e-Weldone
www.adorwelding.com
December 2013
Vol. 49
Technical Newsletter from
ADOR WELDING LIMITED
Formerly Advani - Oerlikon Ltd.

SAFETY AT THE WORK PLACE

Part 3: Chemical Hazards

Preamble:

In the earlier 2 articles we discussed hazards at the work place due to electrical and magnetic forces as well physical hazards encountered during welding and cutting operations. In this third and concluding article, we will discuss the chemical hazards prevalent during welding and cutting operation and some steps to minimize/ eliminate the hazards

Introduction:

Welders may be exposed to numerous chemical hazards like welding fumes, fuel gases, inert gases, gas mixtures and solvents etc. which are associated with welding and cutting processes.
Many hazards are fairly easy to recognize and to be aware of, but others, particularly some of the chemical hazards, are not easily noticeable. For example, most gases, including Air (Oxygen and Nitrogen), are colorless and have no smell, and so a tank full of inert gas, also colorless and odorless, would seem no different to a tank filled with normal Air. However, someone entering the tank full of inert gas would probably be killed by asphyxiation. This Safety article provides basic information to help you to identify the hazards and reduce the health risks associated with chemical hazards like (i) welding gases and fumes (ii) fuel gases , (iii)inert gases, gas mixtures and compressed gases and (iv) solvents.

(1) Hazards due to Welding and Cutting Fumes:

All welding processes generate welding fume but some produce very little fume while others produce considerable amounts. Welding fume consists of particulate fume, the cloud of smoke you can see rising and gaseous fume that you cannot see but can sometimes smell. In most cases, welding fume is formed close to the arc, near the welder, but some of the gaseous fume (ozone) can be generated well away from the arc. The potential effect on the body of exposure to welding or cutting fume depends mainly on the amount of fume produced, what is in it and how long the worker is exposed to the fume. While all components of welding or cutting fume may present a risk to health, some present a greater hazard like those pollutants which include ozone, chromium (particularly in its hexavalent state- Cr6+), nickel (potential carcinogens),cadmium and lead. The health effects of exposure to fume can include irritation of the upper respiratory tract (nose and throat), tightness in the chest, wheezing, metal fume fever, lung damage, bronchitis, pneumonia or emphysema. The biggest onâ€™s welder's risk is exposure to the manganese contained in fumes that are given off during welding. Inhaling manganese can cause very serious damage to brain and nervous system. Many welders who are exposed to welding fumes suffer from Parkinsonâ€™s disease, a major disorder affecting movement and balance. They often develop â€œmanganismâ€ a disease closely related to Parkinsonâ€™s that also makes it difficult to walk and move properly. Particulate welding fume is usually fairly easy to see, but gaseous fume is invisible. Sampling and analysis is the only way to detect what is in the fume and how much is in the welderâ€™s breathing zone. Therefore, the precise hazard of exposure to welding fume is not usually apparent.

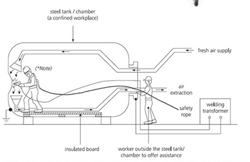
Identifying the risk of Fume hazards:

- Welding processes like FCAW, MCAW, MMA, GOUGING, MIG welding and plasma cutting that produce high volumes of particulate fume give greater risk of inhalation of fume where as TIG, SAW and oxy-fuel gas welding and cutting tend to give low fume levels and so present lower risk of fume inhalation.
- MIG (in Argon-rich gas) and TIG at high currents can give high volumes of ozone and Plasma cutting can give high volumes of Nitrogen Oxides and so present a high risk of inhalation.
- Consumables that generate fume containing chromium, nickel, zinc, manganese, barium or fluorides give a potentially higher risk of health damage. Before usage of the consumable it is advice to check out the consumable data sheets which give guidance on fume composition and constituents.
- It is better to work in open area than confined space. Welding in a confined space can greatly increase the risk of inhalation.

Control Measures for Fume Hazard:

Control measures should be aimed at keeping the particulate and gaseous fume levels as low as possible. Methods that can be used include:

- Ensuring adequate ventilation and/or providing local fume extraction.
- Wherever extraction and ventilation is not sufficient to reduce fume levels to those required, the use of personal respiratory protective equipment such as respirators, air-fed helmets, welding hoods, etc., should be considered.
- Train the welder to use to use good posture to keep his or her head out of the fume plume.



Above Figure shows the typical arrangement for manual electric arc welding operation in a conductive confined space.

(2) Hazards due to Fuel Gases:

Hydrogen, Acetylene, Propane, Propylene and Methylacetylene- Propadiene (MAPD) are all fuel gases. Fuel gases are flammable (obviously) and they also form explosive mixtures with Air or Oxygen, with the amounts needed differing for each gas. Acetylene also forms explosive compounds with copper, silver and mercury. Hydrogen and Acetylene are lighter than Air and will tend to accumulate at the top of a confined space, whereas Propane, Propylene and MAPD are heavier than Air and will tend to accumulate in low-lying areas, presenting a potential explosion hazard. Acetylene, Propane, Propylene and MAPD gases each have a distinctive smell and so are readily detected. Hydrogen gas is odorless and when ignited has a virtually invisible flame, and is therefore difficult to detect and presents a serious explosion, fire or burn hazard. When using oxy-fuel gas processes, a flashback, due to Oxygen and fuel gas mixing in the fuel gas supply line and igniting, can be very hazardous. In a flashback, the flame and associated pressure wave travel extremely fast towards the fuel gas cylinder and can result in the cylinder exploding.
Though Oxygen is vital to life, there are certain hazards associated while working with Oxygen which are as follows:
â€¢ **Oxygen is NOT compressed Air** â€“ Do NOT use it as compressed Air. Oxygen is not flammable, but even materials that do not burn in Air usually burn in Oxygen and can ignite easily and burn violently in an Oxygen-enriched atmosphere.
â€¢ **Never use Oxygen to ventilate confined spaces** â€“ Use Air to replace atmospheric Oxygen consumed by welding or cutting.
â€¢ **Oxygen-saturated clothes** â€“ It is dangerous to clean clothing with an Oxygen stream or hang clothing on Oxygen cylinders. Clothing saturated with Oxygen will burn intensely when ignited.
â€¢ **Grease, oil and oil-bearing materials** â€“ Greasy gloves and rags, and other combustibles that can
readily ignite in the presence of Oxygen, must be kept away from any Oxygen equipment.
â€¢ **Never use Oxygen** as a substitute for Air in air driven tools, in oil preheating burners, to start an internal combustion engine, to blow out pipelines, or to build pressure (as in a container).
â€¢ **Cylinder storage** â€“ Keep Oxygen cylinders at least 20 feet from fuel gas cylinders or other readily combustible materials
â€¢ **When liquid Oxygen** is used, cylinders must be transported, stored and used in an upright position, to maintain the gaseous state for safety devices and to prevent liquid from reaching the regulator.

Identifying the hazards due to Fuel gases:

- When using fuel gases with Oxygen for welding or cutting, there is always a risk of a flashback. If correct lighting up and shutting down procedures are used, this reduces the risk.
- Working without a flashback arrestor for Oxy fuel gas lines is dangerous and causing a serious fire or explosion incident.
- Using sub-standard welding and cutting equipment or equipment in a poor state of repair increases the risk of a flashback or other fire hazard.
- Acetylene cylinders laid horizontally give a high risk of leaking and Acetylene lines connected using copper pipes or fittings will lead to fire or explosion.
- Fuel gases, used in confined spaces, give a high risk of gas collecting in pockets with a high risk of fire or explosion.
- Looking for leaks with naked flames gives a very high risk of fire or explosion when the gas ignites.

Control Measures for Fuel gases Hazards:

- Fitting of good quality flashback arrestors, hose check valves and regulators are the main control measures used when using fuel gases.
- Use of additional protective and air-monitoring equipment are control measures used when working with fuel gases in a confined space.
- Correct storage, transportation and use of fuel gases, use of appropriate materials to join fuel lines and adoption of correct leak detection techniques will reduce accidents with fuel gases.

(3) Hazards with Inert Gases, Gas Mixtures and Compressed Gases:

Shielding gases used in arc welding and cutting are either inert gases like Argon and Helium or active gases like Carbon dioxide. None of these gases will support life and may present asphyxiation hazards when used in a confined space or where ventilation is extremely poor and a concentration of gas can occur. Compressed gases in cylinders are stored at pressures of up to 300 bar. For safe use, this is reduced to the working pressure by a regulator. However, a sudden release of gas at high pressure can cause serious physical injury. Inert gases are non-reactive, have no odor and are therefore impossible to detect directly. They therefore present a potentially serious hazard of asphyxiation.

Identifying the risk of hazard while using shielding gases:

- In confined spaces with poor ventilation, inert gas can build up and concentrate, displacing Oxygen and giving a potentially high risk of asphyxiation. Using air-fed breathing apparatus also lowers the risk.
- Inert gases and gas mixtures stored in cylinders give a high risk of physical injury when the high-pressure gas is released suddenly.
- Free-standing gas cylinders present a high risk of serious injury if they fall or are knocked over.

Risk Control Measures for Shielding gases Hazards:

- It is better to avoid the use of inert gas in confined spaces. However when use of inert gases in a confined space is permitted, breathing apparatus should be used and monitor the Oxygen content by fitting and use of calibrated meters. Providing a source of fresh Air is also used to control the atmosphere of a confined space.
- Fitting and correct use of good quality regulators to reduce risks from accidental release of gas at high pressure.
- The main control measures to reduce risk of physical injury from gas cylinders during handling are use of correct safety equipment and personal protective clothing and ensuring that cylinders are properly secured during storage, transportation and use.

(4) Hazards due to Solvents:

Solvents used in the welding industry may be flammable. The most frequently encountered flammable solvents are acetone, petroleum, ether and white spirits. The most frequently encountered non-flammable solvents are chlorinated hydrocarbon degreasing agents such as trichloroethylene and 1-1-1 trichloroethane. Some solvents break down under the action of the welding arc to form toxic or irritant by-products, the most toxic breakdown product being phosgene. Flammable solvents present a fire or explosion hazard in the vicinity of welding arcs and flames, and hot metal and components.

Most industrial solvents have distinctive smells and can be detected by these. Breakdown products may also have recognizable smells or effects on the nose and throat, making them easy to detect, too.

Identifying the Risk of Solvent Hazard:

- Proper storage of flammable solvents and well away from welding areas will reduce the risk of fire or explosion from heat and flames from welding.
- Allowing all traces of solvents and solvent vapors to disappear from material surfaces before welding. This will help to reduce the risk of fire and exposure to breakdown by-products.
- Providing suitable respiratory protection to operator will reduce the risk of inhalation of solvent vapors.

Conclusion:

Employers have a responsibility to safeguard the health and safety of their employees and other people. The most effective way to ensure that health and safety at work is maintained at a high level by taking following steps:

1. ***Hazard awareness***: Recognize and identify the potential sources of injury or damage to health in the welding environment.
2. ***Risk assessment***: Estimate the likelihood that the hazard will cause harm.
3. ***Control***: Implement the measures to eliminate or reduce risk of Hazard.
4. ***Evaluation***: Appraise the effectiveness of the control measures in eliminating or reducing risk of Hazard.
5. ***Review***: Re-examine the process critically, to ensure it is working effectively to identify hazards and improve the safety.

Please contact cmo@adorians.com or visit our website www.adorwelding.com for any advice you may require in assisting you in making the work place hazard free and safe for the workers.

Product Update

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