Challenges in design and construction of drum tablet coaters

Modern tablet coaters must be able to handle tablets and other dosage forms with a wide range of formulations, shapes, and sizes and using a variety of coating solutions. Solvent-based coating solutions require efficient explosion protection, while highly potent active ingredients require appropriate containment measures. Coaters must also manage widely varying batch sizes, and cleaning must be automated and effective. To maximize efficiency, each step of the coating process should be optimized, and automation is key.

Feeding a coater can include manually scooping tablets into a hopper in the coater or connecting a container directly to the coater’s feed port. Feeding must be fast but gentle, because mechanical forces can potentially damage the tablets. For tablets with highly potent active ingredients, the feeding system typically must include containment valves and closed lines between the feeding container and the coater to ensure containment.

Effective mixing of the tablets is critical for product quality. All tablets must be sprayed with the same amount of coating solution and at the same frequency to achieve an even surface quality throughout the batch and ensure the coating layer’s functionality. Optimized, reduced-height mixing elements ensure that the elements are not exposed to the spray flow, which prevents coating solution from drying on the elements and then breaking off into the tablet bed, leading to defective tablets.

To apply coating solution or suspension as fast as possible, drum coaters with an extended drum, a flatter tablet bed, and more spray nozzles have become popular. Air-atomizing spray nozzles that create a highly homogeneous spray pattern at high pressure levels have become common. Air lines for atomization, control, and pattern air are executed as bore holes in the spray boom to avoid unnecessary piping in the coating drum. As the angle of the tablet bed changes during operation, the spray boom automatically adjusts to maintain a consistent angle and distance between the tablet bed and the spray nozzles and prevent droplets from drying prematurely in the air or excessively moistening the tablets.

Today’s high-spray-rate coating processes require sufficient volumes of treated drying air. The airflow must be optimized to pass through the coating drum with minimal turbulence or disturbance to the coating spray pattern to minimize spray loss and ensure product quality. This means optimizing the inlet air distribution to keep the air velocity low as the air enters the coating drum, while minimizing pressure loss from the drum perforation and exhaust air system. Minimizing spray loss also typically allows for longer campaigns between cleaning cycles and maximizes coating efficiency.

The drying air should generate an even temperature distribution throughout the tablet bed to achieve a uniform coating with the highest spray rates. For certain products, more complex air handling systems may be required to handle solvents or other explosion concerns, as well as for containment applications.

Just as with feeding, coater discharge should be fast but gentle on the tablets. In recent years, helix-shaped welded discharge elements, which serve as mixing elements during forward movement, have replaced special discharge inserts. When the drum rotates backwards, these discharge elements guide the coated tablets from the drum to a discharge port. For containment applications, containment valves and other measures may be required for discharge and can be installed directly on the coater.

Coating systems require cleaning after a product change or a specific number of batches. In general, all surfaces in contact with the product are automatically cleaned using cleaning nozzles, and all possible hose connections between the tank, pump, and nozzles, as well as the nozzles themselves, are rinsed. A GMP-compliant coating system design is necessary for a successful cleaning process. Rotating jet cleaners have proven to be successful for cleaning coating drums if the cleaning agent pressure is high. Coating drums can also be cleaned using ultrasonic cleaning, in which the drum is placed in a cleaning solution and an ultrasonic generator creates high-frequency pressure waves that help to dislodge material from the drum surfaces. As with the coating process itself, the cleaning process should be as automated as possible.

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