TIPS TO IMPROVE TABLET COATING EFFICIENCY

Chris Byers
Solid Dose Solutions

Film coating materials are expensive, and wasting them just adds to their cost. Nonetheless, very few companies compare the amount of solids sprayed with the weight gain of coated products. Nor do they factor in the cost to dispose of the solids that end up in the dust collector. In my experience, it costs about $1,250 to buy and dispose of 25 kilograms of coating material, plus the time and energy required to process material that never reached the product. You should only need to empty the dust collector monthly, not daily, as some companies do.

Another tipoff that you’re not running efficiently: Material covers the coater’s walls and spray arms, which should never occur in a modern spraying system when set up correctly. In fact, you should not even need to clean the coater between every batch if you’re coating the same product. Ideally, you’d only need to clean after every 15 batches or so. If the task takes 2 hours, you can save a lot of time and money by reducing how frequently you clean. Whatever the interval, always follow GMP requirements.

In a coating process that uses modern equipment, at least 95 percent of the coating solids should remain on the tablets. If you maintain the coater well and set the parameters correctly, it’s even possible to achieve 100 percent solids usage. Common sources of inefficiency include turbulence, incorrect bed temperature, and poor spray gun setup.

Turbulence

In efficient coaters, process air flows in and out of the drum smoothly and consistently. In inefficient operations, there’s turbulence, usually because the inlet and exhaust volumes are imbalanced. That causes solids to deposit where they shouldn’t, as shown above.

To correct that, set the inlet air volume according to the weight of the product in the coater and set the exhaust air volume so that it creates a negative pressure within the housing, around 100 pascals. That should ensure the air entering the coater is removed by streamlined air flow through the tablet bed. When the inlet air volume is excessive, it creates turbulence in the coater, causing the coating solution to spray-dry and allowing the solids to deposit elsewhere. When practiced correctly, film coating is a very clean process and there is no reason for coating material to deposit on the coater’s door or spray arm. For some reason, many companies tolerate it or deem it acceptable.
**Temperature**

The temperature of the tablet bed is another important parameter. For the best result, it must exceed the glass transition temperature of the coating’s polymer-plasticizer system. The glass transition temperature is the minimum temperature at which the coating will form a film. If the bed temperature falls below it, you can normally tell because the tablets will not be as shiny as those coated at or above this critical temperature. The more plasticizer a coating formulation contains, the lower its glass transition temperature.

**Spray gun setup**

The heart of any tablet coater is the spray gun system. For efficient coating, the spray guns must be checked and maintained regularly. The slightest damage to the tip of the nib or needle could have a large detrimental effect on the spray pattern and the droplet size distribution.

Don’t waste time trying to gauge the spray pattern and droplet size from outside the coater. The best way to assess them is to pass a sheet of paper through the spray at the start of the process at the same speed the tablets travel. While it’s not a precise method, it gives you an idea of droplet size, size distribution, and how the droplets are deposited.

In fact, spray deposition—how droplets behave when they impinge the tablet core—is very important to efficiency. The droplets must have the correct surface tension so they burst on contact with the tablet surface and form a liquid film, which is rapidly dried by the warmth of the tablet cores and air movement. For this to work as it should, most coating solutions require a viscosity of 250 to 500 centipoise. If the solution is too wet when it impinges the tablet surface, it’s likely to splash back and create tiny droplets that quickly dry and are carried away from the tablet bed. Conversely, if the surface tension of the droplets is too high, they’re likely to bounce off the tablet and be carried away. If all the guns are identical and maintained to the correct standard, then the spray pattern and droplet size distribution should be similar for them all. An example of an efficient spray is shown below.

Once the spray guns are set up, the atomizing air determines the droplet size and size distribution. For optimal results, keep the droplet size between 20 and 30 microns. If the atomizing air is too strong, beards are likely to form on the spray guns, which will alter the spray pattern. Bearding is less of a problem today thanks to the availability of hornless spray caps.

**Examples of efficiency improvement**

It’s sometimes hard to convince people to improve efficiency. In one case, I was accused of not coating correctly because, after 7 hours of coating a product, there was excessive weight gain on the tablets and the coater was clean. Meanwhile, the other coaters at the site were so fouled with overspray that it was impossible to see inside the drum after 1 hour of coating. And there were still about 10 hours left in the process! I spent 2 weeks at that site and I did finally persuade the technicians to change their outlook and initiate new routines. As a result, they were able to optimize their coating processes and thus forego the purchase of a new coater. They also increased capacity by about 60 percent and they no longer needed to clean after every batch. That combination of changes reduced processing times to around 8 hours.

At another site it had become routine to close down the coating operation every 6 months to dismantle and clean exhaust ducts blocked by coating solids (photos). That’s an expensive undertaking and shouldn’t be necessary. And just how does that much material get into the ducts? Little by little: Every time the employees had encountered a coating problem, they removed water from the coating solution and replaced it with 96 percent water.

The buildup of solids in exhaust ducts indicates poor efficiency. It can also lead to turbulence in the drum, further diminishing efficiency. At this site, it was routine to stop the coating operation every 6 months to dismantle and clean the ducts.
ethanol. Over several years, the proportion of ethanol grew. It had reached 50 percent by the time I arrived.

So the “fix” was actually the problem. It was also completely unnecessary, as the coating was a common HPMC formulation used worldwide. While that coating can be applied using organic solvents, it was primarily formulated for aqueous coating. The legitimate fix was easy. We simply reverted to the coating supplier’s parameter recommendations, used water as the solvent, and set the solids content of the solution at the correct percentage to ensure an acceptable viscosity. About 3 months later, the company’s operations director informed me that the increase in productivity reduced the tax levied on them for using organic solvents. Coupled with better process efficiency, those changes saved around $6,250 per month. In the 6 years since my visit, the ducts haven’t required cleaning.

In addition to stoppages, blocked or partially blocked exhaust ducts decrease efficiency by creating erroneous airflow readings, which can allow turbulence in the coating drum to go unchecked. There should be no solids buildup in exhaust ducts. I’ve seen machines that have been operating for more than 20 years that generate little or no buildup.

Many companies believe their product is special and requires special treatment. Sometimes that’s true, but usually the most important criterion when setting parameters is the coating’s polymer-plasticizer system. By simply setting the basic parameters as the coating supplier recommends, it’s possible to consistently achieve 98 percent solids recovery, even when applying a proprietary methacrylic acid copolymer in aqueous dispersion to highly hydrophilic tablets (95 percent ammonium/potassium chloride salts). Nonetheless, many formulators ignore or tweak the supplier’s recommended parameters without really understanding what they’re doing. The results are often disastrous.

To coat efficiently, heed the recommendations of the supplier about how to apply the coatings. If you need to coat a temperature-sensitive product, for example, use a polymer-plasticizer system that will tolerate low-temperature coating. It really is that simple.

There are many more variables involved in running an efficient film coating operation, but it’s impossible to discuss them all in one article. For more information and assistance, just ask your coating or equipment supplier or an independent consultant.

Chris Byers is the owner of Solid Dose Solutions, Longford, UK. Tel. +44 7908 127 440. E-mail: chris@soliddosesolutions.co.uk. He has nearly 40 years’ experience in the pharmaceutical and dietary supplement industries in the areas of manufacturing, development, formulation, scaleup, and validation.