

Mobile Industrial Dust Collector Risk Management

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1. Risk management for airborne dust

As the outcome of any real-world activity involving work personnel is uncertain, project work always poses some element of risk that cannot be fully abated or controlled. For hazardous dust exposure during normal industrious work processes, these risks include: assessment failures, mitigation failures, operational failures, implementation failures, and environmental disasters. Many of these can be coupled with regulatory violations, and consequently they also have large monetary implications (fines and restitution). Some examples of dust producing activities that need dust abatement procedures for which dust collectors are used include demolition and remodeling activities, construction, coating activities, all metal processing related activities, organic and non-organic product manufacturing and handling, bulk handling and transportation, mining, recycling, plant maintenance etc.

In medical research and insurance company studies, it has been demonstrated conclusively that exposure to fine dust of all types causes a measurable reduction in respiratory capacity – often permanent due to lung tissue scarring– and that the higher and longer the exposure, the greater the damage. Further, serious life-threatening illnesses, while less common, are often traced back to occupational dust exposure. For example, seemingly benign fine wood dust particles occurring in wood processing facilities have been found to be extremely hazardous, with insurance company data showing that woodworkers lose about 1 % of their respiratory capacity per year of work and that, in general, woodworkers have shorter life spans. [4]

For well-recognized hazardous waste types statistics speak for themselves. For example, it is estimated that thirteen people a day die from lung exposure to asbestos in the UK alone – more than double the number that die on the roads. In the USA it is predicted that asbestos will be responsible for more than 10,000 deaths a year. The World Health Organization estimates that over 100,000 people die every year due to occupational exposure to asbestos. Statistics on other hazardous and toxic dust types are similarly readily available, with the conclusions always pointing to the strictest risk management to dust exposure for all industries.

With all the risks identified regarding dust inhalation, air quality in the workplace has become a prominent issue for government agencies across the globe. Beginning in 2018, and running through 2019, The European Agency for Safety and Health at Work (EU-OSHA) is conducting a Europe-wide campaign promoting the prevention of risks from dangerous substances, including hazardous dusts, in workplaces. In the United States, the Occupational Safety and Health Administration (OSHA) has recently implemented two new standards to better protect workers exposed to respirable crystalline silica; one for construction, and the other for general industry and maritime. Australia's OSHA air quality standards for workplace dust are even more rigorous than those in the USA and Europe. Despite differing laws and initiatives, the world is united that a failure to comply with set standards, or even worse, failing to recognize and avert potential harmful practices, can be a criminal offense with very steep financial and personal consequences. By way of example, US lawyers have proved successful in obtaining large compensation for their clients suffering from occupational particle material related respiratory illnesses. A Google search on *PM Health Risks* (Particle Material) gives more than 100,000,000 hits.

According to a recent Mealey's Litigation Report, the average mesothelioma trial award in the United States is estimated at 2.4 million USD. [1] The Institute of Faculty of Actuaries reports that although the European culture is not as litigious as that of the US, there are signs that European countries are adopting more litigation-friendly practices. They point to the 2002 House of Lords Fairchild ruling that allowed UK workers to claim compensation, even when the asbestos exposure occurred with more than one employer, and the employee could not prove which employer's exposure was responsible for the mesothelioma. In France, the Supreme Court of Appeal ruled that an employer's inability to provide a safe workplace was an *inexcusable fault*, which made it easier for French workers to sue their former employers. [3] In a recent notable case in South Africa, gold producers agreed to a 400 million USD class action settlement to thousands of miners who contracted the fatal lung diseases silicosis and tuberculosis.

An effective and prescribed way to help deal with the risks associated with work location airborne dust is to continuously remove contaminated air from a work space using an industrial dust collector (more fully described in section 2.) The use of such abatement equipment can be an effective means of environmental control and air quality improvement, however, it is important that the manageable risks of using such dust collectors is properly understood. It is important that organizations develop a sound overall corporate strategy incorporating the latest and safest developments since the management of the company.

2. Dust collectors for project work

Dust is defined as small solid particles, conventionally taken as those particles below 75 μm in diameter, which may remain suspended for some time in the air. [2] In the simplest terms, an industrial dust collector is a machine used to extract-and-filter high volumes of dust-laden air from a work space (Figure 1). In certain circumstances, the filtered air – or a portion of it – may be returned into the work area. Further, an industrial dust collector handles large volumes of dust and is equipped with a filter-cleaning system, an associated dust receptacle and a dust removal process. Ultra-fine dust is the most dangerous for inhalation (remains airborne indefinitely), therefore dual/secondary HEPA filtration is also incorporated in the most effective and modern dust collector systems.



Figure 1: Draw bridge maintenance being performed, employing a containment enclosure and a large mobile dust collector

3. Overview: pressure differential containment system

In work environments subject to hazardous dust species, a dust collector needs to effectively function as pressure differential unit. Examples of such dust types include asbestos, silica, metals, nuclear contaminated dust, moulds, bacteria etc. Typically, such an area is maintained at a minimum continuous negative pressure of at least -0.02 inches of water. By maintaining a negative pressure within a hazardous workspace, the risk of the contaminant leaking into the surrounding is eliminated and the work can take place within the containment area without cross-pollution risks.

The methodology of the pressure differential containment system is therefore to seal outward-leakage air paths such as doorways, windows and HVAC vents so that a negative pressure is easily maintained. For any containment work area, a minimum of

five air changes per hour is recommended to reduce the concentration of dangerous particulates, and effectively improve the air quality and potential contamination (settling of fine dust) in a workspace.

4. Primary and secondary (HEPA) filtration

Laws are specific to countries and regions, but in principal, all address best practices and attempt to protect workers, neighborhoods, and the environment. It is useful to highlight an example from Germany – TRGS 561, October 2017, *Technical Rules for Hazardous Substances*. Point 15, TRGS 561 Page 21 of 47 (Version: 17/10/2017) – translated into English below for discussion:

Machines or devices which remove dust must correspond to the state of the art in technology. For dust extractors and industrial vacuum cleaners, this means a design according to dust class H.

Therefore, to be fully compliant, and reduce the risk associated with the emission of ultra-fine dust from the dust collector exhaust, the use of secondary HEPA filtration is required. A field-ready dust collector used for the filtering of hazardous or toxic airborne dust species must be a fully engineered, self-contained, dual-stage dust collector. An air-cleaner correctly configured for hazardous waste (Figure 2) should, therefore, be equipped with first stage primary filters (generally F8 – Merv 14/15), and second stage H13 filters (HEPA) prior to the fan (all sections under negative pressure). In such dual-stage configurations, 99.997 % of airborne dust is effectively filtered and safely retained within the collector.

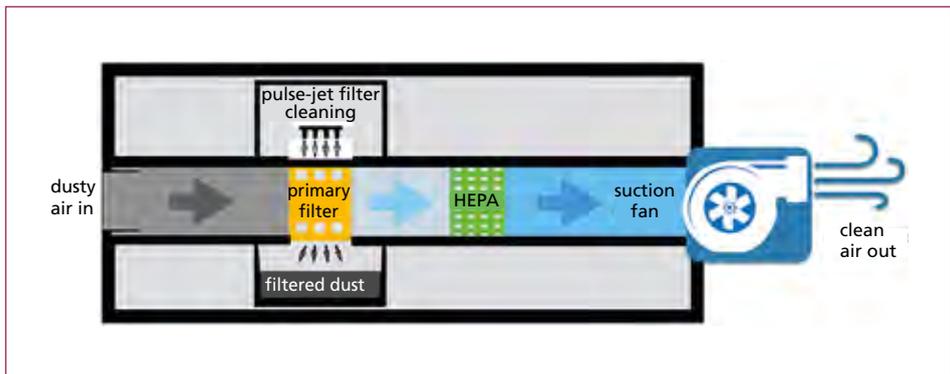


Figure 2: Schematic layout of a two-stage dust collector

The vast majority of dust collectors are designed for benign dust types (e.g. sand blasting operations associated with cleaning, painting and coating). Such standard dust collectors can be retrofitted with HEPA filters to meet requirements related to more hazardous dust types or recirculating into the work space. This can be done with all equipment, but it is misleading to consider such retrofitting to be fully in compliance with good design practice for HEPA filters. As an example, a 20,000 m³/hour dust collector retrofitted

with HEPA filters must be derated by a factor of two (1/2) because HEPA filters do not tolerate high flow rates normally specified for standard filters. Further, HEPA filters cannot be pulsed because the fiber lattice will be damaged and filtration standards will not be met. Consequently, filter life will be very short, as clogging of HEPA membranes occurs rapidly under normal dust loading conditions. The only true methodology to ensure filter life is, therefore, to use the HEPA filters (secondary filters) after primary filtration has occurred, where the bulk of the dust has been effectively removed from the incoming dirty air. Under such design, the primary filter can be pulsed safely and the HEPA filters will perform for longer periods.

A secondary filtration stage that is fully integrated into the dust collector design also significantly reduces the risk that collected dust if a leak develops in the dust collector's primary filtering system. This secondary filtration is a requirement in a recirculating dust collection system that recycles heated or cooled air back into the work area. Besides energy savings, recirculating air safely incorporating secondary filter protection also reduces regulatory paperwork by avoiding the time-consuming permitting involved when air is exhausted outside.

5. Cleaning of dust collectors, and the disposal of dust waste and contaminated filters

Once hazardous dust has been collected, significant risk can occur in three specific areas:

- (1) during the replacement and bagging of used filters;
- (2) as well as the removal and handling of the collected dust waste.
- (3) If the equipment is being used in project work, the cleaning of the internal surfaces of the machine prior to relocation.

Basic industrial dust collectors collect dust in hoppers at the bottom of the machine. From the hoppers the dust is usually channeled into drums. When a drum is full, the dust is thereby containerized for disposal. Unfortunately, however, the removal of the drum from the collector exposes the dust collected, and spillage from the connecting sleeve (rubber) cannot be avoided. Further, during the handling of the open drum, a significant risk is created because an accident or bad weather could release large quantities of highly concentrated dust cake onto a worker and into the surroundings. It is very common to see a highly contaminated work area around the base of a dust collector.

Dust collector designs often promote safe and easy filter change-out – filters positioned for ease of access, sliding in and out of the housing readily, and cam-lock style devices to make access easier and service simpler (Figure 3). However, easy access and simple filter removal does not address the most dangerous aspect of dust collector servicing – the reality that contaminated filters come into contact with the servicing people. Put bluntly – a contaminated filter should never be handled by hand. Where highly toxic dust is being handled, for example in many pharmaceutical processing applications,

a bag-in/bag-out (BIBO) containment system is used to isolate workers from used filters during change-out, but even such systems require skill and advanced training to ensure safety.



Figure 3: A contaminated filter being removed from an industrial dust collector, illustrating potential risks associated (red arrows indicate transferred contamination typically encountered)

Therefore, despite work training and specialized procedures, the containerizing of dust and the removal of filter elements from a dust collector at the work site is always hazardous and poses high spillage and worker health risk. The dust that escapes during these processes can be dispersed by the wind, can be distributed by shoes and clothing, or washed by rain into sewer drains and, over time, be absorbed into the ground. Exposure beyond the work area is inevitable and creates both public risk along with a large future financial risk.

Although not much has changed in dust collector design in fifty years, the most recent technology development, a system called SmartBox (Figure 4), can considerably reduce risks related to handling dust

waste (Figure 5). The unique design effectively ensures that the collected hazardous dust does not pose a threat to service personnel or the environment because the dust, along with used filters, are fully contained in the box. When disposal is needed, the entire box is removed and the waste is never seen or touched. At all times, used filters and the dust remain in the box and are safely discarded as part of the hazardous waste disposal process.



Figure 4:

A SmartBox being removed from a BlueSky Mobile dust collector

Since correctly sealed boxes are protective sealed enclosures, the transportation vehicles will not need to be specially decontaminated, and the clothing worn by the servicing crew will not need to be included in the disposal process. The boxes are therefore treated and disposed of in accordance with appropriate disposal guidelines of the material composition being handled.



Figure 5: Dust collector with SmartBox technology (left) versus traditional dust collector (right)

6. Explosion risk

Dust collectors used in applications where dust explosions can be anticipated, have integrated explosion-venting release panels, or internal suppression systems. When a dust collector is equipped with an explosion venting or a suppression system, a thicker gauge metal, with a higher-pressure rating for the primary containment, is required to control the effects and dangers of a combustible dust explosion.

Further, the location of a dust collector, and the orientation of the machine considering the explosion panels, all play a significant role in the possible injuries that can result from an explosion.

7. Conclusion

The use of dust collectors as pressure differential units, and fine dust contamination filtering devices have been employed for many years. The use of such machines, especially when used to process hazardous dust species, therefore, makes risk management imperative. However, effective risk management faces many obstacles, including lack of knowledge, equipment availability, poor work practices, and poor enforcement of existing requirements. In all cases, bad work practices may lead to situations that pose

serious health risks and environmental exposure threats. Norms generally require that state-of-the-art methods be used, but through willful or negligent actions, many hazardous-work environments are not safe and within legal compliance. This paper has highlighted some of the areas that may be of concern, namely the use of secondary HEPA filtration, the handling and disposal of contaminated filters, and the post project cleaning of equipment.

Again, it is very important, from a risk management perspective, to recognize that ultra-fine particles inhaled or touched (dermatological absorption) during dust collector servicing, or later contact from a contaminated environment, are highly carcinogenic and may cause upper respiratory disease. Over time, breathed-in workplace airborne particles can cause cancer and emphysema, irrespective of the particle composition (i.e. dust does not have to be a toxic substance or a known carcinogen to create substantial risk.) Handling any open contaminated items should, therefore, be avoided as part of a dust collector risk management plan.

8. Sources

- [1] International Standardization Organization (ISO 4225 - ISO, 1994): Dust: small solid particles, conventionally taken as those particles below 75 μm in diameter, which settle out under their own weight, but which may remain suspended for some time
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