



Industrial Ventilation

Many industrial facilities have processes which produce hazardous dusts, mists, vapors or gases. Preventing occupational exposure to these substances often requires an exhaust system engineered to capture and convey the contaminants or products and clean the exhaust stream to recover valuable material or prevent air pollution. Some important items to consider when designing or specifying an industrial ventilation system are:

- OSHA and EPA Regulations
- Air Sampling
- Hazard Reduction
- Administrative Controls
- Efficient Hood Design
- Proper Duct Design
- Materials of Construction
- Proper Fan Selection
- Fire and Explosion Hazards
- Pollution Control Equipment Selection

FACTS:

The first step in an industrial ventilation project is to determine the nature and extent of the industrial hygiene or air pollution problem. This step has two important parts. Part one is an examination of the material inventory of a process and the nature of the process or equipment and is known as a Chemical/Physical Agent Inventory (CPAI). Part two involves air sampling of the workplace and/or the exhaust stack to determine the need to provide ventilation or air pollution controls and to establish a baseline from which to measure the effectiveness of any corrective action. □

The second step of the industrial ventilation process is hazardous source reduction or elimination. Sometimes, certain changes can be made to reduce or eliminate the need for ventilation or air pollution controls. This may involve substitution of a non-hazardous or less hazardous material in a par-

ticular application. Enclosing a process to prevent escape of a hazardous substance can reduce or eliminate exposure, reduce waste and eliminate an air pollution source. Modifying existing equipment or processes can also prevent the release or reduce the amount of hazardous material which is released from a process. Automating a process can help to reduce occupational exposures by removing the worker from a hazardous location. □

The third step is a procedure called *administrative controls* and involves the scheduling and rotation of personnel through a hazardous area or job. It is often accompanied by air sampling and in some cases, medical surveillance to assure that individual exposures to hazardous substances are limited and that OSHA exposure limits are not exceeded. □

The activities in the first three steps will often require the services of an industrial hygienist. The practice of

industrial hygiene is unregulated at this time, but the profession has a thorough certification procedure. Choosing a Certified Industrial Hygienist (CIH) will help assure that you will receive experienced, safe and professional service. □

If these first three steps have not eliminated the exposure or pollution problem then *engineering controls* must be employed. In the case of an existing plant or process, the specific problem already exists and the nature and extent of the problem will have already been determined. For new plants or processes, the same methods can be used to anticipate the need for an industrial ventilation system when the process is being designed. □

There are many components of an industrial ventilation system and all of them must function properly and simultaneously. The “front end” of the system or the *hoods* are often the most difficult to design. A hood must have the proper configuration, inlet velocity and location to capture

the contaminant efficiently. For more common applications there are some classical hood designs which have been tested and proven effective over many years of use. The design criteria for these hoods can be found in an industrial ventilation textbook. For unusual applications, an experienced ventilation engineer can design a hood based on sound theoretical principles. However, since the "real" world often deviates from theoretical assumptions, it may be necessary to experiment with different hood configurations to arrive at the most efficient design for a specific application. □

Once the contaminant has been captured, it must be conveyed to its ultimate destination. This requires a ductwork system designed to accomplish this efficiently, safely, and reliably. The duct sizing and configuration should allow the contaminant to be conveyed at a high enough velocity to prevent the settling of material in the duct while also avoiding excessive velocities and pressure drop. The duct and supports must be fabricated of material which is strong enough to support the pressure differential, its own weight, and the weight of any settled material in the duct. The usual method is to design for a duct half filled with the densest material being conveyed. The duct must also be able to withstand erosion caused by particulates and corrosion caused by chemicals. Carbon steels, stainless steels, plastics such as PVC, polyethylene, and composites such as fiberglass reinforced plastic (FRP) may be employed depending on your application. □

The fan is the heart of the exhaust system and must be of the proper type, with the proper wheel, and of the proper arrangement and size. The fan may require spark resistant construction or other special options. The materials of con-

struction must be compatible with the airstream, like the ductwork. Great care should be taken when selecting a fan for an industrial ventilation system. □

There are many types of air pollution control devices. The common ones are baghouses, electrostatic precipitators, packed spray towers, incinerators and cyclones. A relatively new technology which is becoming popular for eliminating VOC's and odors are *soil beds*. Soil beds, also known as biofilters, utilize the catalytic and microbiological properties of common soil to oxidize and digest both organic and inorganic pollutants. □

CAUTIONS:

The most common problem with industrial ventilation systems is poor hood design. The classic canopy type hood similar to what you might find in your house over your stove is by far the most commonly misapplied hood. The efficiency of these devices is extremely low and they should be used only rarely. The second most common problem is caused by adding exhaust ducts to an existing exhaust system. This usually results in reduction of performance throughout the entire system. □

Fire and explosion protection is important in industrial ventilation systems. Sprinklers or other fire suppression systems may be required in the ducts. Explosion venting may also be required. Most standard non-metallic ductwork has insulating and dielectric properties which can produce large static electric charges. To prevent arcing, these types of ductwork may require a metal grounding strip on the inside of the duct. In the case of FRP, carbon fibers may sometimes be added to the composite matrix to

make the ductwork electrically conductive so it can be grounded. □

A common omission when starting up an industrial ventilation system is the failure to evaluate the performance of the system and make any small adjustments required to bring the system to peak efficiency. □

DILEMMAS:

There are so many types of air cleaning and air pollution control equipment available that it may be difficult to choose between them. One must usually make a trade-off between capital cost, efficiency and operating costs. □

CONCLUSION:

As OSHA and EPA regulations continue to restrict occupational exposure levels and stack discharge concentrations of hazardous substances, and the cost of wasted products compared to the recovery cost increases, the need for effective, efficient industrial ventilation systems will continue to grow. Any system which draws enough air through it can be effective. However, as energy costs increase, the importance of efficiency will demand that more sophisticated approaches be taken in designing industrial ventilation systems. When interviewing an engineering firm to design an industrial ventilation system, ask them to explain their conceptual design process. Then select the firm who will evaluate your specific needs and investigate a range of alternatives to allow you to choose a solution which will meet both government regulations and your capital and operating budgets. □

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