Do closed loop dust collection systems really work?

The above image shows airborne dust particles created by a closed loop dust collection system. The little spots are dust particles reflected in the camera flash. At G.F. Puhl, we call this a "dust bomb" because of the explosion risk created by airborne dust particles.

The old adage "there is no such thing as a free lunch" definitely applies to closed loop dust collection systems

Closed loop dust collection systems were popular in the 1980's and 1990's as a way to avoid handling the dust that was collected from a dust filter. In theory, the concept seemed like the perfect solution. Why handle dust at all? Just dump it back into the system where some of the dust ends up integrated into bales. There's less dust to handle, the system is cleaner, and you make fewer trips to the landfill.

Well, over the past couple of decades, we have found that closed loop systems have some serious down sides that are not apparent on the surface. We've all heard the saying "there is no free lunch." The same is true for closed loop systems.

Over the years, we have gotten calls from customers (and those of our competitors) who have closed loop systems. The complaint is usually that there is no suction anymore and there's a lot of nuisance dust. Our investigation often reveals that the culprit is the closed loop.

To understand how the performance of a closed loop system can start out great but deteriorate over time, it's important to understand what happens to particles in the system. As a system conveys paper or wood from a production machine to a dust collector, each particle is slightly worn away by the impact on the ductwork and blower blades. Over time, the smaller particles become a higher percentage of the total dust in the system that finds its way into the dust filter media (bags or cartridges). This shortens the life of the filter media. In some cases (e.g. systems with cyclones), the small particles never drop out and continue to build up making the filter's task more difficult over time with each pass through the closed loop.

Clogged filters aren't the only problem with a closed loop system. Fine dust is also more explosive. The Kst value of the dust increases by the cube of the particle diameter reduction as the surface area of a given volume (weight) of the dust increases as the average particle size goes down. Kst is the rate of pressure rise over time for a dust when ignited in a test sphere. It's an indicator of how severe the deflagration (sub-sonic explosion) will be when it happens.

So if you are tempted to just duct the dust barrel back into your system to the nearest blower, think again. The consequences may be catastrophic. And the savings you think you are getting will be more than eaten away by shortened filter life and reduced suction at the production machines.
Here's another example of how much more challenging it is for the dust filter to work in a closed loop configuration.

System "X" has four perfect binders each producing 15 pounds of dust per hour. An operator decides that instead of dumping the dust barrel into the compactor, he will re-feed that dust back into the system thinking it will just go into the bale, which means less landfill costs and more revenue from the broker because the dust makes the bales heavier. The operator feeds the 30 pound barrel of dust back into the system in about five minutes. Let's look at the math. The binders are sending a combined 60 pounds of dust per hour to the filter or one pound per minute (total). As the operator re-feeds the barrel back into the system, he is increasing the load on the filter to a total of seven pounds per minute or seven times the design load on the filter which will blind the cartridges or bags. If the compressed air or reverse air blast can't completely clear the filter after the five minutes of running at seven times overload, it never catches up and runs partially plugged with less area of filter. Then each successive time the operator feeds in a barrel of dust, the filter effectively gets smaller and smaller until it plugs up.

Even if the collected dust is re-fed into the system using the vacuum, at a minimum, the re-fed dust will double the dust load on the filter and the re-fed dust is always going to be the smallest of the particle size distribution which further increases the demand on the filter. Smaller particles are more difficult to filter because they travel further into the filter media (bags or cartridges). Some of the smallest particles never come out of the media and that is one of the determining factors in the life of the filter media.

So is a closed loop system ever a good idea? Usually not. But there are always exceptions. It's best to have a qualified engineer review your system before attempting to operate it in a closed loop configuration.

Questions? Just give us a call at 615.230.9500 or email us.