Factors affecting dust capture hood performance

Industrial Ventilation: A Manual of Recommended Practice for Design, published by the American Conference of Governmental Industrial Hygienists (www.acgih.org) is a helpful resource that engineers use when designing a dust collection system. The manual covers topics such as capture hood and duct design, exhaust fan selection, and dust collector applications. With resources such as this available to solve dust capture problems, why do so many dust collection systems fail to perform as expected? Why is there still too much dust in the air and dust accumulation around the work area?

The problem frequently has to do with dust capture hoods being improperly applied for the specific process generating dust. Two processes that use the same equipment may have different dust capture needs. Variables such as operating rate, product formulation, and production procedures can make a dust capture system work well in one case but not in another. A system's performance depends on how effectively you apply textbook solutions to the real-life situations in your plant. In this column, I'll discuss different dust capture hood design options and explain how process requirements and process equipment operators can influence hood performance.

Canopy hoods

Many dust collection systems are built with canopy hoods installed directly above each dust source. Canopy hoods are easy to design, fabricate, and install but, in many cases, are misapplied. Whatever dust a canopy hood captures is drawn up through the process operator's breathing zone before it enters the hood. This means that the dust collection system isn't providing respiratory protection for the operator. Since the canopy hood must be high enough to prevent interference with the process operator and process, much of the dust generated gets diverted away from the hood by the cross drafts typically found in a manufacturing environment.

You could install a larger (and more expensive) dust collector and exhaust fan to increase the exhaust airflow and capture more dust, but this would be throwing away good money after bad. You could also improve dust capture by dropping side panels from the canopy hood down to the dust source to enclose the process, but such panels can interfere with the process operator's daily tasks and hinder maintenance requirements and are often quickly removed by plant personnel.

An exterior hood is positioned at the dust source but doesn't enclose it. A properly designed exterior hood can result in a 90 percent reduction in the dust concentration level that the operator is exposed to. Many variations and combinations of enclosure and exterior hoods are depicted in Industrial Ventilation. The publication has details on hoods for bag filling, barrel filling, bucket elevator ventilation, conveyor belts, screeners, buffing and grinding and suggests exhaust air quantities for each hood application.

Local hoods

A more effective approach is to install a local dust capture hood as close to the dust source as possible. Work closely with production and maintenance personnel to ensure that the hood design at each dust source in your plant is acceptable to the workers using and maintaining the equipment. Modify the hood design and the calculated exhaust airflow amount to meet their needs. This approach will ensure that you have all the dust control you need without having to install expensive, oversized dust collection equipment.

Industrial Ventilation suggests two local exhaust hood types: enclosure hoods and exterior hoods. An enclosure hood is a booth-type hood that mostly surrounds or fully encloses the dust-generating operation. This design is very effective at capturing the dust generated within the hood while using minimal exhaust air. But, as with side panels on a canopy hood, an enclosure hood can be confining and interfere with operator function and equipment maintenance.

Open-ended ducts

You can also capture dust without a capture hood by placing an open-ended dust collection duct close to the dust source. However, placement of the open-ended duct is critical: too close to the source, and the duct will capture process material along with the dust; too far away from the source, and dust will
escape into the workspace. Dust capture performance may also be influenced by process operators since they sometimes place the open-ended duct where they’d like it to be rather than where it should be for optimal dust capture.

Connecting ducts directly to process equipment

Process vessels such as mixers and blenders are sometimes kept under negative pressure for dust capture. Directly connecting an exhaust duct to these equipment types can control the dust generated when the equipment is loaded with material. After loading, keeping the mixer or blender under vacuum from the dust collection system will keep fugitive dust from escaping through rotor shaft penetrations, loose access ports, poorly fitting gaskets, and other leak-prone areas. However, this approach does create the risk of capturing process material along with the dust.

If you’re handling combustible dust, directly connecting the dust collection system ductwork to process equipment can result in the chance of a secondary dust explosion in the process if an explosion occurs in the connected dust collector. Although the dust collector is most likely protected with explosion vents or a chemical suppression system, this protection alone won’t prevent pressure and flames from a deflagration that starts in the dust collector from traveling back through the ductwork to the process. If your process equipment and dust collector are directly connected by ductwork, you must install a deflagration isolation device on the duct. If the process equipment is itself protected by deflagration venting or deflagration suppression, the ductwork protection can be provided by chemical isolation, but if the process equipment isn’t protected, then the ductwork isolation device must be a high-speed knife-gate valve.

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