Clearing The Air: The Importance Of Filter Replacement For Welding Fume Extraction Systems

The purpose of a filter in a welding fume extraction system is to capture and remove airborne particulates from the workplace environment. Mechanical filters incorporate a filtering medium made from microscopic fibers (fiberglass, cellulose, or polyester fibers, etc.) woven in sheets and typically pleated in a "V" pattern. The pleating of the material increases the surface area of the filter providing an increased capture surface. This white paper discusses several important factors about filter replacement for a welding fume extraction system.

What are the types of mechanical filters and what do I need to know about each?

There are three basic types of filters used in welding fume extraction systems. Each performs a specific function:

- **Pre-filter.** The purpose of a pre-filter is to capture larger particulates and remove them from the system so they do not reach the main filter. The pre-filter is typically made from aluminum or steel mesh, and may also act as a spark arrestor.
- **Main filter.** The main filter is designed to capture the majority of the particulates generated from welding and its allied processes. Mechanical filtration can also be used effectively for the grinding process.
- **After filter.** The purpose of the after filter is to filter out any remaining small particulates (approximately 0.1 to 0.3 microns). This is similar to the High-Efficiency Particulate Air (HEPA) filter on a vacuum cleaner.

Lincoln Electric weld fume control products utilize one or more of these filter types, depending on the model.

THE LINCOLN ELECTRIC COMPANY
22801 Saint Clair Avenue · Cleveland, OH · 44117 · U.S.A.
Phone: +1 216.481.8100 · www.lincolnelectric.com

When should you replace the filter?

Overtime, a filter may become saturated with particulate matter. Once this happens, the filter needs to be replaced. Certain indicators will signal the need for a filter change. Some are specific to your fume extraction system itself. Others are related to the welding materials you are using and/or the ambient conditions in the manufacturing environment. Here's what to look for and be aware of:

- The need for filter replacement is typically indicated by a gauge, an audible tone, an indicator or a combination of these depending on the features of the system. Always reference the instruction manual to find the indicator mechanism on your extraction unit. You may also notice a decrease in extraction capacity and possibly a reduction in extraction of welding fume if the filter has become oversaturated and is not changed.
- The rate of welding fume generation may vary based on the welding processes that are used in your operation and the particular welding settings selected. The choice of shielding gases, where applicable, can also influence fume generation. Stick and flux-cored welding tend to generate a higher volume of fume compared to MIG welding and TIG welding, which typically generate less particulate than the other processes. The welding process and settings used may impact the life expectancy of your filter and you should take them into account when you are setting up your replacement schedule.
- Another factor that will help you anticipate the need to replace your filter includes how many hours and shifts you system is operating. The more hours and shifts worked, the sooner the filter needs replaced.
- Changes in climate or the environment may warrant a filter check and replacement. When companies do extensive maintenance in the summer months, it's a good time to schedule a replacement of filters. In the fall and winter months, when windows and doors are closed due to cooler weather, it is a good reminder to make regular checks to ensure that the exhaust systems are functioning properly.

What filter should you use?

While the importance of replacing filters may seem obvious, it only works if you select the appropriate replacement filter for handling weld fumes.

First, ensure your replacement filters meets welding ventilation requirements established by OSHA and the EPA at the local, state and federal levels.

Second, confirm your replacement filter has the right MERV (Minimal Efficiency Reporting Value). The industrial air filtration industry offers numerous choices of filters – so determining the best option for your welding operation and overall work environment can be challenging.

Fortunately, there is the MERV industry-wide metric for ranking filter performance. The MERV is used to indicate the filter's particle removal efficiency (PRE) for a specific range of particle size. Rankings are made from MERV 1 to 16; the higher the number, the smaller the particle size and the higher the PRE. The details and method of measuring PRE are provided in ANSI/ASHARE Standard 52.2. Welding typically requires MERV 11, 15 or 16, but welding application and consumable type will dictate what filter MERV rating is required for your system so refer to the ANSI/ASHRAE Standard 52.2 "Understanding MERV" User Guide (November 2014) created by the National Air Filtration Association (NAFA®).

For example, if you have a stainless steel welding application, a filter with a higher MERV rating will generally be required because of the low OSHA PEL for hexavalent chromium. If you use a mild steel MIG process, a filter with a lower MERV rating can be sufficient. Once you have selected a filter, always check to be certain it is controlling worker exposure to constituents in the fume by having a qualified person measure exposure levels upon installation and periodically thereafter to ensure levels are within applicable OSHA, PEL and ACGIH TLV limits.

Third, a filter should be selected based on the volume, frequency and type of welding performed.

What are other indicators that can affect your fume extraction filter replacement strategy?

As particles are trapped in the filter, the medium becomes more densely clogged, or opaque, and the ventilation system motor and fan are forced to work harder to maintain optimal air flow. Eventually, the resistance of the filter reduces the air flow to an unacceptable level and the filter has to be replaced. Monitoring the static pressure across the filter is a good indicator of the tradeoff between desired flow rate and filter efficiency. Most filter replacement indicators use this method. If there is not a clear indicator on the system you are using for filter replacement – such as a light and/or audible tone, as mentioned previously – you can estimate a regular maintenance/replacement strategy based on your welding process and arc time.

Filters have a specific surface life. Filter life is determined by (1) how long it takes the fine particles to penetrate into the filter weave and form a cake, and (2) the type of material (i.e., oily versus dry) penetrating the filter medium. Some filters are designed to be removed and properly disposed of when saturated, while others are designed to be reused if the system is equipped with a self-cleaning mechanism. In these systems, the filters are cleaned with blasts of compressed air directed through the filter. Typically these filters have a significant extended filter life because the cake on the outside of the filter is removed.

Of course, fume extraction filters – like any replacement parts – add certain costs to your operation. For as much as you might be tempted to cut costs, filter replacement isn't a good place to do it. Not all replacement filters are alike – even if they are specifically designed to fit your system. Opting for a generic replacement filter over an OEM filter may impact the performance of your fume collection system, especially over the long term. OEM or genuine filters are made by the manufacturer of the equipment and will fit, seal and operate properly. Third party filter replacements are similar to the original filter, but may not be made according to the same specifications and design criteria as the OEM. In addition, if the OEM makes design adjustments to the equipment, the third party filter supplier could be making filters according to old standards. Generic replacement filters may be the less expensive option at the time of purchase, but they are likely to result in a waste of time, productivity and money over the long term.

Why should you create a filter replacement and preventive maintenance strategy?

Preventive maintenance is planned maintenance activity designed to ensure consistent and effective operation, improve equipment life and avoid system malfunction. The purpose of any fume control system is to help control worker exposure to welding fume. If not maintained properly, the system may not adequately control that exposure.

Preventive maintenance ensures that the equipment is consistently efficient and effective, and that long-term use does not subject the equipment to stresses or potential failures caused by improper care or handling. For instance, if the filter is clogged, the fan motor must operate at a higher level to try to operate effectively. This can result in reduced fume capture efficiency, motor failures or other associated issues.

A successful preventive maintenance strategy includes changing the filter on a regular basis. In addition, equipment operation and cleaning should be scheduled and coordinated to ensure that ducting is clean, fume extraction arms are tuned properly and more. Certain tasks must be scheduled at varying service intervals in order to keep the fume extraction equipment from experiencing any unexpected breakdowns. Preventive maintenance for industrial equipment is an effective way to maintain and extend weld fume control equipment operation and life.

When establishing a filter replacement and preventive maintenance strategy, keep the following suggestions in mind:

- Use Lincoln Electric genuine filters rather than a generic replacement filter. Lincoln Electric cannot warrant or ensure proper operation of the unit if a generic filter replacement is used. This can affect the operation of the system.
- Know the regulations, requirements and restrictions that apply to the filter's disposal. It may be necessary to have the material tested in order to understand if the waste material is regulated. Environmental regulations regarding waste disposal can vary, depending on federal and local requirements.
- Make sure to have a consistent schedule for procuring and installing spare parts and conducting regular service.
- Allow for regular system checks of the cleaning program within the programmable logic controller (PLC) and the differential pressure monitoring system.
- Ensure that employees are not overexposed to airborne dust and contaminants during filter maintenance activities. Take any proactive measures necessary to protect against overexposures such as using protective equipment, disposable coveralls and/or respiratory protection.

What factors affect filter disposal?

Proper protocol should be followed when disposing of a used filter. Depending on what elements have built up on the filter, you may have to treat it as a hazardous material. It's important to understand the correct method for disposal as this can have an effect on the overall cost of operation. Answer these questions when determining proper fume exhaust filter disposal for your welding application.

- What is your company's or facility's hazardous waste generator status?
- Do you have sufficient generator knowledge to "profile" the waste stream?
- Do you need to perform testing to determine what the hazardous waste codes are?
- Do you know the federal, state, and local regulations related to disposal?

If your team is not experienced with these issues, contact a qualified local environmental consultant or your state environmental regulatory agency (EPA) for guidance on the requirements of your state's environmental rules.

Factors that could adversely affect filter life

In addition to the usual factors that degrade filter effectiveness over time, there are additional factors that can actually shorten filter life:

- Contaminants can enter the compressed air system, which in turn make their way into the fume control system. Keep your compressed air system as clean, dry and oil-free as possible.
- Additives to the base metal. Be aware of any oily process or coatings (such as anti-spatter agents, rust preventatives, etc.) that have been applied to the base metal. These have a high probability of vaporizing and entering your fume control system.

Conclusion

Fume control is an integral part of any welding operation, and proper filtering is critical to an effective fume control system. Safe execution of filter replacement and proper fume exhaust system maintenance can help ensure employees are not overexposed to airborne particulates. This will result in a cleaner, safer, more efficient and more productive manufacturing operation.

The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.