High Containment Local Dust Control: Improving Safety and Reclamation

By Nick Hayes, Volkmann Inc.

The control of dust emissions when handling bulk powders remains one of the more challenging aspects of powder handling. Not only does the powder escaping into the environment pose a safety risk, but in many instances also represents substantial losses in productivity. The calculated and designed central dust collection systems using large filter banks and suitably sized fans are well established within the industry to provide dust control, but these systems are not always in place, particularly when it comes to local containment. This article will address systems that can be used to provide local dust containment and potential product reclamation, without a large capital investment.

Establishing a satisfactory level of local containment for small systems is difficult for reasons ranging from defining the level of dust that is acceptable to the associated cost of achieving a level of high containment. Through the use of a powder's MSDS sheet we know the acceptable emission levels, yet often when handling bags or drums of bulk powders in relatively small volumes, and without the use of a central dust collection system, those dust levels are exceeded. Add to this the risks associated with explosions due to poorly designed systems, and we can easily understand the importance of addressing the issue of containment.

If we look at Figure 1, the standard chart for operator exposure bands (OEBs), the areas with the strictest levels of containment, OEB4 and OEB5 shown by the reddish orange bands, are generally serviced by custom-built isolators with special designs using HEPA filtration, push-push filters, and clean-in-place designs. They may also require operators to wear full respiratory suits and other protective equipment. These situations, typical in potent pharmaceutical or hazardous chemical applications, generally require a great deal of sophistication and can justify the relatively high cost of the containment.

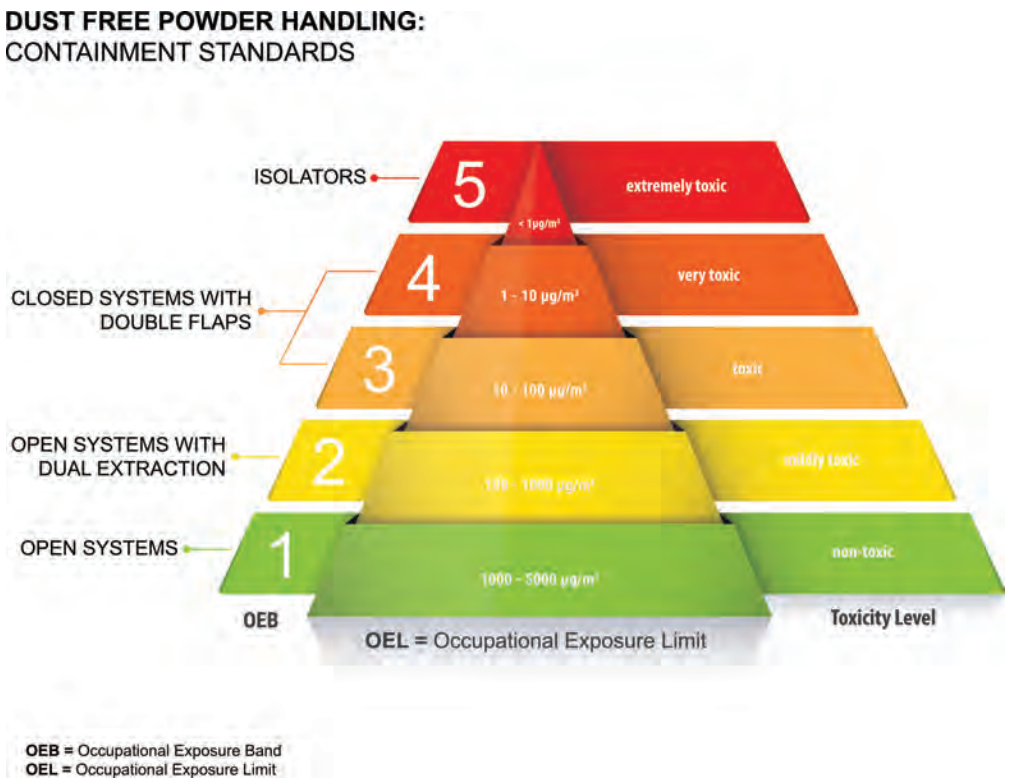

Figure 1 (graph)

Establishing a satisfactory level of local containment for small systems is difficult for reasons ranging from defining the level of dust that is acceptable to the associated cost of achieving a level of high containment.

Addressing OEB 2 and OEB 3 Situations

Where life becomes a little more challenging is in the areas of OEB 2 and 3 applications. Whether the issue is operator safety, housekeeping, or the risk of potentially explosive dust accumulations, it is desirable to avoid dust emissions during the processing of powders. Consider the examples of sugar, starch, and creamer powders. None are hazardous from the perspective of the operator handling the product, yet all have housekeeping and potential explosion issues. Take a moment to Google "Mythbusters Coffee Creamer" and watch the video.

We would all consider creamer to be a safe product to handle, but look what happens when it is mixed with a combination of air and a source of ignition. In itself, the explosion although shocking, might not be too catastrophic. However, when a

small initial explosion occurs in a factory with poor housekeeping, it results in all the dust in the surrounding area – the powder on ledges, structures, roof beams, etc. – becoming airborne. The result is a processed mixture of the creamer or powder with air. This combination, coupled with the ignition source, results in a much larger secondary explosion such as seen with the Georgia sugar facility accident – potentially and practically resulting in injury or even death of those within the building. Examples of this type of explosion occurrence in sugar processing, grain silos, and the like are well established.

Thus, where we might not consider emissions from processing with non-health risk related powders, we can easily be creating a potentially dangerous condition because of poor housekeeping. Furthermore, we are wasting product, which if contained, can be sold or result in a potential reduction in the overall use of a possible minor ingredient.

In United States' manufacturing, we tend to consider explosion risk in terms of the electrical standard; in the case of powders, these are Class II, Div 1 & 2, Groups E, F, & G. There are in fact 13 different potential sources of ignition:

- Chemical reaction
- Elevated temperature surfaces
- Mechanically generated sparks
- Flames or hot gases
- Electric Sparks
- Lightning
- Electrical compensation current
- Ultrasonic
- High frequency radiation
- Electromagnetic waves
- Adiabatic compression
- Ionizing radiation
- Electrostatic discharge

NFPA 654, 652, and 70, as well as a number of other standards, address these issues, but often companies give insufficient consideration to these documents. There is no one standard that applies increasing the complexity. However, containing powder within the production system is a significant first step to avoiding possible ignition risk.

Common processes within the production environment where powder can escape containment and give rise to concerns are:

1. Bag Opening and Dumping
2. Drum unloading
3. Bulk Bag Unloading
4. Mixer or vessel loading

Best Practices for Containing Initial Bag Opening without a Large Capital Investment

When one considers the first of these common practices (i.e. bag opening), this can include anything from the simple slitting of a bag, tipping the contents into a hopper, vessel, or reactor, and using a suction wand to suck product from the bag to the use of either manual or automatic bag opening stations. Each has its own level of containment or lack thereof.

In Figure 2, the operator is hand tipping from drums or bags into the mix tank thereby giving rise to the following issues:

- Danger because of the potential for hybrid mixtures of gas and powders if volatile fumes are present
- Danger of generating high electrostatic charge levels
- Danger of electrical isolation of operator and/or filling equipment
- Heavy weight lifting (not ergonomic)
- Dust generation and exposure without dust extraction
- Dangers from the powder in terms of toxicity for the operator

Figure 2: The wrong way to feed bulk powders

What are the best ways to combat this without resorting to a large capital investment?

Consider the development of bag or drum tip stations as shown in "The Evolution of Bag Unloading Stations to Improve Containment" sidebar. Initially these simple units were comprised of a hopper with a lid. Later developments added filters with stand-alone fans, and reverse pulse filter cleaning systems. As the demand for more containment has increased, so has point of contact containment, leading to further development of product unloading stations. Examples of units that are capable well beyond the OEB 2 and 3 levels include a glove box opening, double valve isolation for bags entering the unit, HEPA filtration and easy clean C-I-P designs. In the case of the last unit shown in the sidebar, the station has further been developed to allow drum tipping.

An advantage of these advanced unloading stations with enclosures is the ability to retain all of the product dust and increase the yield. The filtration systems are not in a remote location and therefore, do not necessarily collect dust from multiple sources involving multiple dust products and possible product contamination. The retained product cleaned from the filters discharges back directly into the process. Furthermore, when one couples the bag dump station to a conveyor, material can be transferred directly to the process. The use of vacuum conveying is particularly effective in this regard as the vacuum created by the conveying process draws all material into the conveying line as opposed to pressure conveyors or even pressure neutral auger or drag conveyors where powder can escape.

As more equipment is added to the system the vacuum process results is a contained transfer from bag dumping or drum emptying to the process discharge point such as

a mixer or packing machine. Using so called “pull thru” techniques can accommodate inline screening, size reduction, and blender loading, providing a dust controlled process economically.

The introduction of the bulk bag and associated bulk bag unloading station has followed a similar path of development to these aforementioned unloaders. Initial units were simplistic with little consideration given to dust generation. During discharge the careful design of the connection of the bag to the process has steadily seen improvements. However, the aspect of the empty bag is frequently overlooked. Typically, the operator changing a bag folds the empty bag for storage, not appreciating that the bag is still full of air and likely has dust on the inside surface. The resultant folding releases this dust into the atmosphere. More sophisticated units offer the ability to pull a vacuum on the bag containing and collecting this dust – again safeguarding the environment and minimizing product loss.

Achieving Local Containment

As with all powder handling and processing applications it is important to consider all stages of the process and while it may not be possible for all companies to have a central dust collection system, it is pos-sible with a careful selection of powder unloading and transfer products to result in local con-tainment, thereby resulting in a cleaner, safer, and higher yield facility. Recognizing the need to address containment is an essential first step in any new project.

As the demand for more containment has increased, so has point of contact containment, leading to further development of product unloading stations.

Nick Hayes is president, Volkmann Inc. Volkmann engineers and manufactures high-quality, high-performance Multijector vacuum conveyors, bag dump sta-tions, unloaders, and equipment for the contained, gentle, and damage-free transport of fine chemicals, granules, pellets, tablets, food par-ticles, and small components for the pharmaceutical, nutraceutical, food, chemical, and allied indus-tries. For more information, call 609-265-0101 or visit www.volkmannusa.com.

The Evolution of Bag Unloading Stations to Improve Containment

Hopper with a lid

Glove box and filtered bag dump station

Bag inlet feed through side chamber and empty bag exit to an empty bag compactor

High containment with drum tipping and HEPA filter