (Fig. 1) consists of a measuring device (1) for feeding tablets, an assembly (2) providing application of the protective film, an arrangement for feeding heated air (3) for drying, a solution of film-forming material (4), and a ventilation system (5) for removing dust and solvent vapor.

Tablets from the measuring device enter into a horizontal cylinder (6) which has a screw conveyor (7) in the form of a spiral fastened to the inside surface of the cylinder. The cylinder is composite and has a main section of length 1200 mm and internal diameter 330 mm and two further sections of length about 600 mm. Thus, it is possible to vary the duration of the process by increasing the length of the cylinder to 1800 or to 2400 mm. The pitch of the screw conveyor was 88 mm and the height of the spiral 50 mm. At the input to the cylinder there is a closing device with an end disc (8) (supporting ring).

The cylinder, resting on roller bearings, was brought into rotation by a driving gear capable of a variable number of revolutions. The rotation of the cylinder must coincide with the direction of the helical line of the screw. This provides reverse transportation and mixing of the product, and makes it possible to obtain the necessary duration of stay of the product in the cylinder for applying and drying protective coatings of the required thickness. The input and output portions of the cylinder are connected with the ventilation system. The rotating joints of the cylinder are sealed into stationary compartments for charging (9) and discharging (10). Delivery into the cylinder of tablets preheated to 40 °C takes place through the charging tube (11). A tube (12) with nozzles (13) for delivery of drying agent is fixed inside the cylinder.

Between the nozzles three (or more) pneumatic jets (14) are located for spraying the solutions of film-forming materials. Through the first jet, 50% of the total amount of solution is sprayed, through the second 30%, and through the third 20%.

On operating the equipment the delivery rate of the measuring device can be varied from 0.5 to 1 kg/min and the rotation of the cylinder can be adjusted from 7 to 20 rpm. The product being mixed is transported along the cylinder axis under the action of a head generated by the product being fed into the cylinder and also as a result of the slope (2-5°) of the cylinder in the direction of the outflow. On rotation of the cylinder the screw conveyor provides backward mixing and transportation of product, distributing it evenly along the whole length of the cylinder. This makes possible uniform movement of the product and its delivery into the discharge bin. On transporting the product, drying occurs with air heated to 40°, which is supplied by an air-delivery system through a heater.

Thus the product in the process of passing along the cylinder is sprayed with atomized liquid, covered with a protective film of the required thickness, dried, and delivered into the discharge bin.

In the process of carrying out experimental work on the described equipment, the possibility was demonstrated of obtaining protective coatings on vitamin tablets, and the principal limits of modifying its operating parameters were established. Thus the productive capacity of the equipment may be within the limits of 30 to 60 kg/h. The optimal loading of the cylinder compartment of the equipment in relation to the necessary thickness was from 10 to 20 kg.

Methods are known for determining the thickness of the covering deposited on the tablet for a batchwise process of obtaining film coatings [4].

In the present work a method is proposed for determining the thickness of the applied coating in the continuous process, and equations are given for the dependence of the thickness of the coating on the operating parameters of the process and certain properties of the product.

1. The volume of the film applied to the tablet:

\[ V = S_T \cdot h, \]

where \( h \) is the film thickness (in m) and \( S_T \) is the surface area of the tablet (in m²).

2. The mass of the film applied to the tablet:

\[ g = V \cdot \rho_f = S_T \cdot h \cdot \rho_f, \]

where \( \rho_f \) is the density of the dry film (in kg/m³).

3. The number of tablets in the assembly: