WHITE PAPER

An Examination of Air Filtration in Today's Welding Plants

With employee health, plant safety and cleanliness becoming more of a priority for the robotic welding industry, the air filtration industry has grown quickly and developed a wide range of air filtration methods and products. With such rapid category growth, some misconceptions have become commonplace and decisions on how to filter air in a plant and what equipment to use to filter air in a plant have become challenging.

Selecting the right air filtration system is a process that involves closely evaluating your welding operation, the methods of air filtration and the air filtration products and systems available. Embracing this process can impact your bottom line as studies have shown that maintaining cleaner facilities leads to fewer accidents, lower employee turnover, lower health care costs and a positive impact on customers who visit the plant.

There are four basic methods of air filtration in use today. They are:

General Ventilation (Ambient Air Treatment or Exhaust) – Large exhaust fans draw contaminated air from the plant and exhaust it directly into the environment, typically through the roof or walls;

Ambient Filtration – Large blowers or air cleaning equipment draw contaminated air from the plant (typically at the ceiling level), filter it and return it to the plant;

Source Capture Exhaust – Air in the immediate area of the welding activity is captured in a hood, sent through ductwork, and exhausted directly into the environment. The intent of this system is to exhaust as little of the plant air as possible, while still capturing the welding fumes;

Source Capture Filtration - Air in the immediate area of the welding activity is captured in a hood system, then filtered and cleaned, and returned to the plant.

Each method has particular uses, benefits and drawbacks, which are examined here.

General ventilation (exhaust) systems are generally used in geographical areas where climate is temperate, heating and cooling costs are a minimal concern and contaminants in the plant's air do not violate EPA air quality standards and can safely be emitted into the environment. This method sucks climate-controlled air out of the plant, which greatly increases energy costs to keep the plant comfortable for employees in less temperate climates. With the lowest general equipment costs of any method of air filtration, investing in this method can sometimes offset the increased energy costs. Additionally, it requires no ductwork within the plant.

General ventilation systems are the least desirable option for air filtration in colder climates. Employees are exposed to weld fumes that are dispersed throughout the entire plant and eddy currents of slow-moving air are formed in corners of the plant, where structural obstacles restrict airflow and where weak air currents are generated by poorly placed or undersized fans. Buildup of dust and oil in the air often occurs and forms a haze in the plant.

The *ambient air filtration* method is very similar to the general ventilation system with one notable difference.

Contaminated air from the plant is collected in the same manner but is forced through a filtration media and returned to the plant. This eliminates much of the increased energy costs for climate control because climate-controlled air is kept inside the building.

Problems with employees being exposed to weld fumes that disperse throughout the plant and dust and oil buildup within the plant are still present. In addition, maintenance and cleaning costs increase as the filter media needs to be frequently replaced and the area around the intake must be cleaned often of oil and dust deposits that build up rapidly.

The initial equipment investment is slightly higher than the general ventilation system, but it is among the lowest priced systems. Energy costs to operate the system blowers and fans will be slightly higher due to pressure differentials created by the filtration media.

Source capture exhaust works by separating contaminated air generated in the welding area from ambient air in the plant using specially-designed intake hoods or a containment structure, like a hood or walled area. Captured contaminated air is then passed through a duct system and exhausted outside the plant into the environment. Hoods used in this system range from large hoods that are mounted above and cover the entire welding area to small hoods that are mounted inches from the welding activity.

This method is very effective at capturing contaminated air inside the plant and keeping air inside the plant clean. However, costs are high as climate-controlled air is exhausted out of the plant, raising energy costs, and an extensive network of ducts must be installed in the plant to carry contaminated air out of the plant. The ductwork generally is permanent making production line changes in the plant difficult and expensive as the ductwork must be rebuilt to accommodate layout changes.

This method is only appropriate when contaminants exhausted into the environment do not violate EPA environmental regulations. Additionally, hoods mounted close to the welding activity pose a high risk of fire started by sparks sucked into the hoods. Initial cost for the equipment is also higher than *general ventilation systems.*

Source capture with filtration incorporates filtration equipment into the process and is the most effective method of air filtration. In this process, contaminated air created in the welding process is separated from ambient air in the plant with hoods or containment structures, then passed through a filtration system and returned to the plant as clean, filtered air.

With this system, there is little or no impact on energy costs for climate control as climate-controlled air stays inside of the plant. The filtration units can be mounted near or above the welding station or welding cell, eliminating the need for extensive ductwork. Operational costs are low, the air quality inside the plant is outstanding and employee health risks are minimalized.

Initial investment for this equipment is higher than other systems, but long term energy savings and the payoff make the investment worthwhile.

Great Lakes Air Systems of Clawson, Michigan has developed the RoboVent® product line of *source capture* air filtration systems. The RoboVent is a completely self-contained air filtration system specifically designed for robotic welding. It has been engineered to efficiently capture and filter 100 percent of the contaminated air generated in the welding process.

The patented system includes all components including a specially-engineered hood and filtration unit. It has revolutionized air filtration for robotic welding and dramatically improved employee safety by eliminating air contaminants and successfully addressing the relatively few drawbacks inherent with *source capture* air filtration.

The FloorSaver model features a hood and filtration unit that are both attached to the top of the welding cell, requiring no floor space. The FloorMount model features a hood mounted over the welding cell and a collection unit that sits on the floor next to the welding cell. Contaminated air travels through a duct to the self-contained collection and filtering unit where it is cleaned and returned to the plant. Multiple hoods or robotic welding cells can be ducted to a single FloorMount collection unit, and in some cases the unit is installed outside the plant.

The unit's filtration process starts with the hood and a specially engineered spark arrester that prevents fires as it sucks air laden with smoke, welding dust and airborne particulate directly from the source in the welding cell. The hood's capture point for smoke and debris is in the back of the welding cell. This is the farthest point from where sparks are generated in the welding process. (Placing a filtration hood or smoke extraction gun close to the actual welding point is a sure way to start a fire.) To further prevent sparks from entering the filtration unit and causing a fire, a specially engineered baffle is built into the unit to prevent a direct shot of sparks from entering and the air inlet is sized to reduce air velocity enough to prevent spark intake. Finally, there is a series of baffle filters covering the entire intake to stop any spark that may make it to that point.

It is critical to stop sparks before they are sucked into the ducts or filtering system. The collected particulate and dust builds up on duct walls and this is what burns in a fire. Inline spark arrestors, as commonly used in source capture filtration for manual welding stations, are not effective at preventing fires.

The air travels into to a self-contained collection and filtering unit. The collection/filtration unit consists of a housing with a blower, motor, silencer, filter cartridges and a powerful compressed air pulsing system to automatically self-clean the filters.

Once inside the collection unit, the air is cleaned using a patented filtration process in which air flows in a downward path. This is unique to the RoboVent product and provides more efficient air cleaning. As the collection unit receives air from the hood, it immediately shifts the airflow 90 degrees downward, which causes separation and deposition of the larger, heavier smoke and welding dust particles, which reduces the load on the filter cartridges. The air then flows through the filter elements where the air is cleaned.

The down flow of air within the collection unit reduces air turbulence inside the collection unit housing and virtually eliminates re-entrainment, or re-blowing dust back onto the filters after the dust has been cleaned off of the filters. Re-entrainment is the primary cause of short filter life.

The collection unit uses vertical filters, which can be cleaned more effectively and and have a much longer filter life than the horizontal filters used in most air filtration units. Vertical filters allow collected dust and debris to shed off of the filter and fall directly down (with the direction of the airflow in the collection unit) into the containment or collection tray when the filters are pulsed by the filter cleaning system.

Great Lakes engineers believe that using horizontal filters is very inefficient because dirt and debris tends to get stuck on the top of a horizontal filter and fall off only the bottom two-thirds of a horizontal filter. This renders the top of the filter ineffective as it becomes clogged with debris and loses 30-40 percent of its filter area, and subsequently, causes a substantial reduction in filter life.

The vertical filters manufactured by Great Lakes and used in the collection unit are treated with a proprietary high-pressure pre-coat that extends filter life even more. The pre-coat fills the pores of the filter, which protects the filter from becoming clogged with too much oily particulate in its early stages of life. The result is the formation of a light "dust cake," which improves filtering efficiency, helps prevent debris from becoming embedded too deeply in the filter and allows debris to be easily cleaned off the filter by the pulsed cleaning system.

Additionally, the system is designed with a low air-to-cloth* ratio, meaning that air flows through the collection and filtration unit very slowly so dust and debris is laid on the filter media very gently and easily pulsed off the filter during the cleaning cycle.

A proprietary filter cleaning system is used to keep vertical filters clean and extend filter life. Each time the unit shuts down, the automatic cleaning system sends a strong pulse of compressed air to blow debris off of the vertical filters, keeping them clean. The debris falls downward (in the same direction as the downward airflow) into the collection tray, where it is later removed by maintenance personnel. The valves used to release the compressed air are four times the size of the industry standard, resulting in a cleaning pulse of air that is six times more powerful.

The RoboVent filtration systems offer a tremendous amount of flexibility, making reconfiguration of a plant for a new program quick and easy. Plants equipped with the FloorSaver unit can be reconfigured in hours. With no ductwork to disassemble and relocate, the robotic welding cell and the air filtration unit can be picked up together and easily moved without the aid of a subcontractor.

The FloorSaver unit also conserves valuable floor space within the plant. By mounting on top of each welding cell, it takes up no floor space whatsoever, leaving that space available for other revenue generating operations.

The FloorSaver and FloorMount systems can both be equipped with an automated on/off switch developed by Great Lakes engineers, which automatically cuts power to the unit during periods of welding inactivity. The on/off switch uses a power sensor to turn on the unit when it senses the welder is striking an arc. The switch will then automatically turn off the unit five minutes after it senses the last arc and the unit has had an opportunity to capture all weld smoke from the most recent welding cycle. The result is energy savings of up to 20 percent and extended filter life.

What it all means is that air filtration should be present in every welding plant today. There are options available with minimal (*general ventilation* exhaust systems) and maximum (*source capture* filtration) effectiveness. These systems help to improve employee health and safety, a big concern with rising healthcare costs. In addition, these systems help keep the plant clean and running smoothly and effectively. Select air filtration systems based on your needs and budget, factoring in short term and long-term costs of each system.

* The air-to-cloth ratio is a measurement of cubic air per moving per minute (CPM) to the square footage of the filter media. The higher the square footage of filter media, the slower air passes through the filters. The slower air moves through a filter, the longer the filter life, as dust does not become deeply embedded in the filter media.

1238 ANDERSON COURT CLAWSON, MICHIGAN 48017 248.655.1800 248.655.1801 FAX WWW.ROBOVENT.COM