FEATURE

The Threat of Airborne Contaminants in Manufacturing Facilities

What you can do to protect your employees, your equipment… and your profits.

Of all the factors that can effect the operations of a manufacturing facility, most managers, other than those involved in certain applications, would seldom consider the air in the plant to be of much consequence, especially if the air quality seems to be acceptable. However, the air quality in your facility may be much worse than you think and the consequences can impact the health of employees, productivity and the profitability of your operation. In this article we outline how common airborne contaminants can severely affect a manufacturing plant. We also look at methods of air filtration and where they should be used.

The Effects of Airborne Contaminants on Employees and Equipment

Air Quality and Employees

Poor indoor air quality can degrade working conditions, and poor working conditions lead to lower worker productivity. Poor air quality also causes respiratory problems and increased absenteeism. Evidence from studies suggest that up to half of the cases of upper respiratory disease in the workplace may be associated with the work environment itself. One report published by the U.S. National Center for Health Statistics reports that over 50% of absenteeism is caused by upper respiratory infections.

Airborne Contaminants and Equipment

The air inside most manufacturing and fabrication facilities is contaminated with weld-fumes, smoke, dust, dirt and oil mists. These contaminants coat work surfaces and equipment, damaging electronic controls, servo motors, optics, the DC and CNC drives of grinding machines, lasers, robotics and other equipment. Part quality can be affected by airborne contaminants if the dirty air interferes with laser optics and spray-booth operations. The result can be high part rejection, frequent re-working and lower part yield.

The Costs of Airborne Contaminants

HVAC Equipment

In a typical manufacturing plant the single biggest energy expense is often the heating and cooling of the facility. The dust and oil in the air may be too much for the equipment's built-in filters to deal with. As a result, coils can become coated with dirt, dust and oils, reducing their heat transfer efficiency. Keeping air filters clean can reduce energy use by up to 20%.

Make-Up Air

One of the primary advantages of using air filtration systems in manufacturing is the collection, filtration and recirculation of air, rather than ducting air to the outside. This reduces the cost of heating or cooling make-up air.

Furthermore, exhaust air from a manufacturing facility often contains oil mists. These oils settle on roofs and can contaminate aquifers. Contamination such is this is coming under increased government scrutiny and legislation.

Facility Maintenance

Facility maintenance is another area where savings can be substantial. For example, without proper filtration, dirt and dust can build up and be introduced into the air in high concentrations by employee activity. Oil mists coat walls and lighting fixtures, reducing light levels and increasing lighting costs because more lights are needed, and bulbs coated with dust and oil will fail prematurely.

Fire Hazards

Machining operations occasionally result in flash fires or even explosions caused by sparks in the presence of oil mists. A filtration system that removes combustible materials will reduce the risk. Reducing combustibles can reduce insurance premiums for fire and general liability. It is common for metalworking organizations to be rewarded with savings of 5% to 7% annually.

Insurance Costs

Healthcare costs is a growing issue. In addition to annual costs for health care insurance premiums, consideration should also be given to long-term liability costs associated with contaminated air.

Worker compensation costs are also affected by the hazards of slippery surfaces due to oil mists. If oil covers a factory floor, it represents a high potential for falls that can impact healthcare and liability insurance premiums, and even lead to litigation. If airborne contaminants are reduced to achieve sufficient improvement in air quality, a manufacturer can expect to save 10% to 15% on general liability and health insurance premiums.

Clean Air and Filter Efficiency

What is "clean air"?

The term "clean air" is relative. Whether air can be said to be clean or not depends on the needs of the specific environment. For example, air that is adequately clean for an office environment would be much too dirty for an industrial clean room area.

The cleanliness of air also depends on how you measure the level of contaminants. Contamination by particulates can be measured in three ways: *particle count*, *particle area*, and *particle weight*. It is important to know what size of particles are of greatest concern. In a given volume of air, for example, the percentage of total weight from particles smaller than 1 micron may only be 30%, but that may make up over 99% of the total number of particles.

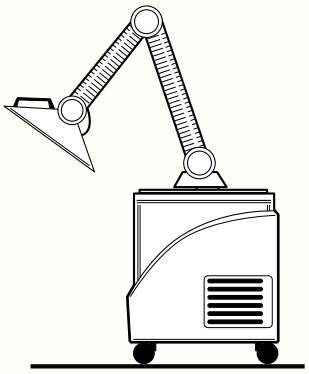
Filter Efficiency

The removal efficiency of an air filter can be measured in two different ways: *dust holding capacity* and *arrestance*.

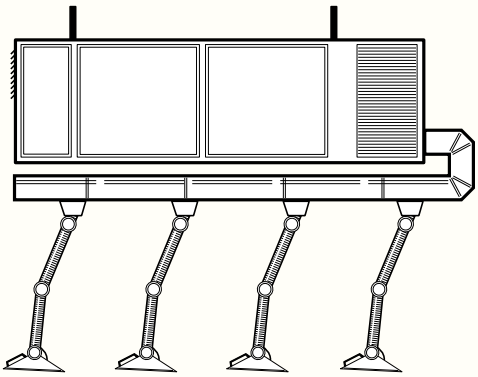
Dust holding capacity measures how much dirt by weight a filter can hold before it reaches a predetermined final resistance.

Arrestance measures the percentage of particulates that are captured as the particulates pass through the filter. For example, if 100 grams of particulate reach a

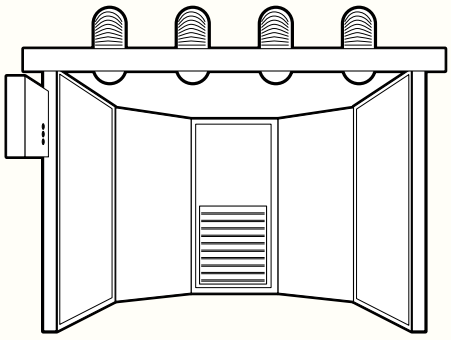
Today, a wide variety of air filtration options are available. Below are three of the most commonly used types of filtration systems.



Portable Filtration Systems with extractor arms are used for source capture of fumes, dust and gases at workers individual work stations. Another option is downdraft work tables, which have the capture vent built into the table.



Central Systems: In cases where many workers need filtration of the same substances, central filtration systems with ducted extractor arms are often used. Central systems are also used for ambient filtration of dust and other contaminants when source capture is not necessary.



Other more specialized applications include spray booths, and mist collectors.

filter and it captures 80 grams, the filter has an arrestance efficiency of 80%.

Arrestance efficiency also depends on the size of particulates being captured. A filter with a rated efficiency of 99% for capturing particles larger than 10 microns, may have a much lower efficiency at capturing particles smaller than 2.5 microns. Capturing particles that are 2.5 microns or smaller can be an important consideration because these size particles are "respirable particles", which means they are small enough to penetrate deep into the lungs.

Filters with seemingly comparable efficiencies may not be so comparable. For example, a HEPA (High Efficiency Particulate Arrestor) filter, which is 99.97% efficient at capturing particulates 0.3 microns in size, is more than 30 times more effective than a filter that is 99% efficient at 0.3 microns.

Filtration Methods and Maintenance Costs

Selecting the right air filtration system requires balancing many factors. No single type of air filtration system is best for all applications. Selection must be based on the type and quantity of contaminants in the air. The cost differences between types of air filtration comes down to maintenance costs – pay for labour to clean filters or pay for disposable filters.

Cartridge Filters

Cartridge filters provide an economical and easy-to-use solution for filtering dirt and weld fumes. Well-designed cartridge filters can provide efficiencies higher than 99%. Most cartridge filter systems use a blow-down process to clean the filters, where a pulse of compressed air is triggered by timer or by a worker.

Bag Filtration

Dust collectors using bag filters are economical to operate and easy to maintain, with up to 99% efficiency. Collected particles are removed by a shaking mechanism that dislodges particles from the media.

Electrostatic Precipitators

Electrostatic precipitators are effective at removing sticky or wet submicron contaminants such as oil smoke and welding fumes. Particles are ionized as they pass by charged wires and are attracted to charged metal plates. They are not very effective with large particulates. Although they are extremely efficient, they require more maintenance than other types of filters because the collector plates can load up relatively quickly, and once they are covered, they are rendered ineffective. Cleaning involves either wet-washing or by impacting, rapping or vibrating the filter.

Centrifugal Mist Collection

Centrifugal mist collectors remove coolant mist from machining operations, right at source. As air passes through the filter media, submicronic mist particles are retained until they grow to droplet size, then thrown free of the perforated rotating drum to the inner wall of the casing. High velocity drives the liquefied oil into a collection chamber. The clean, recycled oil is drained from the unit for re-use or recycling. Centrifugal mist collectors are equally effective for petroleum-based, synthetic, semi-synthetic or water-based coolants.

Gas Filters

Gas vapour filters contain either activated carbon, potassium permanganate, activated alumina, zeolites or combinations of these, depending on the types of gas being captured. The list of chemicals that may be in the air is indeed long. The different media are suited to capture different types of gases, and are able to adsorb different gases to varying degrees. Carbon filters can be refurbished with fresh carbon.

Modular Media Filtration

Modular media systems use a number of selected filter modules in one unit to provide solutions to many air contaminant problems. The units are customized with different types of filters to provide the optimum balance of filtration effectiveness and maintenance cycles in a specific environment. A typical system can incorporate pre-filters, some type of disposable or cleanable filter media, a HEPA filter, and a gas vapour filter.

Today we know much more about the health effects of airborne contaminants. Reflecting this growing knowledge are ever more stringent air quality regulations and greater awareness among employees. We also know more about the associated costs of poor air quality and how poor air quality can damage machinery and equipment, and increase facility maintenance costs. Given these factors, it is now more important than ever to consider the air quality at your facility.

Sources: Nederman, Inc., (www.nederman.com), Donaldson Company, Inc.(www.donaldson.com)