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PREVENTIVE MEASURES FROM FIRE AND EXPLOSIONS DURING WELDING

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ABSTRACT
Performing welding works, especially in the manufacturing and installation of welded structures, as well as when performing maintence and welding surfacing repair, is one of the most difficult tasks due to the nature of the welding process, accompanied with light and heat radiation of the electrical arc, the emergence of harmful flue gases and metal vapor, splash of the molten metal and slag, work in the confined spaces, unnatural body position during the welding process and so on.
Welding process produces molten metal, sparks, slag, hot desktop. Any of the above mentioned can cause a fire or explosion if they are not implemented adequate safeguards. When working with gases, we have to be careful to adhere to the instructions given and regulations. The work with gas is one of the activities with increased danger due to their chemical and physical properties, such as flammability, explosiveness, toxicity and compressibility.
In the area of technological process of welding or in their parts may be flammable gases, vapors or mists which mixed with air can form explosive mixtures.
For the area with potentially explosive mixtures, it is conducted the analysis of hazardous areas and its classification in the danger zone with the purpose of easier selection of suitable devices for safe use in such environment.
Keywords: fire, explosion, flammable gases, explosive mixtures, the danger zone

1. INTRODUCTION
Fires, explosions and other accidents that occur when working on the gas, indicate that they mainly due to insufficient knowledge of the properties of this gas and safety measures and fire protection. A very important factor is the man, because the neglect of some little things that at first seem like a harmless, can cause side effects, ie fire and explosion. All of safety and control devices to be installed must be always correct and under constant supervision. They must have a certificate of producers and must be designed to work with the appropriate gas.
In the surroundings and within the room, where are located facilities for gases, gasification stations, substations, warehouses, distribution centers and others, must not be left combustible material (paper, wood, different fuels, etc.).
Facilities for technical gases and their immediate surroundings must be kept neat and clean. The buildings and premises that use gas, passes must always be free and accessible, in order to fire as soon as carried out the evacuation and fire fighting. In the place of consumption of gas taken measures to prevent the penetration of gas in the operating rooms. To this end, it is necessary to take care not to damage the conduit, as well as maintaining safety devices and appliances by which gases are used. Gaps in the installation of gas equipment in the work with her as well as in its maintenance, can cause not only material damage but may endanger the safety and lives of people who are employed there.

2. FEATURES GASES USED IN WELDING
The gases, that are used in welding and allied processes are: Argon, Carbon dioxide , Nitrogen, Oxygen, Acetylene, liquefied petroleum gases (propane, butane, etc.), Natural gas, Hydrogen.

For work with gases it is necessary to know the characteristics of these gases, and specific preventive measures to protect against fire and explosion should be taken with flammable and explosive gases.

2.1 Acetylene (C_2H_2)

It is used for oksiacetylene flame in welding and cutting metals. Flammable gas has no color, low odor of essential and non-toxic. Technical acetylene has a sharper characteristic odor due to the presence of impurities, mainly phosphorus hydrogen and hydrogen sulfide.
Acetylene is obtained by decomposition of calcium carbide with water, gas cleaning and dissolving under pressure in a suitable container.
In normal conditions the gas is unstable. The minimum ignition temperature is 305 ° C. Flame temperature at stoichiometric combustion of 2590 ° C. Explosion limit is 2.2 to 85% at 20 ° C and 1,013 bar. Working with acetylene is subject to special regulations. Not allowed rapidly emptying bottles, tumbling and uncontrollable changing of volume - pressure in an enclosed space.

Table 1. Explosive and stoichiometric mixture of some flammable gases

Flammable gas	Explosion limits volume%		Stoichiometric mixtures volume%
	DGE	GGE	
Natural gas	5,3	14,9	9,50
Hydrogen sulfide	4,3	46,0	12,30
Acetylene	2,5	100,0	7,75

Determination and classification of hazardous areas is a major issue in resolving the location for storage of technical gases, because of the explosion characteristics of some of the gases in the mixture with air.
In the space for the accommodation of oxygen, carbon dioxide and argon, because of chemical characteristics of these gases, there is no risk of explosion, and the space immediately be classified security-zone non-hazardous or non-hazardous explosive area. Acetylene has the widest range of all explosive gases.

3. DETERMINATION OF HAZARDOUS AREAS AND DANGER ZONE

Determination of hazardous area and classification of hazardous areas is a complex process which essentially can not handle technical regulation which treats this kind of problem. In support of this fact is the fact that it aims to find a more efficient antiexplosion protection, which is the maximum for all project designs and studies. Because of this reason, the process of classification of hazardous areas, and thereby so defined the conditions, to be met by electrical equipment, appliances and installations engaged in the given areas.
The applicable regulations and standards for potentially explosive mixtures, require analysis of the endangered area and its classification in the danger zone. These zones are defined as "0", "1" and "2". According to their definition is implemented appropriate protection of electrical installations and equipment to prevent them to be agents of ignition explosive mixture.
It is important the classification of space and analysis and classification of the environment in which can occur explosive mixtures, to facilitate the election of suitable devices for safe use in such an environment, taking into account the group of gases and temperature class. In situations where can occur explosive mixture should take the following steps:
a) eliminate the possibility that the explosive mixture occurs in the vicinity of ignition.
b) remove the cause of ignition.
Where this is not possible, we should choose and develop protective measures, process equipment, systems and procedures so that the possibility of coincidence of a) and b) is minimized.
It is obvious that the solution to the problem comes down to the proper classification of the area in danger zones and planning and installing electrical installations, equipment and installations which can't be causes of ignition or relocation of inappropriate equipment outside the danger area.

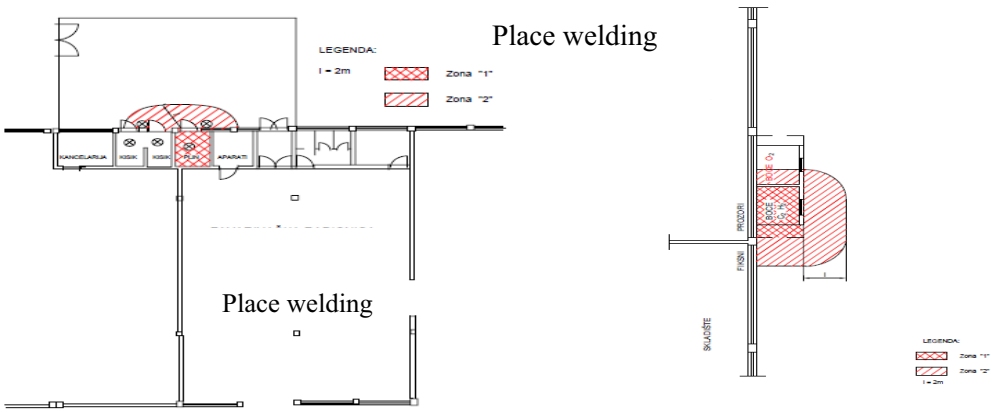

Figure 1. Zone dangers warehouse C_2H_2 and O_2 located by a soldering workshop

3.1 Calculation of the presumed (contaminated) volume Vz

The theoretical minimum speed required for dilution ventilation observed discharges combustible matter to the desired concentration below the lower explosion limit may be calculated using the formula:

$$(dV/dt)_{min} = \frac{(dG/dt)_{max}}{k \cdot DGE} \cdot \frac{T}{293} \qquad (1)$$

where:

$(dV / dt)_{min}$ minimum flow rate of fresh air (m^3 / s)

$(dG / dt)_{max}$ largest amount of emissions with the source (kg / s)

DGE Lower Explosive Limit (kg / m^3)

T ambient temperature (Kelvin)

k safety factor applied to the DGE; is typically:

k = 0,25 (permanent and primary sources) and

k = 0.5 (secondary sources).

The lower explosion limit is usually given in volume percentages, so it is necessary to carry out conversion in the following form:

$$DGE\ (kg/m^3) = 0{,}416 \cdot 10^{-3} \cdot M \cdot DGE\ (vol\ \%) \qquad (2)$$

where:

M - molecular weight (kg / kmol)

With the fixed number of air changes per unit time-C, depending on the general ventilation space, the default volume Vz of potentially explosive mixtures, about the sources of emissions can be estimated using the following formula:

$$V_z = \frac{(dV/dt)_{min}}{C}$$

where:

C = the number of changes of fresh air per unit time (s-1)

Figure 2. "Gas cylinders as bombs"

Table 2. *Example: Classification of sources of danger*

WAREHOUSE TECHNICAL GASES	
SOURCES OF RISK	The valve on the bottle
VENTILATION	Closed, naturally ventilated space
TYPE OF SOURCES OF DANGER	Secondary
MEDIUM	acetylene
DANGER ZONE	
ZONE "0"	The interior of the bottles of gas
ZONE "1"	The interior of the warehouse of technical gases
ZONE "2"	1.5m spherical of all openings

4. PREVENTIVE MEASURES PROTECTION FIRE AND EXPLOSION

Implementation of preventive measures to protect against fire and explosion comes down to it -to remove the combustible materials are at least 10 meters from the place of welding, if not previously possible

-cover flammable materials with fire resistant materials, if possible,

- surround the working area moving fire resistant screens, cover or close any openings such as doors, windows, cracks with fire resistant materials.

-in the welding zone within 10m of the place of work, all openings or cracks must be covered, to prevent sparks pass in an adjacent room, or to set a curtain or screen around the place of work, the amount of which shall not be less than 1.8 meters.

Welding close to walls, partitions, ceilings or roofs, built of flammable material, shall be made only if they are placed refractory guards or screens.

If a combustible material may not remove, then must be set up fire guards at the workplace. During welding with bottles of acetylene and oxygen must be a distance of at least 5 m away from heating appliances and 10 m of open sources of fire.

5. CONCLUSION

The paper deals with the basic principles which based on conduct of the procedure for determining hazardous areas which boils down to this:

- defining the list of flammable substances in their basic physical and chemical characteristics that are important from the aspect of anti explosion protection,
- determining the source of danger.
- it is also important to control the operation of the plant-the work must be within the parameters of the project like planned, which means that it excludes cases of abnormal operating conditions (eg cracking process equipment),
- budget spreading potentially explosive mixtures. The calculation is based on the methodology treated in the relevant standards and literature in this area as well as historical data and
- final adoption of the danger area by type and location of (width, length, height or volume).

In the process of classification of space will be given the greatest attention to these principles. Within the majority of the technological processes involved media which under certain conditions can become flammable and explosive, and already their presence alerts and calls into question the safety of both staff and facilities involved. In the areas of technological welding processes or parts thereof may be flammable gases mixed with air can form an explosive mixture.

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