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Dynamic Response to welded joints of low Carbon Steel with Different Edges

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ABSTRACT

This research is investigating the mechanical properties of the welded joint of low carbon steel. They were welded by two different welding process (Arc-welding and gas welding) with three different edge type (X, V and I) on a specific size of two groups have a dimension (200 & 100) mm in length with square cross-section area (10x10)mm. changes in mechanical properties according to heat input were studied to compute impact, tensile, bending and hardness. The results have shown that Arc- welding is better than gas- welding because the second method gives a reduction in mechanical properties further more than (Arc-welding). With increasing heat put, some features were reduced (tensile and hardness), others were increased (impact).

Keywords: HAZ, low carbon steel, Mechanical Properties, and welding process.

I. INTRODUCTION

Welding has become one of the principal methods of fabricating and repairing metal products because of its economical and produces a very dependable result. Create many sorts of welding process lead to fabricate a wide range of material with different composition ratio and dimension. Oxygen and acetylene together in a flame provide the heat necessary to melt most metals. This combined with a neutral welding atmosphere and suitable filler material allows a skilled operator to weld most metals [1]. Other fuel gases such as LPG or propane produce a reactive secondary flame that interferes with the molten metal, making them unsuitable for welding. These and

other fuel gases are suitable for heating and cutting purposes. Arc-welding happened by passing electricity (AC or DC) current between electrodes and base metal, raise the heat at the welding point lead to fusion. Many variables factor influence on mechanical properties such as (toughness, tensile and hardness) of welded Carbone steel by Shielded metal Arc-welding (SMAW) the results show that increases in voltage and current lead to increase in hardness but a decrease in yield strength and tensile[2].

Also, change in parameter weldings like voltage and current applying on two different edge samples(V&I) of low carbon steel have (10mm) in thickness used two different methods of welding play important role in effect at mechanical properties [3]. Properties of metals after welding have been driven from a combination of different metallurgical mechanisms take place during the process. This can be effective at the overcome of mechanical properties [4]. Lastly, the types of connection in welding process have a large effect on mechanical properties distributed between (HAZ and base metal) this investigated in the paper [5]. Heat temperature used during welding effect at the microstructure of metal, later at properties (like hardness) as well as the type of joint.

Welding is inherently dangerous to humans so many safety precautions must be practiced to protect them. like a hazard of electrical shock, the high temperature of molten metals, ultraviolet radiation, ventilation… etc. because of this hazards of manual welding as well as to increase production with high quality, various forms of mechanization and automation have been developed (machine welding, automatic welding and robotic welding[6]. Welding can be considered as an integrated process of casting and melting site in a short time. In electricity welding, the weldability of base metal and metal filler can be considered in regard to control of the quality of the process [7].

II. METHODOLOGY

There are many factors effect on amount of metallurgical damage in the (HAZ) such as heat input ,peak temperatures reached, distance from the fusion zone, time of exposer that the metal subject with high temperature, rate of cooling and thermal properties of metal used .in (HAZ) welding process always effect negatively on mechanical properties of metal and failures often occurs so as far as from the fusion zone increases the unaffected zone reached nevertheless this zone be in state of high residual stress then be the main cause of shrinkage infusion zone to compute the stress can employ "equation 1"

$$\partial = \frac{P}{\sum al} \qquad (1)$$

Where ∂: Tensile or compressive stress in the throat section

P: Applying a load a: throat thickness

L: Effective weld length $\sum al$: Total area of the throat section

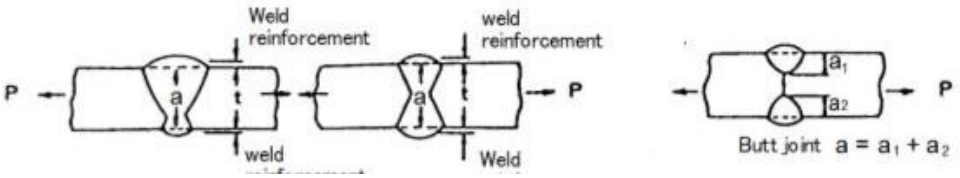

Figure 1.explain the symbol of the equation above

The specimen of low carbon steel has been cut up in two groups, the first has a dimension of (200× 10 × 10) mm second groups (100× 10 × 10) mm used for impact, tensile and hardness testing with different types of welding. (Gas and Arc) welding as shown in "Fig.2". And "Fig.3"

Figure2.The samples

Figure3. Electrical saw

Then give samples X-shape and V-shape with angles((45º and30º) respectively, while I-shape adjusts the edge to have samples with straight line edges.as shown in "Fig.4" and "Fig.5"

Figure.4. X-shape sample

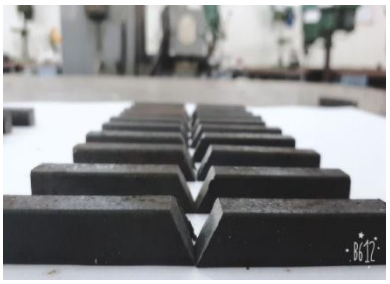

Figure.5. V-shape sample

Two type of welding has been done (Arc) and (oxy-acetylene) welding using a current of (210 Ampere) and the wire type is (60/13) as shown in ‘figure6’

Figure.6 Sample after welding

Figure. 7 Sample after impact

then clean the surface to remove any flying spot during the work by grind it with SIC paper to remove any verdigris, dust ,color and oil , washing with distal water and alcohol then dried with hot air and piece of clean cloth to prepare for examine,the device that uses in tensile is (United) model(SHFM-600KN) in Central Agency for standardization and quality control which can work with several types of cross-section area for samples as shown in "Fig.10".while "Fig.11" shown hardness device that uses.

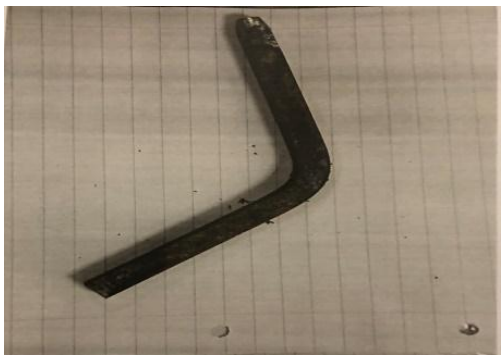

Figure.8. Sample after bending tests

Figure .9. Sample after tensile test

Figure.10. tensile machine device

Figure.11.hardness device

III. RESULT AND DISCUSSION

The result of welded metal depended on many variables like time, temperature, frequency and power input. In the welding process to gain high-quality metal, must be select proper parameters. Effect of some welding parameters was studied to predict the behavior of welded low carbon steel samples. As well as they have an important effect on the mechanical properties of the welded samples. Results have shown that Arc- welding is better than gas welding by giving higher mechanical properties amount because of tensile strength and hardness decrease with increase in heat input. This can be seen clearly in "Fig.12", and "Fig.15", this can be returned to heat emitted by reaction(oxy-acetylene) be a very high while "Fig.14" show the close result in impact force desorb in three different type of welding but Arc- weld method have best overcomes. The hardness, tensile and impact strength of the welds are functions of the microstructure, Grain size change depends mainly on heat set especially in the heat effective zone. Properties differences across the weld can be related to many factors, spatially to residual stresses just after welding. Others are grain size, phase composition and metallic inclusion and carbon contain [8].the chemical composition of the sample used in the welding process is shown in "Table I" , the impact strength increase with increasing heat input, preheat and temperature, unlike hardness which decreases with the increase of these factors "Fig.13"show the changes of forces applied in bending test with different welding method and type of joint, regarding types of joint (I-weld, X –weld lastly V-weld) force decrease respectively .while Arc-method of welding was the best.

Table I. Show the chemical composition of low carbon steel used in research

Elements	Ratio %	Elements	Ratio %
C%	0.149	Mo%	0.002
Si%	0.079	Ni%	0.037
Mn%	0.758	Al%	0.053
P%	0.008	Cu%	0.049
S%	0.004	Fe%	Bal
Cr%	0.024		

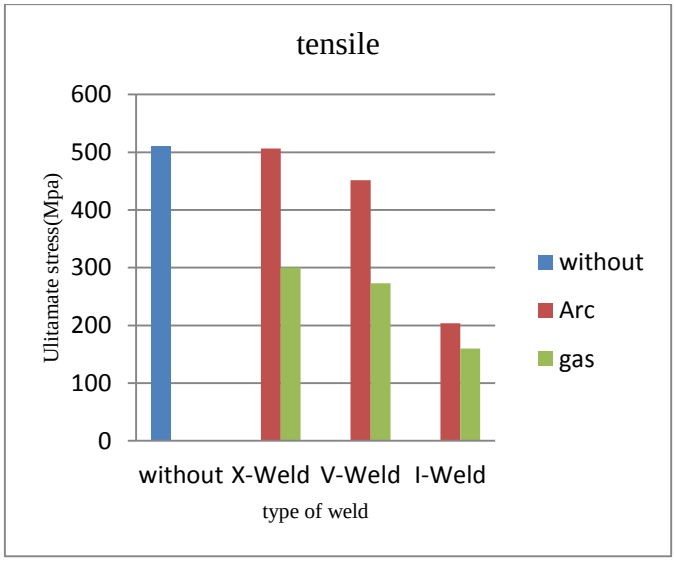

Figure.12. tensile machine tester

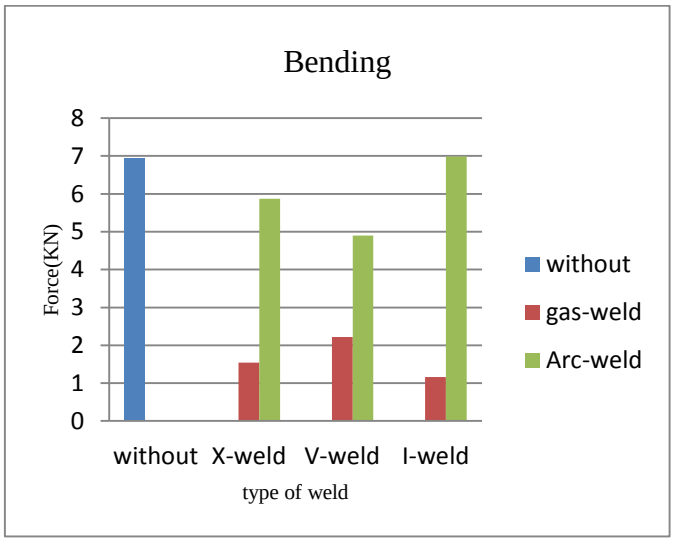

Figure.13. Force employ in bending

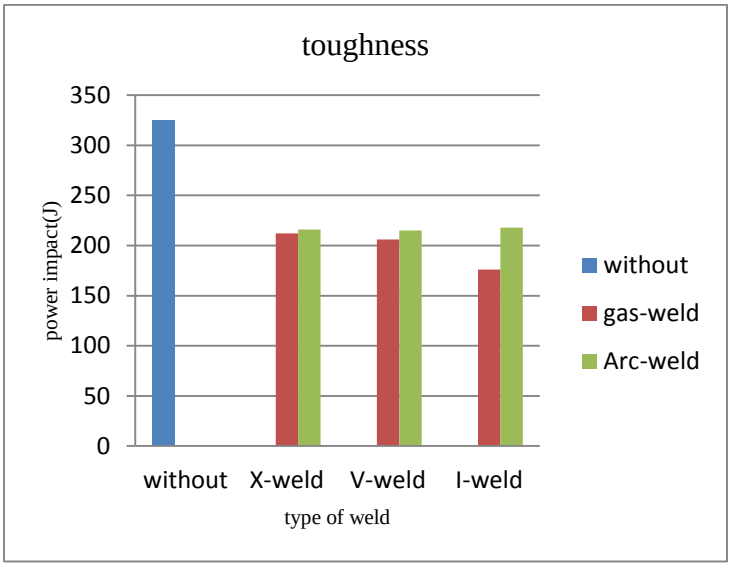

Figure.14. Force employ in toughness

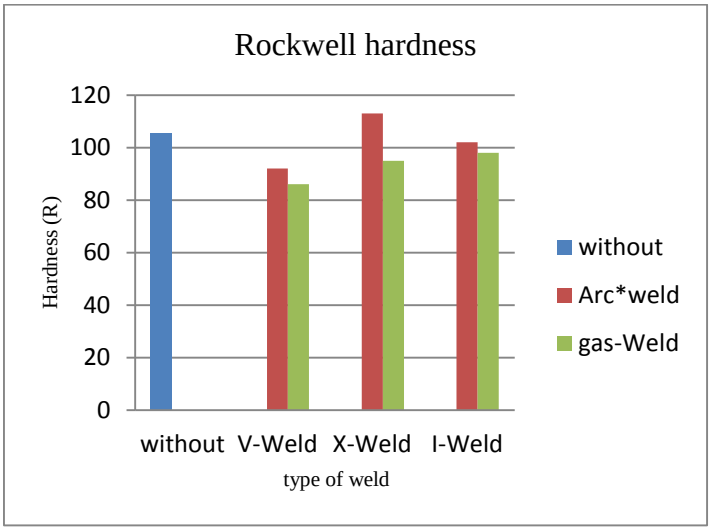

Figure.15. Show hardness with different types of weld

IV. CONCLUSION

Unless the Arc-welding and gas-welding are the oldest methods that used in joint metal but till now it used because of its several advantages. Arc-welding gives the best result in mechanical properties when compared with gas. Effect of weld shape at penetration in weld pool is very sensitive so joint with thinner, wider lands are less sensitive when compare with narrower grooves but have thick and this can explain the difference in properties to the samples. So with high control and proper select to the procedure of welding can give high product characteristics.

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