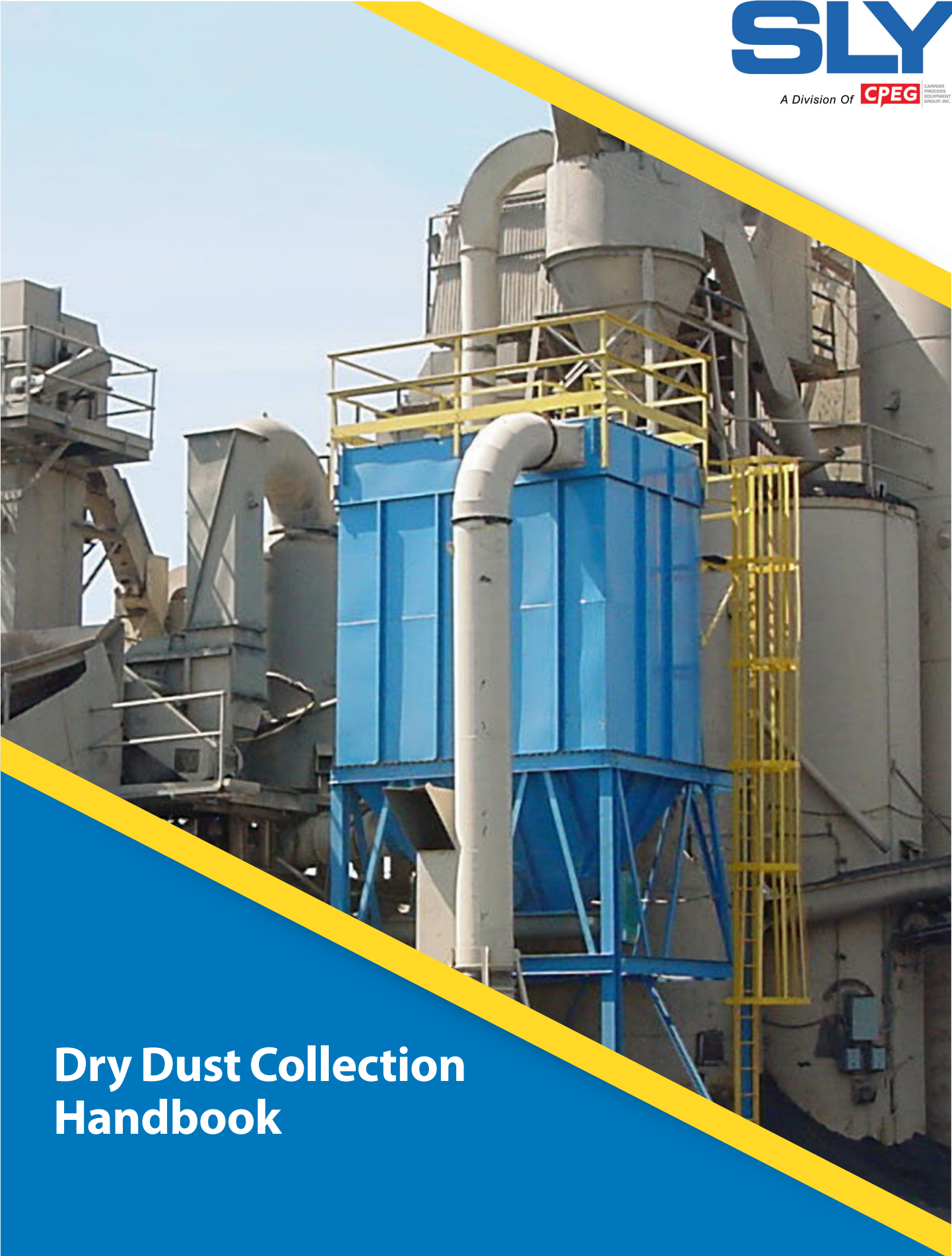


SLY

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PROCESS
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GROUP, INC.



Dry Dust Collection Handbook



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Nearly every manufacturing plant or processing facility pollutes the air in some fashion, and thus every manufacturer needs to be concerned with the quality of their air. Uncontrolled pollutants can lead to health problems for your workers, safety issues with your products, and even plant-wide shutdowns. To avoid these things, you must employ a means of air quality control.

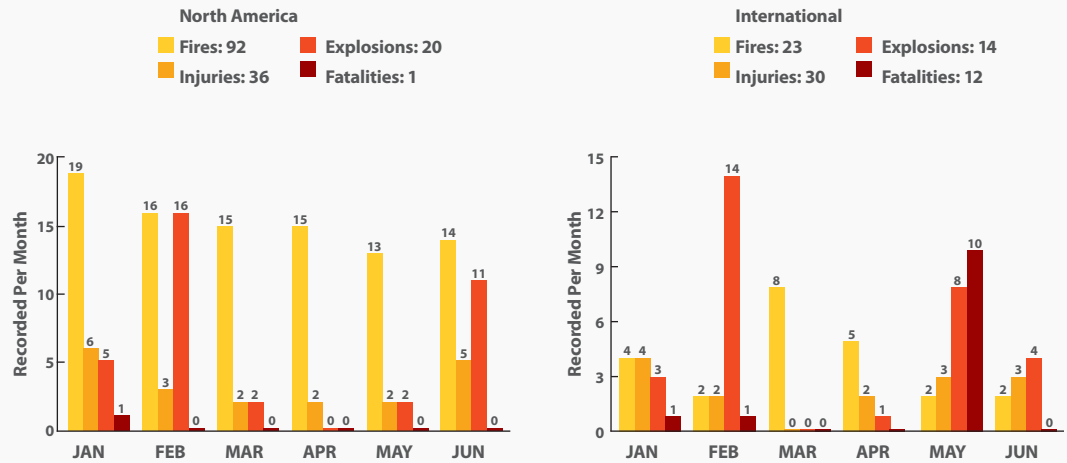


One of the oldest and time-tested methods of air quality control, and one that Sly knows better than anyone, is dry dust collection. Dry dust collection involves capturing and removing industrial particulate using a dry dust collector like a baghouse or cartridge collector. Dust collector designs can vary, but typically, dust-laden air enters the collector through a baffled inlet, where particulate is collected on the filter media. Regular bursts of compressed air dislodge the collected dust from the filters and into a hopper, preventing too much buildup on the filter media. The particulate is continuously discharged out of the hopper and into a container for disposal, or conveyed for reintroduction into the process.

Beyond general worker and plant safety, it's important that dust collection is done in a controlled and reliable manner in order to help prevent dust explosions. Dust explosions occur when an ignition source causes the combustible dusts that build up in the air to combust rapidly. These explosions are deadly workplace hazards that can start from a variety of dusts (wood, aluminum, plastic, etc.), with reported incidents going as far back as the late 1700s. Since then, thousands of explosions and dust-related fires have happened around the world. According to the 2018 Dust Safety Science report, in the US alone, a total of 158 fires and 36 explosions occurred relating to dust accumulation. Some of the worst industries were wood and wood products, agriculture, and food processing.

Today, the focus is on dust safety and figuring out how to stop facilities from allowing dust levels to accumulate while increasing awareness and education across affected industries. Since preventing dust is practically impossible, this work boils down to better dust collection equipment.

2019 RECORDED INCIDENTS (January – June)



Incident Data Overview

	UNITED STATES			CANADA			INTERNATIONAL	
	2016	2017	2018	2016	2017	2018	2017	2018
Fires	—	117	158	—	15	17	37	38
Explosions	31	28	36	2	4	4	36	25
Injuries	22	52	39	0	9	1	102	73
Fatalities	3	6	1	0	0	0	7	16

Source: DustEx Research Ltd. 2018 Incident Report

Government Regulations

There are multiple agencies that work to regulate the methods of dust control that industries use. To stay compliant, and keep your plant operational, here are the top agencies and their regulations that you must abide by:



The biggest piece of government regulation on emission control in the US is the Environmental Protection Agency's (EPA) Clean Air Act (CAA). The Clean Air Act is a comprehensive federal law that regulates air emissions from both mobile sources, more for consumers and vehicles, and stationary sources, which directly affects industry. The CAA goes into more detail and provides emission limits for specific stationary sources, primarily targeting coal-fired power plants, petroleum refineries, plants that manufacture sulfuric and citric acid, and glass and cement manufacturing plants. More info on specific sources can be found [here](#).

To enforce these regulations, the EPA employs the CAA Stationary Source Compliance Monitoring Strategy. This provides national-level consistency in stationary source air compliance monitoring programs. In order to comply with the CAA, you must follow the regulations put forward for your specific industry, as well as the general CAA standards.

OSHA

Like the EPA, the Occupational Safety and Health Administration (OSHA) has determined mandatory federal standards regarding dust hazards that you must follow to stay compliant and remain operational. Their general industry standards, [29 CFR 1910](#), provides a list of industry-wide and industry-specific regulations.

1910 Subpart G, Occupational health and environmental control, contains one of the most applicable standards to industry: [1910.94 Ventilation](#). Here, OSHA defines the need for dust collectors and dust collector equipment. They provide a thorough list of standards that you must follow regarding your air quality control equipment, as well as proper protocol for dust accumulation and timely removal.

Anything not specifically covered in 29 CFR 1910 is subject to Section 5(a)(1) of the OSH Act, commonly referred to as the General Duty Clause. This clause requires employers to "furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees".

For applicable conditions, OSHA also has their Respirable Crystalline Silica Standard for General Industry and Maritime. This requires employers to take measurable steps to protect their workers from exposure to respirable crystalline silica, which is known to be very dangerous for operator health. If this applies to your workplace, you can read more [here](#) to make sure you stay compliant.



The National Fire Protection Association (NFPA) has issued their own Standard on the Fundamentals of Combustible Dust, referred to as NFPA 652. With a deadline of October 2020, the NFPA is set to conduct a Dust Hazard Analysis (DHA) on applicable industries. If you are creating or handling material/particulate that is combustible and/or

exposable then you need a DHA. A major focus of this analysis is to review your dust collection systems since they are a leading cause of combustible dust incidents. As such, the DHA will take a close look at the housing, hopper, inlet ducting, and outlet/return ducting of your dust collector to make sure that high standards of safety are being followed.

What Happens if I Violate These Regulations?

More than just guidelines, these regulations are necessary to maintain the health and safety of your business, workers, and products. While the ramifications vary from one organization to the next, violating any of these regulations can lead to monetary fines, additional inspections, and even a shutdown of your plant. You also become more liable for operator illness/injury. Incidents can still occur no matter what you do, but failing to put your best foot forward further risks the very life of your business.

Key Challenges

There are many challenges that you'll face in your air quality control efforts. Here we detail the top challenges and how to face them head on.

Worker Safety



If there are problems with your air quality control system, the operators in your facility are going to be the first ones affected. Workers who are exposed to certain respirable dusts are at an increased risk of developing serious dust-related diseases. For instance, respirable crystalline silica particles can travel deep into a worker's lungs, which can cause silicosis, an incurable and deadly lung disease.

Choosing and Designing a System

Before selecting a dust collection system, you need to analyze the dust you're going to collect. Understanding the characteristics of the dust you're filtering starts with measuring bulk density and particle size distribution. These measurements can be used for diagnosis of re-entrainment, aid in fabric filter design, and predict filter performance. It's good practice to also perform a particle analysis whenever something changes with your process.

Sly offers both filter bag failure analysis and particle analysis services to help you reach the most efficient and cost-effective pollution control solutions for your specific needs.

Preventing Explosions

Dust explosions and dust-related fires are going to be your biggest immediate concerns when dealing with a dust collection system. The five risk factors for an explosion are:

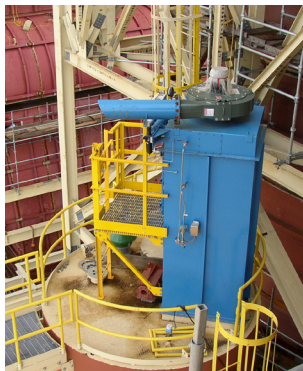
1. Fuel (combustible dust)
2. Ignition source
3. Oxygen
4. A dispersion of dust particles
5. The confinement of dust clouds

While dust collection systems are going to work to make your products and work environment safer, the dust collectors themselves are a likely place for an explosion to occur due to their inherent prevalence of these risk factors.

As such, your risk of an incident is directly influenced by the type of dust collection equipment that you have, along with the Kst value (the dust deflagration index) of your dust. The larger the Kst value of your dust, the more severe the explosion.

To help prevent an incident, you can add fire safety features to your system, like flame-retardant filter media, explosion venting, suppression system or spark arrestors. For higher-risk applications, installing sprinkler systems can help control an incident before it gets out of control. You'll also want to make sure that you're not storing dust in the hopper of your collector, as it creates a potential fire or deflagration risk. Anything you can do to lessen the prevalence of the five risk factors will help.

Testing Your System



To ensure your equipment is continually operating efficiently, it's best to run regular tests on your dust collector system. This involves testing your equipment itself, as well as analyzing the particulate that you're collecting.

If you're using filter bags in your design, you should periodically conduct a filter bag failure analysis. By analyzing filters that have already failed and combining those findings with your operating data, you can diagnose the source of your problem. This gives you the insight to take appropriate corrective action, like switching to an alternative bag type that's better suited to your dust's characteristics or your operating conditions. Improving the performance of your filter media leads to lower emissions, higher airflow rates, and less unscheduled downtime.

Sustainability

No matter how effective a dust collection system is, it must be sustainable for you to consistently make your plant a safer environment. To that end, you'll need to choose high quality equipment and maintain it as best as possible, replacing any parts as soon as they break or become ineffective. You'll also need to design an energy-efficient system that can operate effectively in any condition you'll encounter.

Designing a Dust Collection System

Every dust collection system is unique to the workplace and particulate for which it's designed. As such, the process of designing a system requires you to take a comprehensive look at specifics of your application and environmental requirements. The process below provides a summary of the factors that you need to be concerned with when designing a new dust collection system.

Identify Collection Points

System design starts with finding, identifying, and mapping out the areas and processes in your plant that are generating dust. You should also make note of additional collection points that may be added in the future. Designers should know the different Threshold Limit Values (TLV) for any handled materials, and those exposure limits should be investigated as part of the total system ventilation requirements.

Determine Hood or Enclosure Design Requirements

After the collection points have been identified, you need to determine whether the dust at each individual point should be controlled using a collection hood or if it should be contained within an enclosure. Going with an enclosure is typically optimal, but not always possible, as personnel access to processes, such as mixing or screening, may be required for production and maintenance. For either method, you need to generate enough capture velocity in order to contain the dust in the enclosure or move it to the hood. This includes overcoming any surrounding air currents in your system that could prevent dust flows.

For containment applications, openings in the enclosure need to be kept at a minimum while maintaining a slight vacuum and sufficient velocity to optimize air flow. For capture systems, you want to place the hood as close as possible to the source. Including flanges around the hood in your design will improve capture velocity while reducing turbulence in the system.

Calculate Air Volume

Calculating air volume is critical to properly designing your dust collection system, as insufficient air volume will cause inadequate dust collection. Over time, many proven formulas for designing hoods for specific applications have been developed from extensive research and practical experience. Anyone involved in the design of your dust collection system should consult *Industrial Ventilation: A Manual of Recommended Practice for Design* available from The American Conference of Governmental Industrial Hygienists (ACGIH®). There are many qualified companies experienced in system design and well-versed in calculating the air volumes that are required for different types of dust generating processes if you don't have this expertise in-house.



Design Ductwork

Ductwork is essential for moving captured dust to your dust collector. To design your system's ductwork, it's important to map out the locations of each collection point in relation to the dust collector, designed to scale since the length of your ductwork will affect your overall system design. Choosing the right location of your dust collector will be influenced by factors such as collector size, particulate characteristics, how particulates will be handled during final disposal, and maintenance accessibility.



The bulk density and loading of the dust being conveyed is important to consider since these values affect the required conveying velocities in the ductwork. Other considerations include designing elbows/transitions to minimize turbulence and friction, using blast gates to adjust airflow at each pick-up point, and using round ducts over rectangular ones for more uniform conveying velocities.

Calculate Ductwork Losses

Limiting the amount of ductwork and the areas where additional air flow resistance and turbulence can be created, such as elbows, will help create a more efficient system. The goal here is limiting friction, also known as static pressure. Due to friction, each foot of duct and each elbow will require more energy. Your system must be able to overcome this friction. Lowering system static pressure will ultimately lead to more efficient, and less costly, design.

Select the Collection Device

Selecting your dust collector will depend on your specific application and what utilities you have available to you. This involves understanding the type of dust, its particle size (microns), system temperature, inlet dust loading (pounds/hour), your airflow's chemical composition, and the desired outlet emission rate (grains/standard cubic foot or pounds/hour.)

Select the Exhaust Fan

The next consideration for your dust collector design is the exhaust fan. This is what's used to take the dust-laden air from your collection points, through all your ductwork, and finally through your dust collector itself. You need to properly size your fan to generate the desired air flow at the previously calculated static pressure. Selecting the correct exhaust fan/motor combination will ensure your system delivers the design air volume.

Auxiliary Equipment

To have the most efficient dust collector, you'll need to consider how dust will be discharged from your hopper. Remember, it's not just about removing particulates from your system, but also disposing of them in a proper manner. Auxiliary equipment such as rotary valves, slide gates, drum filling attachments, and screw conveyors can all be used in conjunction with the critical pieces of your dust collector for an overall more efficient design.

Equipment Design Considerations

The value of a system is determined only by how much you use it. A dust collector that's difficult to operate or perform maintenance on will ultimately lead to lower plant productivity and safety. You need to be mindful of design features such as access platforms, support structures, and maintenance accessibility before your dust collector goes into operation. Also, make sure that the design of your collector fits in the footprint space that you have available. Nothing is worse than building a cog too big for your machine.







Baghouse vs Cartridge Dust Collectors

There are two main types of dry dust collectors: baghouse dust collectors and cartridge dust collectors. Baghouse dust collectors use long, cylindrical bags/tubes made of fabric to help filter out dust and other particulate, while cartridge collectors use pleated cartridge filters instead of bags. Both types of collectors use pulse-jet cleaning methods.

While cartridge dust collectors are newer, and thus commonly thought of as an improvement over baghouse dust collectors, both have a place in the world of air quality control. Choosing which types is best for you ultimately comes down to one thing: application.

Baghouse dust collectors are great for more demanding applications where there is a heavy dust loading, like when venting dryer applications or filter receivers. Cartridge collectors are a good choice when you have dry and light loading applications. Use the matrix below to determine which type is best for you based upon the conditions of your application.



Condition		Baghouse	Cartridge
	High Temperature	■	
	Sticky Particulate	■	
	Light Dust Load		■
	Heavy Dust Load	■	
	Small Particulate		■
	Large Particulate	■	

In addition to the above, bag filters are typically more durable, flexible, and have a longer service life than cartridges, allowing for less frequent filter replacements. On the other hand, cartridge collectors are more compact in size, making them ideal for small-space operations.

With their different features, both collectors have their place in industry. It's important to determine which one is right for you, as the wrong collector can lead to high maintenance costs and inefficient filtrations.



Maintenance Checklist

Maintenance of your dry dust collector is critical for the safety of your workers and air pollution control. For optimal system reliability and performance, Sly recommends a consistent schedule of inspections and the timely repair of damaged or malfunctioning equipment. This checklist provides a sample periodic maintenance program for all styles of dust collectors that you can use as a guide to help tailor your own programs. To see a more detailed and comprehensive list, click [here](#).

- 1. Pressure Drop:** Pressure drop, or differential pressure, is a good indicator of the amount of dust your filter media is accumulating and, if regularly monitored, the condition of your bags. As the bags develop a dust cake, particulate will embed itself into the inner fibers of the filter media, increasing the pressure drop. While this can offer a higher efficiency of dust collection, it causes bleed-through or binding of the filter media. Maintaining a daily log of a baghouse's differential pressure change will allow you to diagnose or prevent problems.
- 2. Cleaning System:** Effective cleaning systems help prevent dust from building up on your bags. Without them, you'll see increased pressure drops, a reduced volume of ventilation air at the pick-up points, and reduced airstream velocities. This could choke the entire system, rendering it ineffective. For those reasons, these systems require more than just periodic monitoring. Every component of your cleaning system must be regularly inspected, with all corrections made as soon as possible.
- 3. Hopper Discharge:** Material buildup in a hopper can lead to dust accumulating as a solid mass, requiring intensive labor and downtime to correct. As such, your material discharge methods should be inspected frequently, as well as at shut-down times and during bag changes.

- 4. Visible Emissions:** Visible emissions discharged from an exhaust stacks indicate a breach in a seal or a broken/torn filter bag. These emissions can cause health concerns, damage property outside the plant, and may result in monetary fines imposed by the EPA. Dust collectors should be continually monitored, both with visual inspections and Broken Bag Detectors, as any leaks must be located and corrected immediately.
- 5. Exhaust Fan:** Exhaust fans are required to move ventilation air from the point of pickup, through the filter media, and out the exhaust stack. When exhaust fans have loose/worn belts or an imbalanced impeller, they will not exhaust the volume of air they were originally designed to handle and your system won't operate effectively. You should perform thorough fan inspections on a semi-annual basis and contact the original manufacturer any time you observe unusual vibrations, squealing, or other obvious changes from standard operation.
- 6. Filter Media:** The most important item in a baghouse is the filter media, since it allows for dust cakes to accumulate and provides high filtering efficiencies during operation. Too high of a pressure drop here can cause excessive caking or filter bag blinding, so periodic inspections of the filter bags/cartridges are mandatory. Make sure to inspect the clean air side of the baghouse for leaks and the bags for tears.
- 7. Structural Integrity:** Beyond affecting system performance, the structural integrity of your equipment can cause health concerns and reduce equipment life. A comprehensive inspection should be done annually, including welds, joints, and flange seals.
- 8. Auxiliary Equipment:** In addition to the baghouse itself, thorough system inspections include a check of all miscellaneous complementary equipment, including exhaust fans, rotary airlock valves, inlet/outlet dampers, etc.
- 9. Ductwork:** Ductwork allows particulate to reach the baghouse. Standard practices suggest a minimum airstream velocity within any duct of 3500 feet per minute (fpm), and between 4000-4500 fpm for heavier dusts like sand. If these velocities aren't reached, dust tends to accumulate in the ducts, choking the system. This increases the pressure drop in the system and its energy requirements, resulting in reduced ventilation air at the pick-up points. To prevent this, periodically inspect the entire length of your ductwork for accumulated dust and clean it out before it becomes a problem.

Conclusion

To succeed in the manufacturing world, you simply must maintain a high level of air quality control. Dry dust collectors can capture and remove industrial particulate from your system, increasing safety and worker health across your plant. With the right dust collector, you'll be able to keep your operations running efficiently with minimal downtime. Our expert team at Sly is here and ready to help you pick the right dust collector for your operation and customize it to best fit your needs.

Glossary

Blinding: Blockage in a fabric or media by dust that cannot be discharged by the cleaning mechanism, resulting in a reduced gas flow and an increased pressure drop across the media.

Change-out: Scheduled or nonscheduled removal and replacement of dirty, damage, or clogged filters.

Collection Efficiency: The measure of a dust collector's ability to remove particulate from the inlet gas, typically expressed in percent or emission rate (grains per cubic foot).

Deflagration: Rapid burning through subsonic combustion.

Differential Pressure: The difference in air pressure between the dirty air plenum (DAP) and the clean air plenum (CAP), commonly known as the difference of pressure "across the filter bags".

Dust Cake: A buildup of dust on filter bags that increase the efficiency of the filter media.

Dust Collector (Baghouse): An air filtration device that uses fabric filter bags to remove solid particulate from an air stream.

Filter Media: The permeable barrier used in fabric style dust collectors where the dust cake is supported (bag).

Kst Value: The dust deflagration index, which measures relative explosion severity compared to other dusts. The larger the value, the more severe the explosion.

Particulate: Any airborne solid material.