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INFLUENCE OF VOLTAGE AND EFFECT ON THE SHIELDED METAL ARC WELDING EFFICIENCY

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Abstract - Welding plays a very vital role in manufacturing industry. As welding defects can generally affect the performance of the welding, early detection and correction are important to ensure that weld can carry out the required strength ensuring the welding of the joint. The main objective of this project is to "INFLUENCE OF VOLTAGE AND EFFECT ON THE SHIELDED METAL ARC WELDING EFFICIENCY". Various electrodes have been used with having high voltage and low voltage. A non-distractive test has been used to find the defects in the welding of high voltage and low voltage to get the defects obtained in both the voltages.

Key Words: Welding current, welding voltage, Non-Destructive testing.

1.INTRODUCTION

A welding power supply is utilized to make and keep an electric bend between a terminal and the base material to melt metals at the welding point. In such welding processes, the force supply could be AC or DC, the cathode could be consumable or non-consumable and a filler material might be added. A process that uses a coated consumable electrode to lay the weld. As the electrode melts, the flux coating disintegrates, giving off shielding gases that protect the weld area from atmospheric gases and providing molten slag which covers the filler metal as it travels from the electrode to the weld pool.

The Shielded Metal Arc Welding SMAW is a welding process, also called "stick welding", which is widely used in the construction industries and in repairing, as it offers more flexibility and portability. It utilizes a consumable electrode that is coated with a protective coating called Flux which provides the shielding of joints. During welding, the Flux coating on the electrode starts to burn which causes the release of shielding gas which protects the base metal and weldment from atmospheric contamination. The main atmospheric contaminants are Hydrogen and Oxygen, which cause defects in welding such as cracks and porosity, respectively.

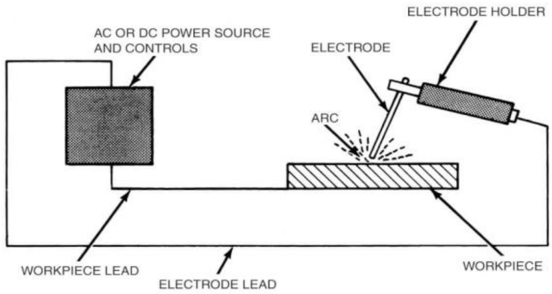


Fig -1: SMAW

2. PROBLEM STATEMENT

Joining materials with the help of a submerged arc welding machine is widely used in the concerned industries. It is a process of joining any two workpieces. The main aim of this project is to realize the effect of voltage and current on welding efficiency. Non-destructive testing like Liquid penetration testing was performed where the problems are identified on the two workpieces performed under both low and high current. The problems may arise like Porosity, Blowholes, spatter, undercut, deformation, etc. These problems can be resolved by setting the current and voltage ranges with the selected electrode diameter.

3. SELECTION OF MATERIAL

The material of Mild Steel is selected as workpiece for project. Because mild steel consists of the low carbon percentage of 0.25% to 0.30% which is also called as low carbon steel. For welding the mild steel very easy to weld when compared to high percentage carbon present in the metal.

S. no	Material	Length (mm)	Width (mm)	Thickness (mm)
1.	Mild Steel	150	100	6

Table -1: Selection of Material

4.SELECTION OF ELECTRODE: -

E6013 is the most widely used welding electrode for sheet metal welding, general fabrication & structural welding. E6013 is a delicate steel cathode that chips away at both low and high voltage and current in all positions. E6013 electrode flux coating contains titanium – potassium materials. The potassium compounds permit the electrodes to operate with ac at low amperages and low open-circuit voltages. E6013 passes on the smooth and stable bend with a low sprinkle and smoke and slag.

The welding amperage (current) setting mainly depends on the electrode diameter used:

Diameter	Low Current (Range)	High Current (Range)
2.5	50	100
3.15	60	125
4	100	160

Table - 2: Electrode specification

5. V-GROOVE CUTTING

Sheet metal V-grooving is used for bending and it is a method of establishing the bend line and bend angle using grooves cut along the bend line. It's also known as score-folding. V-grooving thins the material and reduces the bend radius. Bending with V-grooving also reduces the straightness deviations of the radius edge on long and narrow pieces. Using V grooving technology can produce crisp, clean, and consistent bend dimensions and angles. V-grooving also will improve notch accuracy and the look of the finished part.

Fig -2: V groove cutting

6. WELDING THE MATERIAL

The welding is done to the mild steel material with various diameter eletrode. Parameters has effecting the weldbead by varying the low voltage and high voltage to ARC welding.

Size(mm)	Current (Range)	Voltage
2.5	50	20
3.15	60	24
4	100	24

Table - 2: Low current welding

Size	Current (Range)	Voltage
2.5	100	40
3.15	125	30
4	160	30

Table – 3: High current welding

7. LIQUID PENETRATION TESTING

The liquid penetrates testing is one of the most widely used NDT methods. Its popularity can be attributed to two main factors: its relative ease of use and its flexibility. It can be used to inspect almost any material provided that its surface is not extremely rough or porous. Materials that are commonly inspected using this method include metals, glass, many ceramic materials, rubber, and plastics. However, liquid penetrant testing can only be used to inspect for flaws that break the surface of the sample (such as surface cracks, porosity, laps, seams, lack of fusion, etc.). The technique is based on the ability of a liquid that can be drawn into a clean surface discontinuity by capillary action. After a period called dwell time, excess surface penetrant is removed and a developer applied. This acts as a blotter that draws a penetrant from the discontinuity to reveal its presence.
The main advantages of LPT are the speed of the test and the low cost. Disadvantages include the detection of only surface flaws, skin irritation, and the inspection should be on a smooth clean surface where excessive penetrant can be removed before being developed. Conducting the test on rough surfaces, such as "as-welded" welds, will make it difficult to remove any excessive penetrant and could result in false indications. A water-washable penetrant should be considered here if no other option is available. Also, on certain surfaces, a great enough color contrast cannot be achieved, or the dye will stain the workpiece. Limited training is required for the operator — although experience is quite valuable. Proper cleaning is necessary to assure that surface contaminants have been removed and any defects present are clean and dry. Some

cleaning methods are detrimental to test sensitivity, so acid etching to remove metal smearing and re-open the defect may be necessary. Penetrant inspection can only be applied on non-porous materials.

Fig -2: LPT Test

Pre-Cleaning: The test surface is cleaned to eliminate any soil, paint, oil, slag, corrosion, or any free scale that could either keep penetrant out of deformability. Cleaning the area of interest on weld joints by cleaner or remover. The ultimate objective of this progression is a spotless surface where any deformities present are available to the surface, dry. The consumables used in the removal are Acetone (CH3COOH) + Solvent base.

Application of penetrant: The penetrant is then applied to the surface of the item being tested. The penetrant can be applied either by brushing or spraying to the entire area of interest.

Dwell Time: The penetrant is allowed "dwell time" to soak into any flaws (5 to 10 minutes). During this time the penetrant search for any openings or defects on the surface and sweep into those openings or defects.

Removal of excess penetrant: The excess penetrant is then removed from the surface. When using remover and free cloth it is important to not spray the remover on the test surface directly, because this can remove the penetrant from the flaws. If excess penetrant is not properly removed, once the developer is applied, it may leave a background in the developed area that can mask indications or defects.

Developing: After excess penetrant has been removed, a white developer is applied to the workpiece. Develop the area of interest by applying the developer. The developer used is Talcum powder + Solvent base. Ensure that the area of interest developed 100% by maintaining the interest distance of 6-7 inches between spray nozzle and area of interest. The developer draws penetrant from defects out onto the surface to form a visible indication, commonly known as bleed-out. Any areas that bleed out can indicate the location, orientation, and possible types of defects on the surface.

Interpretation: The inspector will use visible light with adequate intensity for visible defects. Inspection of the test surface should take place after 5 to 10 minutes of development time and is dependent on the penetrant and developer used. This time delay allows the blotting action to occur. The inspector may observe the sample for indication formation when using visible dye.

Post-Cleaning: The test surface is often cleaned after inspection and recording of defects, especially if post-inspection coating processes are scheduled.

8.HARDNESS TEST

Hardness addresses the obstruction of material surface to scraped spot, scratching and cutting, hardness after gives obvious sign of solidarity. In all hardness tests, a characterize power is precisely applied on the piece, changes fit as a fiddle for various tests. Normal indenters are made of solidified steel or precious stone. Rockwell hardness analyzer presents direct perusing of hardness number on a dial gave the machine. Essentially this testing is like Brinell hardness testing. It contrasts just in distance across and material of the indenter and the applied power. Despite the fact that there are many scales having various mixes of burden and size of indenter yet normally 'C' scale is utilized and hardness is introduced as HRC. Here the indenter has a diamond cone at the tip and applied power is of 150 kgf. Delicate materials are regularly tried in 'B' scale with a 1.6mm dia. Steel indenter at 60 kgf.
Rockwell hardness testing machine basically comprise of a supporting table for setting, a hand wheel to raise or lower the supporting table, a Rockwell ball indenter which is a solidified steel ball 1/6" in distance across, a Rockwell cone indenter which is a diamond cone of 120°.

1. Select the load by rotating the Knob and fix the suitable indenter.
2. Clean the test-piece and place the special anvil or work table of the machine.
3. Turn the capstan wheel to elevate the test specimen into contact with the indenter point.
4. Further turn the wheel for three rotations forcing the test specimen against the indenter. This will ensure that the Minor load of 98.07 N has been applied
5. Set the pointer on the Scale dial at the appropriate position.
6. Push the lever to apply the Major load. A Dash Pot provided in the loading mechanism to ensure that the load is applied gradually.
7. As soon as the pointer comes to rest pull the handle in the reverse direction slowly.
8. The Rockwell hardness can be read off the scale dial, on the appropriate scale, after the pointer comes to rest.
9. The test will be conducted on the Welding Zone, HAZ Zone, Base metal.
10. The same procedure will be continued on the root side of the both High and Low voltage workpieces.

S.no	Welding Zone	HAZ Zone	Base Metal
1.	50	51	46
2.	50	52	38
3.	55	52	33

Table – 4: Hardness testing of High Voltage welding

S. No.	Welding Zone	HAZ Zone	Base Metal
1.	57	68	70
2.	75	76	75
3.	71	60	62

Table – 5: Hardness testing of Low Voltage welding

9. TENSILE TESTING:

Tensile testing is a destructive process that talks about the tensile strength, yield strength, ductility of a specimen. The tensile test measures the resistance of a material to a static or slowly applied force. The Ultimate tensile of a material is a concentrated property; subsequently its value doesn't rely upon the size of the test specimen. However, depending upon the material, it may be depended upon on the elements, like the planning of the specimen, the presence or in any case of surface imperfections, and the temperature of the test climate and material.

Procedure:

1. A tensile specimen is a standardized sample cross-section.
2. Put the marks on the Low Voltage specimen and cut the specimen in the required dimension.
3. Measure the initial specimen length, width and thickness.
4.Place the specimen between upper and lower jaw faces.
5.After a gripping of a specimen between the faces tight the jaw.
6.Now check the elongation scale in a zero position.
7.Apply load on the specimen gradually.
8.As the load is gradually given to the specimen breaks at a point due heavy load induced.
9.As it is a tensile test the elongation must be measured on the scale.
10.When the specimen breaks note the load readings and the elongation of the work piece
11.Repeat the same for the low voltage weld joint specimen.

Length	Thickness	Load	Deflection	Elongation	Tensile Stress
190mm	6mm	25KN	7	120	200N/mm2

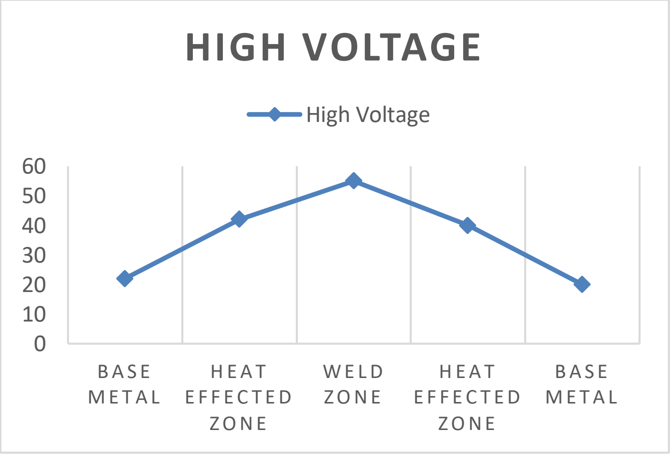
Table - 6: Low Voltage

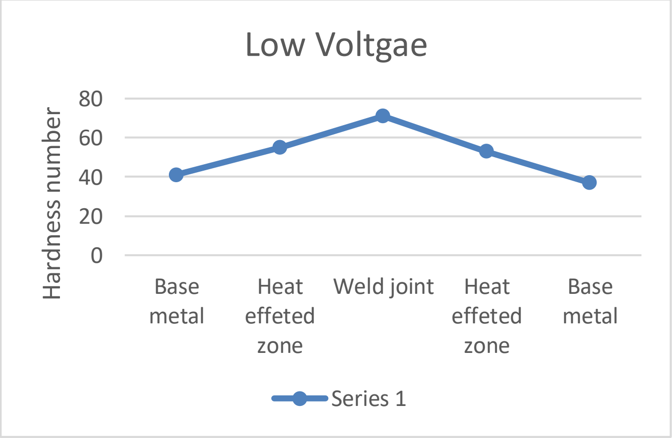
Length	Thickness	Load	Deflection	Elongation	Tensile Stress
190mm	6mm	60KN	221	210	480N/mm2

Table-7: High Voltage

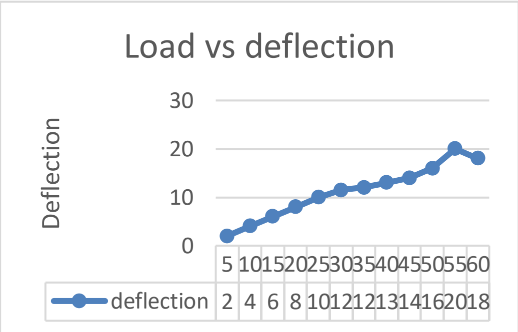
10. CONCLUSIONS:

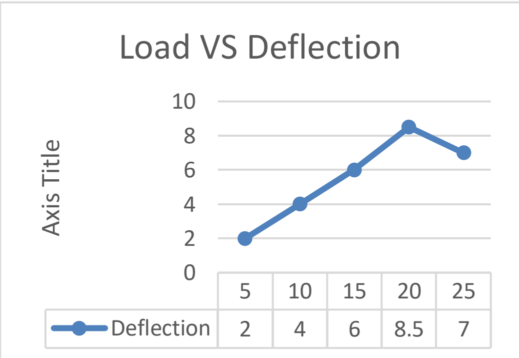
In this journal we have concluded the weld joint has been performed with voltage parameter variation we have found the various different defects has been observed by using the non-destructive testing "LPT test". When the joint is welded with the high voltage then we have found the over penetration, spatter and under cut. When it comes to low voltage parameter, we found lack of penetration and blow hole. Hardness test has been done using Rockwell harness test on both high voltage and low voltage specimen. To determine hardness of welded specimen we can see the harness number in the graph. By using hardness number, we can determine the welding zone has highest harness point in the graph

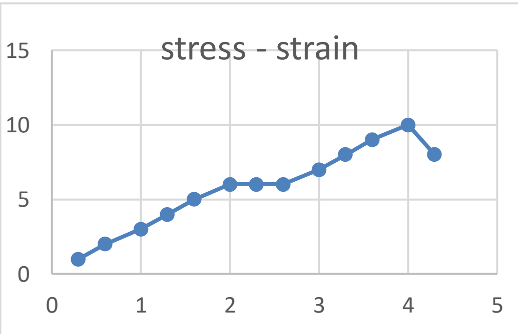


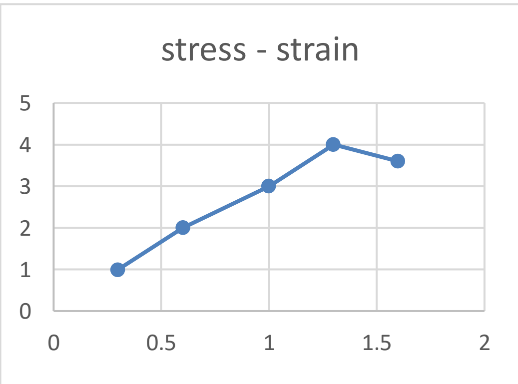


Then we have performed the tensile test to check weld bead efficiency by giving the loads on each end as the loads are gradually given on weld bead at a point the joints break. As we can see the graphs of the tensile test using high voltage parameter gives the more elongation compared to the low voltage parameter because when we use low voltage parameter to weld the electrode does not melt properly so weld bead is not formed correctly. Due to improper penetration the low voltage parameter doesn't elongate and doesn't hold the stress and strain to the maximum load.









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