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DIFFERENCE BETWEEN TENSILE STRESS OF WELD JOINT PERFORMANCE BY E6013 AND E7018 ELECTRODE

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Abstract - Welding plays very important role in the manufacturing industry and to check the quality of manufacturing. As welding defects can generally affect used performance, early detection and correction is important to ensure that weld can carry out their designed purpose for ensure the quality of welding joint. Various inspection methods are available in today's modern industries.
The main object of the project is "Study of Electrodes and tensile stresses on weld joint".
Non-destructive testing is done by liquid penetrant testing to Identify the defects on weld area using 6013 and 7018 electrodes. Non-destructive testing plays a main role in finding the defects on weld joint. Hardness testing is to identify the mechanical properties of the specimen by using Rockwell testing machine.
Destructive testing machine is done to identify the strength of the weld area using E6013 and E7018 electrodes. In destructive testing stress and strain of a material also identified.

***Key Words*:** Manufacturing, Non-Destructive Testing, Destructive Testing, Electrode, Liquid Penetrant Testing, Hardness testing.

1.INTRODUCTION

Welding is a permanent process of joining two pieces of metals together to form a single piece of metal by heating the metal to their melting point. For lower temperature metal joining process use soldering and brazing. Which do not melt the base metal. To melt the base metal, we use filler rod used to join a pool of molten metal, can be stronger than parent metal. Different types of energy sources are used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. They can use direct current (DC) or alternate current (AC) and the electrodes are consumable and non-consumable. The welding region is protected by shield to protect from air to not oxidized at molten metal region.

2. PROBLEM STATEMENT

Joining of two materials with the help of Shielded Metal Arc Welding (SMAW), this welding process is used commonly in daily life. By non-destructive testing using liquid penetrants we identified 6013 electrodes has no significant indicates on cap face and coming to 7018 we have indicated the defects like Blow hole, Undercut.

To overcome this problem, we better prefer to use 6013 electrodes. 6013 electrode is deeper penetrant than as compared to 7018 electrodes. 6013 and 7018 electrodes are used commonly for welding applications like shipbuilding, constructions. 6013 electrode rods can weld through contaminants like rust.

3.MATERIAL SELECTION

Material selection Material selection is the act of selection the material most suitable to achieve the necessity of a given application. there are different factors to selection requirements, such as mechanical properties, chemical properties, physical properties, electrical properties, and cost.

4.ELECTRODE SELECTION

We use two types of electrodes:
1. E6013
2. E7018

i. 6013 Electrode:

E6013 is a medium rutile coated mild steel electrode that operates on low voltage and current i.e., 50v AC in all positions and is ideally suited for general structural welding, welding of pipe sockets grill general repair welding in automobile garages. E6013 delivers smooth and stable arc with low spatter and smoke, excellent slag detachability and smooth weld bead appearance. The weld deposit is of a radiographic quality. It is mostly used for arc wildings.

Figure 1: Electrode 6013

C	Mn	Cr	Si
0.08%	0.5%	0.06%	0.3%

Table 1: Composition of E6013

ii.7018 Electrode:

Low-hydrogen welding is a main component of many fabrication and maintenance applications. Covered electrodes are frequently used in all types of weather and in hard-to-reach locations. Expert welders want a stick electrode they can rely on for deep penetration, expected quality, and X-ray caliber welds. But not all covered electrodes are produced equal. The same quality and expertise that goes into the Atom Arc line also goes into the 7018 covered electrode. 7018 electrodes are best for general fabrication and welding, offering consistent performance and welder interest.

Figure 2: Electrode 7018

C	Mn	Cr	Si
0.9%	1.10%	0.1%	0.6%

Table 2: Compositioin of E7018

5. V-GROOVE

Making a V-Groove for work piece of MS plate with making an angle of 30-35 degrees to the 4 work pieces

Figure 3: V-Groove Cutting

6. WELDING

The two Mild steel work piece metals are joined by using shielded metal arc welding. A support plate is placed on the two mild steel metals for making proper welding between the two Mild steel plates. By using 6013 and 7018 electrode two work pieces are joined by shielded metal arc welding.

Figure 4: Welding done by E6013

Figure 5: Welding done by E7018

7. LIQUID PENETRATION TESTING

It is a type of non-destructive testing method using to find the defects on the weld area (Cap and Root)

Cleaning

Cleaning the area of interest by penetrant removal or cleaner. Apply cleaner on the weld area.

Figure 6.1: Applying Cleaner

Application of Penetrant

After cleaning with the help of cleaner on surface after applying penetrant by spraying on the area of interest and enters into defects on weld area.

Figure 6.2: Applying Penetrant on weld area

Dwell Time

Given some time to penetrant to enter the defects on area of interest by giving 5-10 minutes.

Removal of Excess Penetrant

Take the cotton and remove the excess penetrant on the weld area in one direction.

Figure 6.3: Removal of excess penetrant

Applying Developer

Apply developer to absorb penetrant on to the surface. And usually takes approximately 5-10 minutes.

Figure 6.4: Developer applied on work piece

Interpretation

Finding the defects on the weld area.

Figure 6.5: Defect on the weld area

Inspection

Inspecting the work piece and identifying the defects.

Figure 6.6: Inspecting on Cap face weld

Figure 6.7: Inspecting on Root face weld

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. Even though 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 worktable 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 both E6013 and E7018 workpieces.

S No	Base Metal	HAZ Zone	Welding Zone
1	42	59.5	67
2	40	58	65
3	38	58	62

Table 3: Hardness Test of E6013 Electrode

S No	Base Metal	HAZ Zone	Welding Zone
1	40	58	69
2	37	56.5	65
3	35	52	62

Table 4: Hardness Test of E7018 Electrode

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	65KN	220mm	30	520N/mm^2

Table 5: Electrode 6013

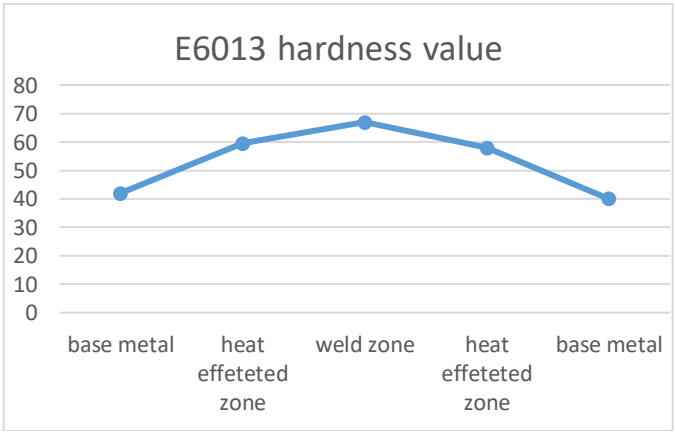
Length	**Thickness**	**Load**	**Deflection**	**Elongation**	**Tensile Stress**
190mm	6mm	58KN	10mm	200mm	484KN/mm^2

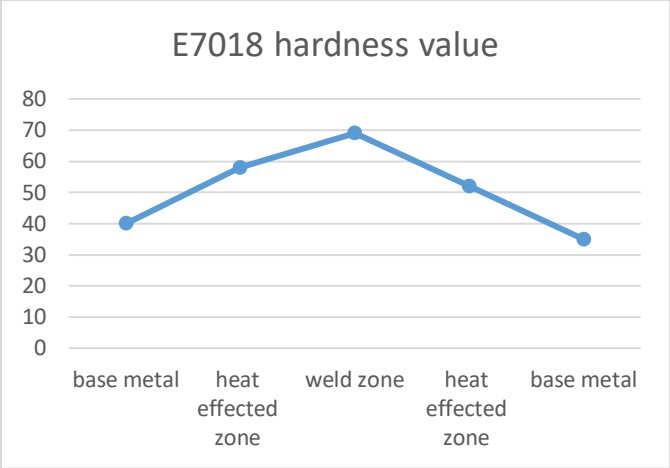
Table 6: Electrode 7018

10. CONCLUSIONS

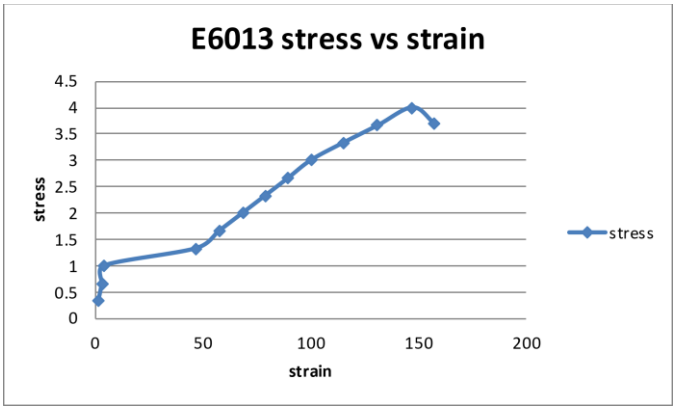
In this journal we have concluded the weld joint has been performed with voltage parameter variation we have found the various defects has been observed by using the nondestructive testing “LPT test”. When the joint is welded with the Electrode 6013 parameters, we have found no significant on cap side and lack of penetration and excess penetration on root side. When it comes to Electrode 7018 parameters, we have found Blow holes and undercut on cap side and lack of penetration and incomplete penetration on root side. Hardness test has been done using Rockwell harness test on both E6013 and E7018 specimen. To determine hardness of welded specimen we can see the hardness number in the graph. By using hardness number, we can determine the welding zone has highest hardness point in the graph.

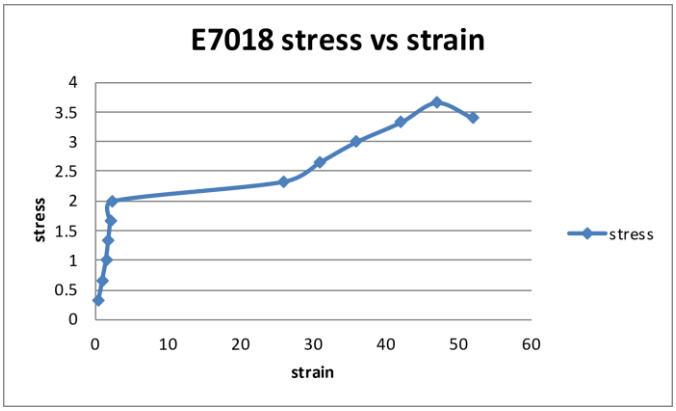
Graphs:

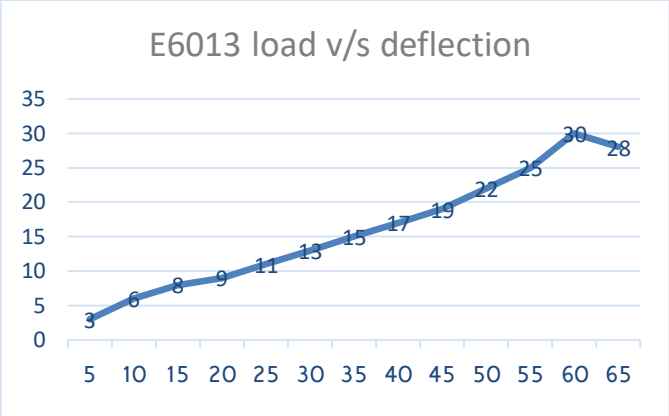


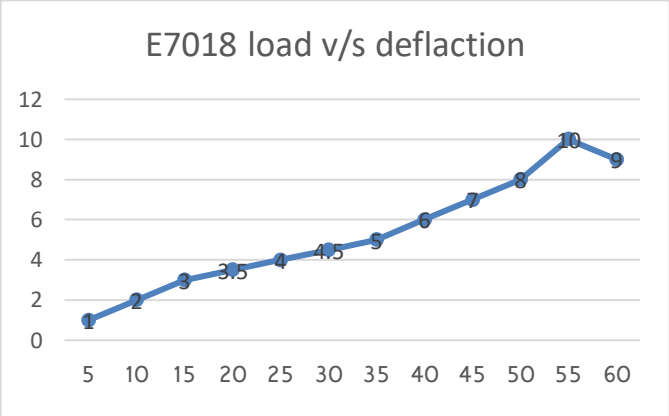


Then we have performed the tensile test to check weld bead efficiency by giving the loads on each end as the loads are gradually given on weld bead at a point the joints break. As we can see the graphs of the tensile test using E6013 parameter gives the more elongation compared to the E7018 parameter because when we use E7018 electrode it should be placed in oven before we use the electrode. Due to low hydrogen electrode, it may reacts fast with the atmosphere and form the defects on the weld area and it does not withstand a maximum load.









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