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PERFORMANCE OF BUTT WELD WHEN USING E 7018 ELECTRODE

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ABSTRACT

Welding is a fabrication process that joins two or more metals parts by heating together and fusing them. In this project we find the properties of a weld joint of a Mild steel with Shielded Metal Arc Welding (SMAW) process.

SMAW is a fusion welding process that uses a consumable, flux-coated electrode to create an arc between the electrode and the work piece. The E7018 electrode is a type of low hydrogen, iron powder electrode used in welding applications. The "E" in E7018 signifies that it is an electrode, while "70" indicates a tensile strength of 70,000 pounds per square inch (psi), and "18" suggests the welding position(s) in which the electrode can be used.

The cap means the final weld bead in a weld joint. It may be completed in the form of a stringer bead. After finding the weld defects with non-destructive test, the strength of the weld joint is demonstrated by performing hardness test on butt joint.

Keywords: GTAW, SMAW, Weld strength, Weld defects

I. INTRODUCTION

WELDING

Welding is a fabrication process where two or more metal parts are fused together by heating their surfaces. In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material (the weld pool) that cools to form a joint that, based on weld configuration (butt, full penetration, fillet, etc.), can be stronger than the base material (parent metal). Pressure may also be used in conjunction with heat or by itself to produce a weld. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized.

These processes use a welding power supply to create and maintain an electric arc between an electrode and the base material to melt metals at the welding point. They can use either direct current (DC) or alternating current (AC), and consumable or non- consumable electrodes. The welding region is sometimes protected by some type of inert or semi-inert gas, known as a shielding gas, and filler material is sometimes used as well. Some of the most common current welding methods are:

• Shielded metal arc welding (SMAW), also known as "stick welding." • Gas tungsten arc welding (GTAW), also known as TIG (Tungsten Inert Gas).

• Gas metal arc welding (GMAW), also known as MIG (Metal Inert Gas).

• Flux-cored arc welding (FCAW), very similar to MIG.

• Submerged arc welding (SAW), usually called Sub Arc.

Electroslag welding (ESW), a highly productive process for thicker materials.

Welding produces stresses in materials. These forces are induced by contraction of the weld metal and by expansion and then contraction of the heat-affected zone. The unheated metal imposes a restraint on the above, and as contraction predominates, the weld metal cannot contract freely, and a stress is built up in the joint. This is generally known as residual stress, and for some critical applications must be removed by heat treatment of the whole fabrication.

II. LITERATURE SURVEY

Kumar Vikas et al. [1] found that during welding, random variations in current and voltage occur, which cannot be recorded with ordinary ammeter and voltmeter. Acquisition of voltage and current signals while welding is in progress at a very high-speed using digital storage oscilloscope (DSO) and subsequent analysis of the stored data can be very useful to understand the arc welding process.

Ravindra Kumar, et al.[2] Shielded metal arc welding (SMAW) was used to weld together ASTM SA210 GrA1(Low Carbon Steel) steel. The oxidation studies were conducted on different regions of shielded metal arc weldment such as base metal, weld metal and heat affected zone (HAZ) specimens after exposure to air at 900

◦ C under cyclic conditions. The thermo-gravimetric technique was used to establish kinetics of oxidation. X-ray diffraction (XRD) and scanning electron microscopy/energy-dispersive analysis (SEM/EDAX) techniques were used to analyse the oxidation products. The base metal oxidized in air indicated the formation of high intensity of Fe_2O_3 (Iron oxide) as revelled by XRD analysis and form a thicker oxide scale on the base metal than that of weld metal at 900 ◦C. The oxidation resistance was found to be maximum in case of HAZ due to the formation of densely inner oxide scale and it was least in case of base metal. The oxidation rate (total weight gain values after 50 cycles of oxidation) of different region of the SMAW welded GrA1 boiler tube steel follows the sequence as given below: base metal > weld metal > HAZ.

◦ **Kim I.S.,et al.[3]** found based on multiple regressions and a neural network, the mathematical models are derived from extensive experiments with different welding parameters and complex geometrical features. Graphic displays represent the resulting solution on the bead geometry that can be employed to further probe the model. The developed system enables to input the desired weld dimensions and select the optimal welding parameters.

Goyal V.K,et al.[4] developed an analytical model assumes the primary heat transfer to weld pool is the initial arc heating considered as continuous heat source (arc heat source) of double ellipsoidal nature followed by deposition of superheated filler metal considered as point heat source of interrupted nature superimposed on the first one. The dissimilar nature of the two heat sources is treated by different analytical techniques to estimate their temperature distribution in weld pool and HAZ at its vicinity. The geometry of the weld pool has been estimated by evaluation of the weld isotherms causing melting of the base metal under the influence of two heat sources acting on the weld pool. **Ghosh P.K et al.[5]** carried out an experiment on plate weld deposition of 10 mm thick the arc characteristics and behaviour of metal transfer affecting the quality of pulsed current GMA weld is depends upon the pulse parameters and arc voltage primarily due to their influence on arc profile, stability in shielding of arc environment as well as nature of droplets transferred during welding. The arc characteristics defined by its root diameter, projected diameter and length, stiffness of arc affecting the weld quality.

Tong L.G,et al.[6] proposed a physical model represents the fluid and thermal dynamics of the SMAW process are quantitatively described, and the drop short circuit transition process is analysed. To investigate the effects of material parameters on the fluid and thermal dynamics of the weld pool during SMAW, FR (Fusion Ratio) and FL (Fusion Length) are proposed to describe the pool accurately. The evolution and geometry of a weld pool with V-type grooves during butt SMAW were investigated. The results provide a theoretical basis for improving the welding process and welding quality while avoiding welding defects.

Palani P.K,et al.[7] uses different methodologies for Pulsed welding is a controlled method of spray transfer, in which the arc current is maintained at a value high enough to permit spray transfer and for long enough to initiate detachment of a molten droplet. Once the droplet is transferred the current is reduced to a relatively low value to maintain the arc. Parameters of peak current, background current, peak current duration, background current duration, pulsing frequency and load duty cycle; it has a distinct effect on the characteristics such as the stability of the arc, weld quality, bead appearance and weld bead geometry. Improper selection of these pulse parameters may cause weld defects including irregular bead surface, lack of fusion, undercuts, burn-backs and stubbing in.

Vivek Goel,et al.[8] developed an expert system can be used, usually by a welding engineer, to plan for SMAW jobs. This paper presents an expert system to help plan and train shielded

metal arc welding (SMAW) operations. It accumulates most of the available information on the SMAW process including edge preparation, electrode selection, economic evaluation, analysis of weld defects and trouble-shooting.

S.M.Tabatabaeipour, et al.[9] studied the ultrasonic testing of two welding processes such as shielded metal arc welding (SMAW) and gas tungsten arc welding (GTAW) and the ultrasonic testing technique used is time-of-flight diffraction (ToFD).The specimens were examined by the ultrasonic ToFD technique under identical conditions. B-scan images obtained fromToFD measurements of the two welds indicate that inspection of the specimen prepared by the SMAW process is easier than the one made by the GTAW International Journal of Scientific& Engineering Research Volume 9, Issue 5, May-
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Masaya Shigeta,et al.[10] developed a quantitative evaluation system for arc characteristics such as arc stability and welding spatter generation related to shielded metal arc welding (SMAW) without human sensory evaluation. Factors that correspond to sensory evaluations by welders were investigated based on image processing. For the quantitative evaluation of arc stability, results show that the root mean square and the standard deviation of the arc center fluctuation, correspond to welders' sensory evaluation at AC and DC discharges. For welding spatter generation, a method of counting white pixels in a binarized image evaluates the number and size of welding spatters which closely coincide with welders' sensory evaluations. Bhargav C. Patel [11**]** et al, in their research paper "Optimizing and analysis of parameter for pipe welding: A literature review" emphasis on the study of the effect of different input parameter of TIG and MIG welding on the weld quality. They studied the effect of various welding parameter by conducting different experiments.

EXPERIMENTATION

Problem Statement :

Shielded Metal Arc Welding is a regularly used procedure in many industrial applications like automotive industry, construction of railway tracks and many others. Shielded metal arc welding is the simplest, least expensive, and mostly widely used arc welding.

Welding has many merits over bolting and riveting. Even though there are some defects in welding joints. Most defects in welding occurs at weld pool due to too fast weld speed, too high weld current and using too large electrode etc. So, Destructive or Non-destructive testing can be done to find the defects and hardness test is to be done to know the properties of the material.

RESULT AND DISCUSSION

Hardness Test:

In this project we have under gone the hardness of the weld joint by using leeb hardness test. We have used Leeb hardness (HL) to determine the harness number on the weld bead. The values and graphs are shown in below Table.

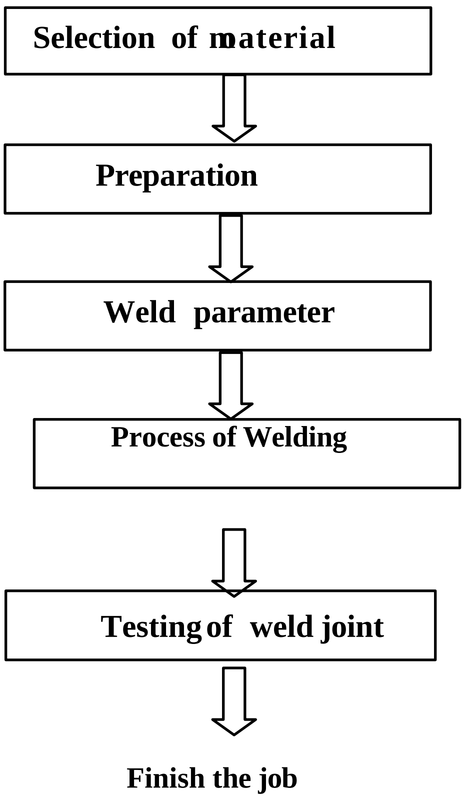
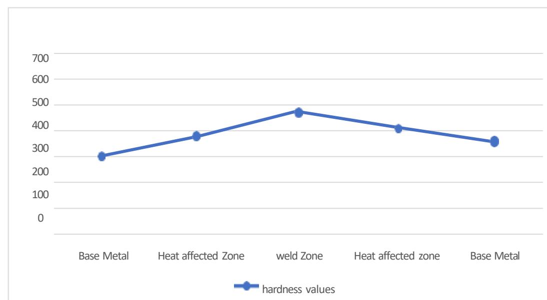


Fig:4: Hardness Test Graph

Base metal	Heat affected zone	Weld zone	Heat affected zone	Base metal
330	376	446	360	294
319	398	479	386	304
322	348	467	345	338

Table 5: Hardness Values of Leeb Hardness Tester



CONCLUSION AND FUTURESCOPE

By performing shielded metal arc welding to make T-weld joint we observed that, strength of the joint is weak as compared to other techniques. We also found some defects by performing liquid penetration test like slag, porosity, lack of fusion, excess penetration and improper welding. Hardness of the material at the weld zone is more than other part of parent material. The reason of low weld strength is E 6013 does leave a heavy slag formation and is relatively shallow penetrating if not correctly used. This electrode is better for welding smaller parts other than heavy parts. So, we can conclude that this technique may not good for strong weld joints. To get the good weld strength of this joint we should weld the joint by penetrating more metal and thicker weld pool. Suitable electrode is to be selected depending on material of parent metal.

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