3 Reasons to Pay Attention
Dust Collector Exhaust

The attention in dust collection system design often focuses on the filtration device (collector). As a result, system designers may overlook other factors such as what options to consider regarding the air leaving the collector. This article explains some of the opportunities and challenges for discharged air from filtration devices. Older dust collection systems employed a very simple approach to handling exhaust air from dust collectors; just throw it outside into the atmosphere. This approach was employed whether collectors were located indoors or outside. While this approach may remain valid in some applications, current concerns with energy savings, combustible dust, and environmental regulatory compliance all suggest the prudence of additional consideration.

1. ENERGY SAVINGS – DISCHARGED AIR HAS TO BE REPLACED

As a dust collection system operates, the air used to draw dust to the collector leaves a void behind that has to be filled with replacement air. That may be simple if you live in a temperate climate, but many plants have to invest energy and money to make their facility comfortable. This means that dumping conditioned air outside and replacing it increases the load on make-up air handlers and increases operating cost.

To prevent the loss of your heating or cooling investment, the decision may be made to return conditioned air back to the building after it has been processed through the collector. This option is typically applied with high performance filter media to ensure effective particulate removal in order to allow recirculation. This approach has the potential to be a great money saver if your facility suffers weather extremes, but you may need to evaluate some additional capital costs before you start returning air to the facility.

Many design practices recommend the system recirculating air into occupied spaces have monitoring systems in place to ensure the quality of the air returned to the space. A relatively common approach is the addition of HEPA or ASHRAE filters as *monitoring* filters between the collector and the exhaust back into the building. HEPA and ASHRAE filters tend to show relatively rapid increases in pressure drop when they capture relatively small quantities of dust. By placing them downstream of a primary collector, they can monitor dust loading in the return air and display an increase in pressure drop to alert the operator there is an apparent leak in the primary filter. The dust passing the primary filter is still captured (by the HEPA), and thus avoids being returned to the occupied space. During normal conditions, the HEPA or ASHRAE filter sees so little dust the

pressure drop will remain low and stable, and filter life will remain reasonable. This minimizes maintenance expense for the monitoring filters.
Is the additional capital investment offset by the savings of recirculating air? An estimate of energy savings on a 10,000 cfm (cubic feet per minute) dust collection system operating 168 hours per week in Madison, Wisconsin is as follows:

Heating costs can be estimated for make-up air by using the following formula:

Cost Savings = (0.154 x Q x T x D x C) ÷ q

So for our example, the annual heating cost would be:
= (0.154 x 10,000 x 168 x 7673 x 6.11) ÷ 824,000 = $14,720 heating cost per year

WHERE...	
0.154 is a conversion factor	
Q is design airflow in cubic feet per minute (cfm)	10,000 cfm
T is operating hours per week in hours	168 hours per week
D is the number of annual degree days	7,673 heating days
C is the cost of heating fuel in dollars per unit (November 2013)	$ 6.11 fuel units
q is available heat BTUs per unit	824 k Btu per Unit

Cooling cost can also be estimated by using a formula:

Cooling Costs = (0.0000258 x Q x T x H x C)

So for our example, the annual cooling costs = (0.0000258 x 10,000 x 168 x 293 x 0.0804) = $1,021 cooling costs per year.

WHERE...	
0.0000258 is a conversion factor	
Q is airflow in cubic feet per minute (cfm)	10,000 cfm
T is time as operating hours per week	168 hours per week
H is equivalent rated full load cooling hours	293 cooling hours
C is cost of electricity in dollars per Kilowatt hour (August 2013)	$0.0804 dollars per Killowatt
q is available heat BTUs per unit	824 k Btu per Unit

Returning filtered air and avoiding the need to replace conditioned air discharged from the filtration equipment, offers a total annual savings for heating and cooling of the necessary make-up air of just under $16,000 dollars. This savings is realized every year the filtration equipment is operating. Additional savings could be obtained with the installation of an automatic airflow control system with a variable speed drive that would maintain the design airflow and keep the load on the air make-up system even. With this system, more savings are available by using a surface-loading media with lower pressure drop. If the system runs at two inches water gauge lower pressure with an enhanced surface-loading media vs. a commodity media on this same 10,000 cfm system, the estimated annual energy savings due to lower pressure drop is $2,262.

Calculator: http://www2.donaldson.com/torit/en-us/pages/excelservices/costsavings.aspx.

These savings do not take into account the lower capital required for the make-up air system. If the consideration is for a new project, check with local utility companies for available rebates and incentive programs that encourage the extra capital of investing in an energy efficient system.

2. COMBUSTIBLE DUST CONSIDERATIONS

Dust control systems handling combustible dust may require additional capital investments to avoid returning energy or smoke from a fire back into the building. An **abort gate** is one of several mitigation strategies that help reduce the risks of combustion events in a dust collector coming back into an occupied space. (See Figure 1)
An abort gate receives a signal from some type of sensor located at or near the collector. When the sensor triggers the abort gate, it slams into a closed position. In this position, discharged air from the collector is diverted outside rather than back into the building. A variety of sensors can be used to trigger the abort gate with a common choice being detectors that watch for sparks or smoke after the collector.

Figure 1 - Abort Gate in return air duct

If your plant is located where weather is a consideration, you might have periods during the year when you would rather avoid bringing air back into the building. Maybe the air around your processes is hot and you would prefer in the summer to dump hot air outside. In these conditions, an abort gate will often be manually triggered so the hot air is dumped outside rather than returned to the building. Keep in mind that running the collector with air dumping outside will increase the demand on your make-up air system.

Whether you're considering a monitoring filter, an abort gate, or both in your exhaust duct, don't forget in addition to the capital expense of the equipment, you have energy costs in pushing air through the device(s). When you calculated energy (static pressure) costs to keep air moving through your original system, you included energy costs to accelerate and get air around your equipment moving into the hoods in order to draw dust to the collector. You also added static pressure costs to keep air and dust moving through the turns, joints, and straight runs of duct until

it reached the collector. You included energy costs for resistance through the ducts from the collector to the exhaust point. And, finally, you included the static energy costs to move air through the collector and the filters. These collector energy losses should include sufficient static pressure capacity to allow air movement through the filters even when they are eventually dirty enough to be replaced. All those energy costs added together directed you to the fan you needed.
Now if you are considering a monitoring filter or abort gate, you may need additional static pressure capacity for the energy required to move your air through those devices. Check to see if you need to modify or replace your current fan to maintain design flow conditions.
An additional consideration around combustible dusts is the requirement of standards such as NFPA for isolation between process equipment or on ducts returning air to occupied spaces. These devices help reduce the risk of a deflagration event in a collector that sends energy and flame back into the occupied space. Isolation devices use sensors near the collector to detect the start of an event in the collector. They then trigger the isolation device to close the duct so flame and energy are not allowed back into the occupied space. Mechanical isolation devices tend to use gates which are slammed closed in fractions of a second using high energy closure mechanisms, such as compressed gas. Chemical isolation is a style of isolation that uses**special canisters or cannons** to rapidly deploy an extinguishing agent into the duct using compressed gas. Isolation devices are not only used on the return air duct from the collector, but also on the inlet duct to the collector to reduce the potential for the energy and flame to travel back into the process.

3. REGULATORY COMPLIANCE REQUIREMENTS FOR AIR MONITORING:

If your process involves handling or producing hazardous air pollutants, local, federal, or state requirements may dictate that you monitor the air quality you discharge to atmosphere. A broken bag detector with an alarm may be necessary to monitor dust loading in the exhaust air from the collector and provide a record of performance for the collector. (See Figure 2) These detectors are located in the clean air discharge duct or stack and must be calibrated at design air volume. Once installed and calibrated, these detectors can often be configured to not only monitor, but to record dust loadings on a timed basis in order to establish a permanent record of collector performance. Several broken bag detector designs also allow them to monitor the pulse cleaning sequence of the collector and correlate increased dust discharge with a particular pulse event. In these configurations, the devices act as preventative maintenance tools to help the collector operator narrow his search for damaged filters.

Figure 2 - Broken bag detector probe & controls

The monitors are often equipped with circuits for audio alarms or visual light indicators to alert operators to upset conditions. These monitors have also been used to trigger devices, such as abort gates, when particulate levels increase dramatically, such as during smoky conditions generated by a smoldering fire on a filter.

SUMMARY:

Don't fall into the trap of ignoring exhaust air from your dust collector. You will want to be proactive in assuring your dust collector exhaust meets any federal, state, or local requirements. You also want to ensure you take advantage of any opportunities to increase the value of your dust collector through saving on heating or cooling costs, or by improving its reliability with better monitoring and maintenance. When it comes to your collector's exhaust air, you simply can't afford to thoughtlessly *throw it outside*.