

Welding Fume Problems

Ed Sithes

Oskar – Avani Environmental, Inc.

Introduction

- Oskar – Avani Environmental, Inc. is a leading manufacturer of air pollution control equipment for industry and vocational facilities.
- Oskar – Avani holds five patents in the welding fume collection industry.
- Headquarters located in Youngsville, NC servicing North America and Taiwan servicing Asia and Europe.



References/Sources

- ACGIH - American Conference of Governmental Industrial Hygienists (Threshold Limit Values TRV)
- OSHA – Occupational Safety and Health Administration (Permissible Exposure Limits – PEL)
- NIOSH – National Institution of Occupational Safety and Health (Recommended Exposure Limits – REL)

Specialty Steel Industry of North America

AWS

The Fabricator

Related Health Issues

Partial lists of risks associated with exposure include:

- Occupational asthma
 - Lung cancer
 - Bronchitis
 - Pulmonary edema
 - Pneumonia
 - Emphysema
 - Siderosis
 - Parkinson's disease
-
- Some of the trigger topic today are Magnesium Oxide (fume fever)
 - Manganese – Mn (nervous system)
 - Hexavalent Chromium (lung cancer, nose, throat and lungs)

It is important to note that the hazards will depend on the type of welding, the materials (base metals, surface coatings, & electrodes) to be welded, and the environmental conditions (whether it is outside or in a confined space.

Welding fumes consist of particulate solids and gases generated by the base metal, electrode, various fluxes and shielding gases. Metal oxides generated by the condensation of melted metal is what creates what we see as the visible plume or ultra-fine particulate what we call "weld fume"

Hexavalent Chromium

Hexavalent chromium is a toxic form of the element chromium..

- Man-Made and widely used in many different industries
- Stainless steel welding or nonferrous chromium alloys
- Work place exposure include but not limited to: lung cancer, irritation or damage to the nose, throat, and respiratory tract, damage to the eyes and skin.
- OSHA standard is based on a eight-hour time-weighted average of 5 micrograms or less per cubic meter of air (this equates to 0.005 milligrams per cubic meter)
- Recommend monitoring at least every 6 months
- Provide employee with protective clothing
- Provide respiratory protection as required (ventilation)



Particles and Particle Sizes

- Particles generated from welding, cutting, and grinding range from submicron to over 10 micron and larger.
- The “respirable fraction” represents 0.1 micron to 10 micron where they enter the larynx and penetrate into the bronchial regions of the lung.
- Normally there is minimal lung retention of particles in this size range.
- However, thermal effects can cause agglomeration forming particle chains and clusters larger than 1 micron which remains in the human respiratory tract.

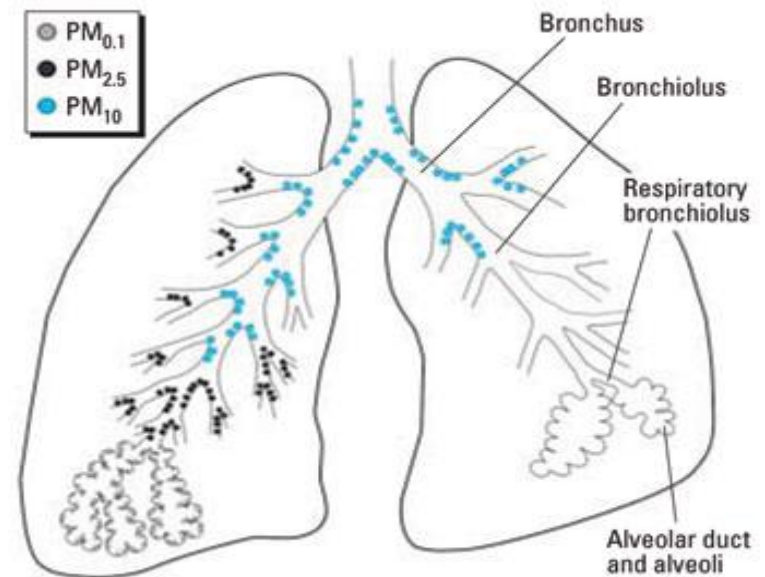


Figure 3. Distribution of PM in the airways. $PM \geq 10 \mu m$ in diameter enter the nose and mouth. The thoracic fraction, PM_{10} , passes the larynx and penetrates the trachea and bronchial regions of the lung, distributing mainly at pulmonary bifurcations. The respirable fraction, $PM_{2.5}$, and ultrafine PM, $PM_{0.1}$, enter the nonciliated alveolar regions and deposit deep within the lungs.

Welding Fume Generation

- Arc welding, resistance welding and gas welding are the largest fume generation.
- Fume generation by arc welding process is function of the particular process, size and type of electrode, amperage and operator experience.
- Most of the fume is generated from melted electrode. The electrode and flux melt at the tip. This causes displacement under the force of the plasma gas stream, leave the area and condense into fume or “the plume”
- Naturally, the higher amperage and larger electrodes create a larger quantity of fume.
- Rust inhibitors and metal coating can increase fume generation and create oily smoke.
- Plasma arc cutting and arc gouging produce high fume concentrations.
- ***Welding wire consumption can often determine the rate of fume generation***; i.e.; the amount of wire in lbs, consumed, multiplied by 1-3% equate to lbs. of fume dust or dirt from the process.

Popular Fume Control Methods

- General ventilation with rooftop or wall exhaust fans
- Portable weld fume collectors
- Downdraft tables
- Exhaust systems with canopy hoods
- Environmental booths
- Swing arms with extension booms
- Welding booths
- MIG smoke guns or vacuum assisted systems
- Portable fans



Equipment/Control Methods



Welding Fume Control

Fume Controls are not only to protect the welder, but all others in the vicinity and the facility from the byproducts of the welding process.

Source capture is always the best choice where possible...

“You must capture the weld fume prior to it entering the breathing zone of the welder to comply with PEL regulations”.



Types of Filtration

Filtration System Options

- ESP or Electrostatic precipitators remove sub-micron particles however require frequent cleaning and will short out or carry over an electrostatic charge of remaining particles (staining facility & equipment).
- Media or ASHRAE/MERV systems remove larger particulate and require HEPA or DOP filters for sub-micron particulate collection requiring frequent filter changes.
- Cartridge filters remove sub-micron particulate and often employ self-cleaning systems with compressed air to ensure longer filter life. Often filters will last 1-2 years prior to replacement.
- Fabric bag collectors are often employed on higher sub-micron fume concentration applications such as; plasma cutting, laser cutting, arc gouging, and abrasive blasting operations.

Collection Systems Installations



Problematic Applications

Why some collectors are not performing as expected...

- Misapplication of systems to meet applications
- Low airflow for application
- High currents in the area ventilated from man-cooling fans
- Lack of regular scheduled maintenance; i.e.; clogged filters and reduced airflow
- High filter costs
- Negative air pressure in building
- Poor installation & ductwork
- Operators not using equipment due to interference with process (overhead cranes, gantries, etc.)
- Sound levels are too high for work area or installation (loud fan/blower)
- Lack of operator/owner training of equipment and usage
- Large and bulky equipment
- Fires

Considerations for Selecting Fume Control Equipment

- Application requirements may dictate portable units, swing arms, hoods, and or custom enclosures
- Exhaust or filtration due to the following; facility air conditioning requirements, air contaminant hazardous or non-hazardous, and or local exhaust codes (EPA or other organizations)
- Operator usage determine if the device is friendly to operator and process
- Electrical and utility requirements
- Floor space or installation space of equipment
- Multiple units vs. centralized units
- Noise level of fan or system blower
- Compliance guarantee from manufacturer
- Evaluation of demo or performance trial of equipment
- Vendor knowledge or expertise of equipment and your application

Reducing Insurance Costs & Claims

- Reduced medical claims, sick days, and insurance costs
- Reduced eye injuries
- Increased employee morale
- Improved plant and or shipyard air quality
- Reduce workers compensation insurance



Summary & Closing

- Promote safety and proper usage of equipment to operators to ensure the health and wellbeing of the shipyard welder
- Reduce exposure to welding fumes with ventilation equipment
- Minimize liabilities with regulatory agencies and insurance companies
- *Thank you for your time!*

