EXPLORING THE MECHANICAL PROPERTIES/ PROS AND CONS OF ELEMENTARY TO ADVANCED WELDING TYPES

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Abstract - One of the oldest methods of electric welding methods that is used today in the industry to one new analytical method is pursued to be describe. After that the present researcher seeks to answer two research questions. First while explaining every aspect of welding properties, the advantages and shortcomings of dry and wet welding and then their risks are investigated. We conclude that its features had their risks and preventive measureshave to be taken to resolve them. In this regard, this study puts forward an applicable cue for further researches

Keywords - Advantages and Shortcomings of Dry and Wet Welding, Risks, Features.

I. INTRODUCTION

The remained works from the far past reflects the fact that Early humans using physical principles, which are the basis of modern welding, connected the metal parts to each other. Analyzed tools which have been discovered from the early centuries show that in order to connect two pieces of metal together, the edges of these pieces were fused to each other and were connected with hammer blows The physical principles that are foundation of conventional welding methods in the present century were discovered and developed in the late nineteenth century and gradually used in industry. In 1887 a Russian scientist named Bernadas invented a method by which he was able to melt a piece of metal electrodes to create an electric arc with charcoal locally between the piece and the electrode. This time he put two pieces of metal at a certain distance from each other, and using the above-mentioned phenomena and moving charcoal electrodes across the gap between two pieces, and the insertion of a metal rod made of pieces inside the arc createda melted bath which filled the gap after freezing and allowed to join the parts.

A few years later, in 1891, another Russian scientist named Slavjaniv invented melting electrodes method. In this method, a metal electrode is used instead of charcoal electrodes at the same time also led task of filler metal. In the melting electrode, melting of metal electrodes at the space between the tip of the electrode and the gap between the two pieces were exposed to air and this issue causes melt oxidation and therefore causes problem in the weld. On the other hand, electrical arc was also unstable and it spontaneously was followed by weld'snon-uniformity.

To fix these defects in 1905, a Swedish industrialist named Oscar Kjellberg invented the coated metal electrode. Cover of the electrode was formed by a mixture of different minerals that was able to produce gas and slag, and protect melt from the melting electrode against the adverse effects of exposure to air. In addition, the electrode cover causesthe stability of electrical arc and welding uniformity. With the invention of covered electrode, the industry was able to generate a weld with the strength of the base metal. The first repairing ten-meter boat which all fittings had been done by welding was launched in 1918. Since the late 1930s, the construction of bridges and railways as well as the construction of ocean-going ships and etc. was begun by welding the parts together quickly,to date the man has built the spacecraft, skyscrapers, nuclear power and so welding is still considered asone of very important methods of connection.

There are four main sources of energy for the welding operation:

- Electrical energy
- Chemical energy
- Mechanical energy
- Energy radiation

II. REVIEW OF LITERATURE

Most recent works exhaust topics of steel, titanium oxide, aluminum, viscosity, oxidation but not main features of welding and its risks which are the main goals of the present study. The metallurgical characteristics, tensile, hardness, toughness and corrosion resistance of dissimilar welds between X5CrNi18-10 grade austenitic and X20CrMo13 grade martensitic stainless steel have been evaluated by Kacar, Baylan (2003). Both austenitic and duplex stainless steel electrodes were used to join this combination, using multipass manual metal arc welding process. Defect free welds were made with each welding consumable. It was found that the tensile strength of weldment, which was produced by duplex electrode (E2209-17), was slightly lower than that of austenitic electrode (E308L-16). The toughness of the both E2209-17 and E308L-16 deposits was acceptable even at low temperature regardless of heat input. Hardness was increased in

both welds made with E2209-17 duplex and E308L-16 austenitic electrode along the X20CrMo13/weld metal fusion boundary due to heat annealing and then following high cooling rate. The pitting corrosion resistance of the weld metal made with E308L-16 and E2209-17 filler metal was found acceptable. Although, heat affected zone in the weldment and X20CrMo13 base metal were affected by electrolytic corrosion.

This investigation has shown that both filler metals can be used to join austenitic stainless steel to the martensitic stainless steel. Spot weldability of dissimilar metal joints between stainless steels and nonstainless steels was investigated by Alenius, Pohjanne, Somervuori, and Hänninen (2007). The aim was to determine the spot welding parameters for the dissimilar metal joints and to characterize the mechanical properties of the joints. Metallographical investigations, microhardness measurements, peel tests, lap shear tests, cross-tension tests, corrosion fatigue tests, and stress corrosion cracking tests were performed. It was found that in the dissimilar metal joints between stainless steel and nonstainless steel, the failure load of the cross-tension specimens was around 72–78% of that of the lap shear specimens.

The weld nugget of the dissimilar metal joints was fully martensitic, but it was ductile enough so that the failure type was plug failure in both lap shear and cross-tension tests. Chou, Liu, Chuang's (2013) study focuses on investigating the increase in adhesive strength and reduction of abrasion in the joint of a vulcanized fabric conveyor belt. Using analysis of mean (ANOM) of the Taguchi method, the optimum conditions for field vulcanizing a fabric conveyor belt with better adhesive strength were obtained, and they included: a curing time of 25 min, a curing pressure of 9 kg/cm2, a dismantling temperature of 30 C; and a cooling method of air. Following the same method, the optimum conditions for field vulcanizing a fabric conveyor belt with less abrasion were obtained, and they included: a curing time of 15 min; a curing pressure of 9 kg/cm2; a dismantling temperature of 60 C; and a cooling method of water. Accordingly, with a fixed curing pressure, it takes a longer period to vulcanize a fabric conveyor belt with better adhesive strength than to vulcanize a fabric conveyor belt with less abrasion. The percentage contribution of each controllable factor within the current investigation range was also determined via analysis of variance (ANOVA) of the Taguchi method. Interestingly, among the four controllable factors, the curing time is the most influential factor on both the adhesive strength of the spliced area (38.61%) and the abrasion of the patched and spliced areas (61.22%) The effects of the dynamic oxidation on the viscosity of Ti-bearing blast furnace slag, on a selective enrichment, a precipitation and a growth of the Ti component were studied by Zhang, Zhang, Wang, Lou, Sui, Jang (2005). The oxygen source was the air that was blown into the molten slag through a lance during the dynamic oxidation process. It was found that the oxidation of TiC, metallic Fe, TiO and Ti2O3 in the slag was not only in favor of the decrease of the viscosity of the slag, but also for the selective enrichment of the Ti component into the perovskite phase as well as the precipitation and growth of the perovskite phase. As oxidation time increases, the precipitation and growth of the perovskite phase rapidly increased, and the slag changed from the melt to a mixture of the melt and crystalline phase(s), that caused the viscosity of the oxidized slag for 12 min increased rapidly.

III. DEFINITIONOF KEY TERMS

3.1. Arc Welding

Electrical flowis created by the current of electrons in a conductor path. If an air gap (gas) appears in the path, a flow of electrons and thus electricity will be cut. If the air gap is narrow enough, potential difference and high intensity of current, gas in theionized gap and electrical arc will be established. The arcis used as the heat source in welding

3.2. UnderwaterWelding

Underwater welding since World War II devised when the damaged ships should immediately repair in water. Bringing the ship out to repair it is already very expensive and not economic. Many people are very curious to know about underwater welding and think that is weird, because they assume the nature of welding isfire. But the nature of welding is electrical arc andits working under water is not so strange.

3.3. Types of Welding Under Water

- Dry welding
- Wet welding

In the wet welding operations, underwater welding is performed while directly dealing with a moist environment. In dry welding method, there is a dry chambernear the area of welding and welders weld in cab under water.

IV. WET WELDING (UNDER WATER WELDING)

Wet Welding indicates that welding is performed underwater, directly exposed to the wet environment. In this welding method, a special type of electrode is used and welding is done manually just as that of which in the outside weather. Freedom, that welder has during welding method, makes the wet welding more effective, efficient and affordable from an economic point. Welding power supplier is installed on the surface and connected to the diver or welders by cables and hoses.

V. HYPERBARIC WELDING (DRY WELDING) HABITAT

Sealed chamber is used in the underwater hyperbaric welding around the structure or the piece which should be welded.The chamberis filled with gas in a normal pressure (usually helium containing half times of 5 oxygen). This position is located on the pipeline and filled with a mixture of Helium and breathable oxygen or runs under more pressure.This method produces high-quality weld joints so that the X-ray and other equipment are used to create them. The tungsten's gas arc welding process will be used in this field. Area under the floor is exposed to water. Therefore, welding is done in the dry weather but is under the pressure of hydrostatic sea water in its immediate environment.

VI. THE BENEFITS OF WET WELDING

1. Diverse cost and low cost, which make it very desirable.
2. The high-speed welding: there is no need to have time to build chamber, equipment transportationis easy.
3. Weldabilityof areas where are not accessible by other methods.

VII. DISADVANTAGES OF WET WELDING:

1. High-speed cooling of the welding area: the weld metal is quenched by the surrounding water which reduces flexibility and impacts resistance to blow and increases porosity in the weld zone.

VIII. THE BENEFITS OF DRY WELDING

1. Diver's safety- welders' welding is performed in a chamber which is immune to the ocean currents or marine animals. This warm and dry place has good lightingand benefits from the control system of a special environment.
2. Good quality of weld– this method is able to create welds, which even can be compared by welding in the open area and in exposure to the air. The reason for this is that there is no water which would turn welding off or cut it off. And that its amount of hydrogen (H2)production is much lower than that of wet welding.
3. Level Control - Joint preparation, pipe alignment, the non-destructive testing (NDT) (7),etc. are monitored and adjusted visually.
4. Non-destructive testing (NDT): Non-destructive testing for dry environment is a facilitated position.

IX. DISADVANTAGES OF DRY WELDING

1. Welding habitat or position requires a great deal of supportive and complex services and the chamber itself is unusually complex.
2. Price and value of the chamber is substantially high and its charge increases with depth of workplace. Welding-place depthaffects on work, so that at greater depths, collecting the arc and the use of higher voltages and appropriatefor it are necessary. Carrying out welding works in this way costs 80,000 dollars. And sometimes a chamber cannot be used for several different tasks, but it depends on the kind and amount of difference between them.

X. UNDERWATER WELDING ELECTRODES

Underwater arc welding electrodes are in a variety of modified electrodes of typical manual ones. There is no special coding system for the electrodes and their coding system is often based on well-known brand and based on functionality and ease of use for welders. The most commonly used electrodes are the ones which are used for carbon / manganese steel.

Underwater welding mechanical properties are strongly dependent on the depth of welding and with increasing depth of welding areas, the properties will be reduced. With increasing depth, the pressure increases.It will cause the oxygen's enteringdue to the water decomposition and increasingits amount and thus reducing manganese and silicon and increasingcarbon in the weld pool, causing porosity in weld when it becomes cold.

It may also increase the amount of hydrogen which results in increased porosity and reduced arc stability as in much depth because of the high ionization potential of hydrogen, arc stability decreases. One of the other significant problems in underwater welding is the probability of cracking hydrogen on the presence of water and humidity. The risk of this phenomenon is increased as the depth is increased. This issue, where the electrodes with acid coating are used, is more significant. Because the ability to absorb moisture is morein this cover and decomposed hydrogen of the moisture is easily absorbed into the molten weld metal. For this reason, in underwater welding,the use of rutile type electrodes is preferred. The electrodes coated with different materials to improve the welding conditions and weld properties. For example, Ferro- manganese to absorb oxygen and to reduce porosity and titanium and boron due to the formation of needle ferrite structure and enhancing mechanical properties is added to the coating material of electrode. Also sometimes nickel is added to the coating materials to improve the toughness of materials. Underwater welding of higher strength steels is usually done by the use of austenitic stainless electrodes to reduce the risk of hydrogen cracking. But in this case, precautions must be taken to prevent cracks in the effected zone by HAZ heat. In manual electrodes typically due to lower speed of burning electrode coating in comparison to the melting of its core, a hole is formed at the tip of the electrode that

an arcis created in the holethat is surrounded around by the flux coating. This phenomenon helps to protect the molten particles which are separated from the electrodes and also control their transfer. Hole at the top of electrodeis very important in the underwater welding issue. Since this phenomenon causes the arc stability and its length control, achieving an acceptable and suitable underwater welding will be very difficult without it. Therefore, using this technique, welders can weldeven in the absence of enough visibility by putting some pressure on the electrode, without any need to control arc length, with a constant feed rate. One of the tasks ofelectrode coating iscreating the protective atmosphere around the weld pool. This phenomenon also exists in underwater welding and due to the presence of water, it has much higher importance. One of theunderwater arc differences fromin the air arc is makingbubbles in the gas around the arc. The behavior of these bubbles in underwater welding is very important. The bubbles, in addition to making arc unstable, can cause turbulence in the weld pool.

XI.

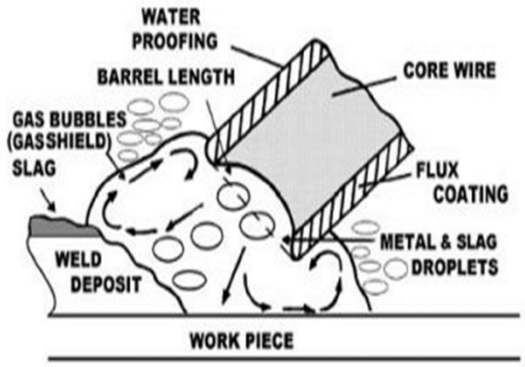


Figure 1. protect the weld pool in hyperbaric welding

XII. RISKS OF THE WELDING

12.1. The heat

The intense heat and sparks from welding may cause burns. Eye injuries from contact with hot slag, metal chips, sparks, and hot electrodes can be achieved, moreover, lead to heat stress or prolonged contact with the heat will be.

Welders should of symptoms such as fatigue, dizziness, loss of appetite, nausea, abdominal pain and irritability patients. Air separation and distance with heating, proper rest breaks and drinking fluids can protect people against the risks associated with heat. Visible light, ultraviolet rays and infrared light associated with arc welding Qrmzvshdt causes damage to the retina of the eye, while infrared radiation may damage the cornea and cataracts will develop the disease. Invisible ultraviolet light from the arc even in a very short time (less than a minute) makes Blight eye. Symptoms usually occur several hours after exposure to UV light and include a feeling of sand in the eye, blurred vision, severe pain, tearing, irritation and headaches. Arc on materials and objects in the environment and other influences will affect nearby welding. About half of the Blight eye on individuals who are not welding work on the ground. People who constantly without proper protection with ultraviolet work may cause permanent eye damage. Contact ultraviolet light can also cause skin burns Is similar to sunburn and skin cancer risk increases

12.2. Noise

Too much noise in the environment may lead to hearing damage, as well as cause Sometimes stress and blood pressure or heart disease. Long-term work environment Excessive noise causes fatigue, nervous, and irritable people. If people work in a noisy area, the employer must OSHA noise standard To assess the noise level and the timing of exposure. If the average noise Eight hours is 85 dB, the employer must provide for the appropriate phone welders and Annual put him under medical examination.

12.3. Muscle injuries – bone

Among welders complained of muscle diseases such as injuries _ bone in the back of the body, shoulder pain, reduced muscle strength, carpal tunnel syndrome, white finger and knee joint diseases are more common. Work postures (especially when the welding overhead, vibration and heavy lifting) can also contribute to these disorders.

These problems can be reduced by the following methods:

_ Carrying the appropriate method
_ No longer work in a mode
_ Working at height
_ The footrest when a person has long standing

working.

_ Putting the right tools and materials
_ To minimize vibration during operation Welding safety hazards Electrical hazards

XIII. THE EFFECT OF WELDING GASES

More particles in welding fumes are infinitely small (usually smaller than 5.0 micrometers in diameter) so they can enter the lungs and cause pulmonary vesicle for their condition. Some of the materials that have accumulated in the lungs can cause a series of changes in the body. This is the main material in welding fumes can be found along with effects and risks they create are described.

13.1. Barium Ba

Not specified threshold limit for barium. Inhalation of fumes that contain barium oxide are considerable irritation of the nose and throat. In addition, barium oxide fumes can cause nausea, vomiting, diarrhea and stomach ulcers, as well as the risk of heart disease, muscle fatigue and increase the contraction.

13.2. Be beryllium

Beryllium metal material that is shaped and the blending mode has a high toxicity (beryllium oxide in fumes welding) alloyed with copper and beryllium primarily And cause health problems in the lungs is called Brylyvzys.

13.3.CD cadmium

Cadmium is a substance with high toxicity. Cadmium oxide in welding fumes during welding metal plates (metal corrosion protection can be covered by Cd) Cadmium is produced. Cadmium poisoning symptoms include shortness of breath, dry throat, cough, chest pain and fever Drqfs·h metal fumes named. These symptoms usually appear when at least a day or more of a back pass. An individual who is repeatedly exposed to cadmium may suffer from pulmonary edema and emphysema may also be affected. Liver and kidneys can also be affected by cadmium fumes.

13.4. CA calcium

Welding fumes Calcium oxide interconnected forms (conjugated) in the base metal arc welding electrodes and welding arc phlox - phlox chord with the original as a filler metal to be found. In high concentrations, calcium oxide can irritate mucus membranes but is not considered a direct health risk during welding

13.5. CR chromium

During welding of chromium alloyed with steel (including stainless steel) Cream 6 3 capacity and capability of the oxide is formed. In both forms, chromium irritate mucous membranes and cause metal fumes fever as well as the flow of breathing and the lungs are also affected. Hexavalent chromium as well as increase the risk of cancer is considered. Hexavalent chromium during welding with coated electrodes are produced.

13.6. CU copper

Copper as both metal and filler metal to be found. Inhalation of copper fumes can cause metal fumes fever, complications in the lung that is called Kvprvzys.

13.7. F fluoride

Fluorine compounds with fluorides mostly during welding with coated electrodes are produced. These compounds can also be connected to the arc welding fluxes - produced cord. If Phlox, base metals, fluorides inhalation can cause mild irritation of the respiratory channels and public intoxication cause acute or chronic. Only in places where there is a risk that incomplete enclosed or ventilated fluorine than the standard threshold value is exceeded.

13.8. FE

Iron oxides in welding fumes to produce a conjugate that can be found throughout welding of metallic iron. Contact iron oxide over a certain period of time can often call a person suffering from a condition called Sydrvzys make the X-rays X, similar to silicosis, but Sydrvzys not dangerous health risk is not in short calls term iron oxide stops and pulmonary complications such as silicosis, a progressive mode will not continue.

13.9. PB

Lead is emitted in large quantities in arc welding fumes, unless special welding for metal surfaces coated done. Lead may be produced when parsing coated electrodes in combination. Lead fumes can cause respiratory symptoms such as headache, fainting, pain in the muscles, muscle contraction, loss of appetite and weight loss. At high concentrations, risk of anemia and memory loss there.

13.10. MG

Magnesium as an alloying element in steel welding and electrodes produced. In this case welding fumes containing high concentrations of magnesium oxide, which is toxic. Symptoms of magnesium toxicity include irritation of mucous membranes, chills, muscle stiffness, weakness, fainting, and impaired intellectual capacity, nervous system and respiratory tract may also be affected. Magnesium can also be due to metal fumes fever.

13.11. MO molybdenum

Breathing fumes containing molybdenum can stimulate the respiratory organs. Continuous and prolonged contact with the molybdenum can cause pain in the joints and affects the liver.

13.12. Ni nickel

Nickel is generally caused when the production of stainless steel. Nickel oxide fumes can cause fever welding smoke is metal. Nickel also in terms of carcinogenicity is also a doubt.

13.13. SI silicon

Some forms of silicon dioxide (quartz) can cause silicosis are. However, there is no evidence indicating that forms the silicon dioxide concentration in welding fumes are hazardous.

13.14. Zn zinc

Zinc oxide fumes during welding metal plates to be produced. Plating with zinc can cause metal fumes fever is.

13.15. Gasses

Here are toxic or suffocating gases behavior and their users. They are formed either during welding or protective gas elements.

13.16. CO carbon monoxide

Carbon monoxide is a dangerous gas that is odorless and colorless. Carbon monoxide in principle in relation to welding in confined spaces or areas that have poor ventilation, high concentrations of the gas can be produced there. Carbon monoxide prevents the transfer of oxygen in the blood. Carbon monoxide poisoning can cause nausea, headaches, heart pains, difficulty in concentration in the blood and is finally losing consciousness.

13.17. No2 and No

In high concentrations ppm15, nitrogen dioxide can irritate the eyes and cause watery them. Higher concentrations can also cause acute bronchitis, fibrosis or pulmonary edema are. The sequel can be a

threat to health and life. But in most cases improve function in patients with associated lung. Symptoms of poisoning include severe cough, wheeze, sickest, nausea and shortness of breath. This marks even from 3 to 30 hours after exposure may also not appear.

13.18. Ozone O3

Ozone gas is toxic and colorless. Ozone affects the mucous membranes as well as respiratory tract. Symptoms of ozone exposure include itching or burning sensation in the throat, cough, chest pain, and wheezing are.

13.9. Phosgene Cocl2

Ppm20 high concentrations of phosgene cause mouth and throat burning sensation in chest pain and vomiting phosgene track. Phosgene is inhaled it can cause pulmonary edema.

13.20. Phosphine PH3

Phosphine gas is high toxicity that causes irritation of eyes, nose and skin. Inhalation of this gas can cause diarrhea, fatigue and headache are. Ppm100 concentrations of phosphine can be fatal. Phosphine can also affect the nervous system and kidneys.

IMPLICATIONS AND CONCLUSION

Prevention strategies can be analyzed in the later articles in different perspectives, however the present work maneuvers on the characteristics of two types of dry and wet welding and their risks. Being aware of dangers is the first step in precautions. in welding usually position of welder is close to arc and the mass of pollutants which arise from the welding point upward. As a result, large amounts of fumes and gases are breathed by the welder. With changing his situation and providingbreathing safeguards against climbed mass of fumes and gases, it is possible to reduce the risks for welder's health. To work in closed areas (the before mentioned chamber) there is a risk of choking, a respirator should be used with an external ventilator.

REFERENCES

[1] Zhang, L., Zhang, L. N., Wang, M. Y., Lou, T. P., Sui, Z. T., & Jang, J. S. (2006). Effect of perovskite phase precipitation on viscosity of Ti-bearing blast furnace slag under the dynamic oxidation condition. Journal of non-crystalline solids, 352(2), 123-129.

[2] Chou, C. S., Liu, C. L., & Chuang, W. C. (2013). Optimum conditions for vulcanizing a fabric conveyor belt with better adhesive strength and less abrasion. Materials & Design, 44, 172-178.

[3] Wang, Z. D., and X. X. Zhao. "Creep resistance of PI/SiO 2 hybrid thin films under constant and fatigue loading." Composites Part A: Applied Science and Manufacturing 39.2 (2008): 439-447.

[4] Http://www.Fa.Wikipedia.Org

[5] Http://www.Irweld.Com

[6] Http://www.Welder.Persianblog.Ir

[7] Http://www.Rasekhoon.Net

[8] Http://www.Kiau-met.Blogfa.Com

[9] Http://www.Koushametal.Com

[10] Http://www.Iran-eng.Com

[11] Http://w`ww.Daneshema.Com

[12] Http://www.Bia2clubs.Com

[13] Http://www.Kntu-mech.Blogfa.Com

[14] Http://www.Weldeng.NeT

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