TABLETS & CAPSULES
Solid Dose Digest
Insights, advice, and industry news about formulating, manufacturing, and packaging solid dosage forms brought to you by Tablets & Capsules *magazine*

August 12, 2019

Ask an Expert

Dust collectors for modular processing

Q: Can a compact, cartridge dust collector provide effective dust collection for modular cleanrooms and processing suites?

A: David Steil, Camfil Air Pollution Control, says:

Self-contained, modular, autonomous cleanrooms and processing suites are revolutionizing pharmaceutical solid-dose processes. These systems are readily deployable, mobile, and scalable and are ideal for multiproduct sites, rigorous containment needs, and on-demand scaling of production and laboratory space. In many cases, you can repurpose these suites to manufacture a different product quickly and easily, which is an important benefit.

As with traditional cleanrooms and processing facilities, safely collecting and disposing of dust, preferably at its source, is essential in these suites. When compressing tablets, the tablet press's airflow, static pressure, climate control, material handling, and compression force are critical to achieving the desired production rates and product quality. Fugitive dust from tableting operations can hinder reliable, consistent performance; cross-contaminate other products; and affect the health of workers. This issue can be even more prevalent in a modular system due to its small footprint.

A compact, cartridge dust collector can provide full containment, deliver effective filtration, comply with National Fire Protection Association (NFPA) explosion-protection standards, and offer a small equipment footprint. For solid-dose applications, you can efficiently address the handling of dust in process areas of modular facilities by using a properly sized and configured dust-collection system. To determine the proper size and configuration, you must identify your formulation's material properties and explosibility, the airflow requirements, the air-to-media filtration ratio, and the negative pressure requirements.

Material properties and explosibility

Material properties. You must determine the toxicological nature of the substances that you must capture, such as a compound's potent, toxic, and/or allergenic properties. These properties govern the safe amount of pharmaceutical ingredients in the air—their occupational exposure limits (OELs). OELs limit the exposure of workers to toxic substances over an eight-hour shift and a 40-hour work week to prevent adverse health effects. The OEL is the maximum allowable air concentration of a substance expressed as a time-weighted average in micrograms per cubic meter of air.

In most cases, solid dose processing requires some level of isolation and/or containment because pharmaceutical dusts are often hazardous, with very low OELs, and you can't release them into the surrounding environment. High-efficiency particulate air (HEPA) after-filters can serve as backup protection to a dust collector, allowing you to release the filtered air from the modular facility directly to the outdoors.

Explosibility. Another concern involves the deflagration and explosion potential of the material being collected. The degree of risk depends on the dust's physical characteristics: its rate of pressure rise (Kst), the pressure developed inside the collector (Pmax), and minimum ignition energy (MIE) as well as other characteristics, such as minimum explosible concentration (MEC), minimum oxygen for combustion (MOC), volume resistivity (Rv), and charge decay time.

To determine whether a dust is combustible, you must perform explosibility testing in accordance with ASTM test methods, as stipulated by the NFPA. Unless the dust is completely inert (Kst = 0), you must incorporate explosion protection into the dust collection plan. The pharmaceutical industry typically handles materials with Kst values higher than those of industry in general, so the risks are higher and the equipment decisions are more complex.

A properly constructed, compact cartridge dust collector can safely contain an explosion event without the need for additional and expensive explosion-protection systems, and you can safely install one in a modular, solid-dose-processing unit. Look for a pressure- and shock-resistant housing that can maintain its integrity with no damage during an explosion event. Ensure that both the primary and secondary filter stages can stop a flame front, doubling your protection against flame propagation. Make sure the collector is fully

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antistatic, including paint, bonding, and grounding and that you have full testing documentation from the manufacturer.

Airflow requirements
You must also determine whether your modular, solid-dose-processing facility requires a compact cartridge dust collector with one or two primary filter cartridges. A single primary filter can serve processes that don't require more than 600 cubic feet per minute (cfm) of airflow, depending on how many square feet of media are in the cartridge. Dust collectors with air volumes between 590 and 1,765 cfm typically require two filters to increase filtration capacity and provide a properly sized collector based on a specified air-to-media ratio.

On average, you need higher airflows and pressures in dust collectors serving coating and fluid-bed dryer operations than those serving tablet manufacturing, especially when coating is continuous. In continuous coating, the dust loads are heavier, and additional moisture may require more frequent filter changes if you don't use the proper filter design and media.

Air-to-media filtration ratio
The air-to-media ratio is the volume of air (cfm) that flows through the collector in relation to the square feet of filter media in the dust-collection vessel. For tableting applications, the recommended air-to-media ratio for cartridge filters is 2.5 to 3.5 cfm of air per square foot of media.

Overly high ratios can cause inconsistent airflow that creates problems, such as excessively high, out-of-specification static pressures, causing the press or any upstream equipment to malfunction. Inconsistent airflow can also shorten the filter life, leading to lost production time and higher change-out costs. It also requires frequent and excessive pulse filter cleaning, which shortens filter life, increases energy usage, and impedes the operation of the dust collector and tablet press.

Negative-pressure requirements
In tableting applications, dust most often travels to the collector from a local pickup point, usually where the material is fed into the press' die cup. Therefore, you must maintain negative pressure—a partial vacuum—in the turret enclosure to capture the dust inside the tablet press housing. If you have a contained tablet press that is processing a hazardous API, negative pressure is a must to ensure a controlled environment and reduce the risk of worker exposure to fugitive dust.

Using a contained dust collector that is the correct size for a modular processing facility, with the correct air-to-media ratio, will create and maintain a negative-pressure environment inside the tablet press housing. It's also critical to control the dust collector's reverse-pulse cleaning system because neutral or positive pressure in the tablet press housing could cause a containment breach, leading to improper operation of the tablet press and process downtime.

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