

Research Article

Concept of Fume Extractor for Welding Station

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Abstract

Welding is a major metal joining process used in industry. Despite of various advantages of welding there are hazardous effect to human health due to welding fumes. Welding fumes consist of metal oxide particles and various gasses like carbon monoxide (CO), carbon dioxide(CO₂), nitrogen oxides(NO_x) and ozone. These particles are directly inhaled by operator which causes various health problems. So there is need of a device which extracts particles from welding fumes. Fume extractor removes these particles from welding fumes by using activated carbon filter and expanded Polytetrafluoroethylene (ePTFE) filter. As particles up to 0.5 micron are extracted, it results into clean and healthy surroundings.

Keywords: Welding fumes, Activated carbon filter, ePTFE filter.

1. Introduction

Welding is a major metal joining process used in industries. As welding gives leak proof joints with good strength it is used in all types of metallic constructions. In this sector presently about 3 million persons are directly subjected to welding fumes and gas action. Welding fumes are very small particles that are formed due to condensation of vaporized metal. Welding fumes contains the metal oxide particles and gasses such as CO, CO₂, NO_x, and ozone. These gasses get mixed with air and inhaled by the operator. This can cause many health problems. So there was need to manufacture a device that extracts hazardous particles from welding fumes.

Fume extractor is used to remove the particles from welding fumes. The fume extractor available in market are too expensive for small scale industries. So a fume extractor with reasonable cost was necessary.

The basic components of fume extractor are suction hood, flexible pipe, activated carbon filter, ePTFE filter, blower, motor, silencer and pressure switch.

The flow of operation takes place as follows:

- Suction is created by blower
- Removal of gasses by activated carbon filter
- Removal of particles by ePTFE filter
- pressure switch to indicate the pressure drop across the filter

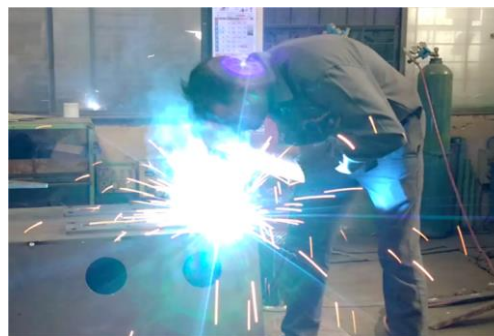


Figure 1 Welding fumes generating during welding

2. Hazardous effect of welding fumes

Various contents in welding fumes can cause the severe health effects as follows:

Table 1 Hazardous effects of gasses in welding fumes

Type of gas	Effects
Carbon Monoxide(CO)	Readily absorbed in the blood stream. Unconsciousness and may cause death at high concentration.
Nitrogen Oxide (NO)	High concentration lead to abnormal fluid in the lung. Low concentration lead to irritation of eyes, nose and throat.
Ozone	Concentration up to 1ppm causes dryness of eyes and headaches.

3. Components: Various components of a fume extraction system, their uses and selection parameters are as follows:

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Suction hood: Welding fumes are taken in by means of suction pressure by the circular diverging cross section component called suction hood. It is directly connected to the suction pipe.

Flexible pipe: This is a pipe of 3 meter in length and 75 mm diameter which carries fumes from welding station to main body of fume extractor. As the temperature of welding fumes is around 40°C PVC can be used as the material for flexible pipe.



Figure 2 Suction hood and Flexible pipe

Activated carbon filter: Fume are first pass through the activated carbon filter which removes gasses from welding fumes by adsorption process. Activated carbon is defined as carbonaceous material with large internal surface area and it has highly porous structure. It is composed of 87% to 97% carbon. Its porous structure allows it to absorb materials from gas phase.

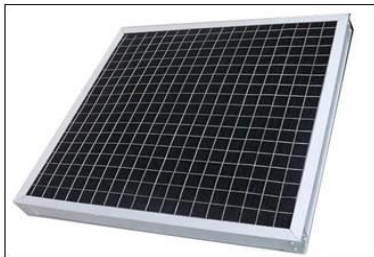


Figure 3 Activated carbon filter

ePTFE filter: Expanded polytetrafluoroethylene filter is a cartridge filter with efficiency of 99.97%. This filter can trap the particles having size up to 0.5 micron. this filter needs frequent cleaning as it get blocked by entrapped fume particles.



Figure 4 ePTFE filter

Blower and motor: Blower creates the suction pressure and maintains required flow rate with the help of motor.

Pressure switch: Pressure switch is used to measure pressure across the filter. When pressure drop decreases beyond certain value (which we can set) gives indication on control panel which indicates the cleaning of ePTFE filter.

Control panel: Control panel consists of switches and indicators for following purpose:

- 1) ON\OFF switch
- 2) power supply indicator
- 3) pressure switch and it's indicator
- 4) motor reverse direction indicator

4. Equations

- $Q=A*V$

where, Q=Discharge

A=Area

V=Velocity

- $P=Q*(\Delta P)/\eta$

where, P=capacity of motor

ΔP =Required pressure drop

η =Efficiency of fan

5. Results and discussion

Size of particles greater than 0.5 micron gets trapped by the ePTFE filter. Due to this harmful gases are avoided to get mixed with the working surrounding and provides clean environment for working and reduce the health risks.

Conclusion

As harmful gases and particles are removed from welding fumes clean environment is maintained in workspace. Health hazards are reduced.

References

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