Feeders in Milling and Micronization of Pharmaceutical Powders

Operations often involve the size reduction of highly potent APIs. As the potency of dry compounds increases, so do the complexities of the application. Here's advice on feeder selection and how it influences the process

'The feed rate into the mill is an important factor in determining particle size distribution.' By Sharon Nowak

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Size reduction mills are used widely throughout the pharmaceutical industry for the reduction of active pharmaceutical ingredients (APIs) as well as bulk pharmaceuticals and excipients such as lactose and hydroxypropylmethyl cellulose. Size reduction is used to increase surface area, improve formulation dissolution properties and maintain a consistent average particle size distribution (PSD) for the formulation, allowing for a better quality mixture when creating solid dosage forms such as tablets and capsules. Conventional dry size reduction in the pharmaceutical industry is accomplished by impact. This impact size reduction generally falls into two categories: mechanical impact and impact via fluid energy. Examples of mechanical impact mills are hammer mills and pin mills. Spiral, loop and fluidized bed jet mills are examples of micronizers or fluid energy mills. In most size reduction mills, the feed rate into the mill is an important factor in determining particle size distribution. Since the resultant distribution is largely dependent upon residence time in the milling device, the feeder is an important tool in controlling this residence time and subsequently the resulting PSD. The types of feed devices used in the industry vary from rotary valves to vibratory tray devices and screw feeders &#151 single and twin-screw types. However, as with any process, the product flow characteristics will often determine the best feed method. Since most pharmaceutical powders and formulations can have difficult flow characteristics, the twin-screw feeder is often the method of choice. The "self-wiping" action of the intermeshed screw flights lends itself well to the feeding of difficult and cohesive powders. Sticky powders that are particularly cohesive or non-granular materials with high aspect ratios can tend to pack. They often cause clumping in a vibratory tray or packing in the vanes of a rotary valve. This agglomeration in the feeder disrupts the even metered flow required for the milling operation below, causing a shift in the resultant particle size distribution. Feed rates for pharmaceutical size reduction or micronization can range anywhere from small jet mill operation rates of 20 g/hour to production mill rates of up to 840 kg/hour. As with all feeders, this rate range is dependent upon the type of screw configuration chosen as well as the drive type and available turndown ratio, i.e. speed controller with a DC motor with an available turndown of 100:1 vs. speed control with a frequency inverter and an available turndown of

17:1. Depending upon the accuracy of feed required, the screw feeder can be supplied in either a volumetric or gravimetric configuration. If the material or formulation is free flowing and of constant density, then the traditional range of accuracy experienced with a volumetric twin-screw feeder is often acceptable. However, it should be noted that when feeding materials with high variations in bulk density, volumetric feeders might have relatively high variations in feed rate due to fluctuations in the filling of the screws. In the case of cohesive materials, in volumetric material bridge building or packing in the hopper can cause almost no material to discharge while the screws are running. Since the feed rate in a volumetric feeder is purely a function of screw speed, the feeder and milling process below have no way of detecting this upset condition. Even the use of level sensors in the feed hopper may not alert the process of this upset in a timely fashion, and off-spec particle size distribution may occur for a significant time. This is especially relevant in high-energy mills with relatively short residences times such as jet mills or micronizers. Loss-in-weight feeding uses a scale or load cells to continuously weigh material flow, offering broad material handling capability in feeding a wide range of materials from low to high rates. Loss-in-weight feeder controls can verify that the material is flowing and send an alarm if material flow is stopped by an upstream problem. In operation, the entire feeder, hopper and material are continuously weighed, and the feeder's discharge rate (which is the rate at which the feeding system is losing weight) is precisely controlled to match the desired feed rate. Due to their ability to provide a more accurate feed rate, despite the difficult flow properties of the pharmaceutical material, loss-in-weight feeders are becoming increasingly popular for a wide variety of milling and micronizing operations. Many milling and micronization operations involve the size reduction of highly potent APIs. As the potency of these dry compounds increases, project engineers are often faced with the requirement to place the entire feeding and milling operation in an isolator or glove box. The purpose of these isolators can be two-fold: protection of the operator from the hazards of the drug and protection of the dry compound from the hazards of the surrounding environment. In designing such milling systems, it is imperative that the feeding device used be completely accessible and dismantled through the use of gloves in glove ports. Integration of a pharmaceutical feeder to the wall of the isolator can be done by means of varied plate mount designs, with the motor and gearbox completely isolated from the glove box. To connect the wall of the glove box with the wall integration plate of the feeder, a static seal &#151 gasket or O-ring &#151 or an inflatable seal can be used. It should be noted that this design is only possible with volumetric feeders because there is no friction-free flexible connector available that does not affect the weight measurement. In the case of gravimetric feeders, the complete feeder is placed in the glove box with a fully vented enclosure around the feeder motor and the gearbox. *Sharon Nowak serves as global business development manager for the food and pharmaceutical industries for the K-Tron Process Group, Routes 55 and 553, Pitman, NJ 08071. She works closely with the R&D and engineering departments to identify new applications and focus on the specific needs of these industries. She also has a 20-year background in the process equipment industry for food and pharmaceuticals as well as a degree in chemical engineering from Rutgers University. She has experience integrating feeders into food and pharmaceutical systems for mills and micronizers, blenders/mixers and contained processes for potent compounds. Questions about this article can be directed to her at*

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