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Effect of SMAW Welding Current Using E 7018 Electrodes on Aisi 1050 Steel on Tensile Strength and Toughness

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AISI 1050 steel using the E7018 electrode is a steel that is involved in making household equipment and agricultural tools suchas scissors, sickles and hoes, which in their application often experience friction and pressure. So resistance to pressure and hardness are very necessary. To find out the mechanical properties, testsare carried out in the form of hardness tests, tensile tests and SMAW welding tests.(Shielded MetalArc Welding). In this research, current variations of 60 A, 80 A and 100 A were carried out using E7018 electrodes with a diameter of 3.2 mm, then tensile tests were carried out.

KEYWORDS: SMAW Welding, E 7018 Electrodes, AISI 1050 Steel

1. INTRODUCTION

1.1 Background

The development of increasingly advanced technology in the construction sector cannot be separated from welding because it has an important role in metal engineering and repair. Nowadays, construction development involves a lot of welding elements, especially in the field of design, because welded joints are one of the types of joints that technically require high welding skills in order to obtain good quality joints.

The factor that influences welding is the welding procedure, namely a plan for carrying out research which includes how to make welded construction according to plans and specifications by determining all the things needed for the implementation.

The quality of the welding results depends not only on the welding work itself but also very much depends on the preparation before welding, because welding is theprocess of joining two or more metal parts using heat energy. According to the current, SMAW welding machines can be divided into three types, namely direct current (DC) welding machines, alternating current (AC) welding machines, and dualcurrent welding machines which are welding machines that can be used for direct current (DC) welding and direct current (DC) welding. back and forth (AC).

The choice when using DC negative or positive polarity is primarily determined bythe electrode used. Some SMAW electrodes are designed to be used only DC- or DC+. Other electrodes can use both DC- and DC+. This welding uses an E7018 electrode with a diameter of 3.2 mm, so the current used ranges from 60-100 Amperes. With this current interval, the resulting welding will be different.

Not all metals have good weldability. Materials that have weldability include low alloy steel. This steel can be welded with wrapped electrodes, low arc welding andMIG welding (noble gas metal welding).

The strength of the welding results is influenced by the arc voltage, the amount ofcurrent, the welding speed, the amount of penetration and the electrical polarity. Determining the amount of current in this welding takes 60 Amps, 80 Amps, and 100 Amps. Taking 60 Amps is intended as a comparison with the current interval above.

2. RESEARCH METHODS

2.1 Test Implementation Method

a. Tensile Test Specimens

Preparing material, namely AISI 1050 steel, forming specimens according to testingstandards, as well as making joints for welding. The seam used is V seam.

b. Welding Process

After the specimen is formed according to standards, then the specimen is welded using SMAW welding (Shielded Metal Arc Welding). Before the welding process, the specimen is cleaned of dirt to avoid weld defects. The following is the welding procedure according to the specified parameters, namely:

1. Single V seam welding for tensile test specimens with currents of 60, 80, 100 Ampere.
2. The electrode used is E7018.
3. After welding is complete, the specimen is cooled with air cooling media.

c. Testing Process

One of the aims of this study was to compare traitsAISI 1050 steel mechanics with SMAW welding based on variations in current to be used.

3. ANALYSIS AND DISCUSSION

3.1 Tensile Test Results (Tensile Test)

The results of the research were carried out on AISI 1050 steel where this test was carried out at the Medan State Polytechnic Laboratory. This research uses E7018 electrodes with current variations of 60, 80, and 100 Amperes. The tensile test results for each variation can be seen in the following table:

Tensile Test Results at 60 Ampere Current

From the results of research on a current of 60 amperes, it can be described as follows:

1. Specimen code 60A-1 with a width of 15.04 mm, a thickness of 7.78 mm has a yield force of 37,100 N, a maximum force of 61,600 N, resulting in a yield stress of 317.06 N/mm2, a tensile stress of 526.45 N/mm2, a strain of 3.43 %, and modulus of elasticity 153.5 N/mm2.
2. Specimen code 60A-2 with a width of 14.47 mm, a thickness of 7.64 mm has a yield force of 38,400 N, a maximum force of 73,000 N, resulting in a yield stress of 374.35 N/mm2, a tensile stress of 660.33 N/mm2, a strain of 6.48 %, and modulus of elasticity 101.9 N/mm2.

3. Specimen code 60A-3 with a width of 14.27 mm, a thickness of 7.6 has a yield force of 47,800 N, a maximum force of 66,800 N, resulting in a yield stress of 437.30 N/mm2, a tensile stress of 611.12 N/mm2, a strain of 6.17 %, and modulus of elasticity 99.0 N/mm2.

From the description above it can be taken that the average value of yield stress is 367.44 N/mm2, the average value of tensile stress is 599.30N/mm2, while the average value of strain is 5.36%, and has an average value -The average modulusof elasticity is 118.14 N/mm2. So it can be concluded that the tensile strength valueat a current of 60 amperes has decreased from the strength of steel without welds,namely 599.30 N/mm2 (the highest test tensile strength at a current of 60 Amperes) and 680 N/mm2 (without welds).

3.1.1 Tensile Test Results at 80 Ampere Current

From the table of research results on a current of 80 Ampere it can be described as follows:

1. Specimen code 80A-1 with a width of 15.08 mm, a thickness of 7.82 mm has a yield force of 52,400 N, a maximum force of 73,400 N, resulting in a yield stress of 444.35 N/mm2, a tensile stress of 622.43 N/mm2, a strain of 5.91 %, and modulus of elasticity 105.3 N/mm2.
2. Specimen code 80A-2 with a width of 13.92 mm, a thickness of 7.74 mm has a yield force of 50,200 N, a maximum force of 65,600 N, producing a yield stress of 465.93 N/mm2, a tensile stress of 608.87 N/mm2, a strain of 5.71 %, and modulus of elasticity 106.6 N/mm2.
3. Specimen code 80A-3 with a width of 14.43 mm, a thickness of 7.6 mm has a yield force of 42,400 N, a maximum force of 69,400 N, resulting in a yield stress of 386.62 N/mm2, a tensile stress of 632.82 N/mm2, a strain of 7.19 %, and modulus of elasticity 88.0 N/mm2.

From the description above it can be taken that the average value of yield stress is 432.30 N/mm2, the average value of tensile stress is 621.37N/mm2, whilethe average value of strain is 6.27%, and has an average value -The average modulus of elasticity is 99.98 N/mm2. So it can be concluded that the tensile strength value at a current of 80 Amperes has decreased from the strength of steelwithout welds, namely 621.37 N/mm2 (the highest test tensile strength at a current of 80 amperes) and 680 N/mm2 (without welds).

3.1.2 Tensile Test Results at 100 Ampere Current.

From the results of research on a current of 80 amperes, it can be described as follows:

1. Specimen code 100A-1 with a width of 14.81 mm, a thickness of 7.69 mm has ayield force of 53200 N, a maximum force of 77600 N, producing a yield stress of 467.12 N/mm2, a tensile stress of 681.37 N/mm2, a strain of 10.06 %, and modulus of elasticity 67.7 N/mm2.
2. Specimen code 100A-2 with a width of 13.47 mm, a thickness of 7.73 mm has ayield force of 61200 N, a maximum force of 71600 N, resulting in a yield stress of 587.77 N/mm2, a tensile stress of 687.65 N/mm2, a strain of 6.01 %, and modulusof elasticity 114.4 N/mm2.
3. Specimen code 100A-3 with a width of 14.49 mm, a thickness of 7.69 mm has ayield force of 48,200 N, a maximum force of 62,400 N, resulting in a yield stressof 432.57 N/mm2, a tensile stress of 560.00 N/mm2, a strain of 6.80 %, and modulus of elasticity 82.4 N/mm2.

The results of the tensile test obtained in the description above can be taken as anaverage value of yield stress of 495.82 N/mm2, the average value of tensile stress is 643.01N/mm2, while the average value of strain is 7.62 %, and has an average value of elastic modulus of 209.6 N/mm2. So it can be concluded that the tensile strength value at a current of 100 Amperes has decreased compared to the strengthof steel without welds, namely 643.01 N/mm2 (the highest test tensile strength at acurrent of 80 amperes) and 680 N/mm2 (without welds).

3.2 Stress, Strain and Modulus of Elasticity Graphs

3.2.1 Tensile Stress Graph

The current draw graph of 60, 80, and 100 amperes can be seen in the followingpicture:

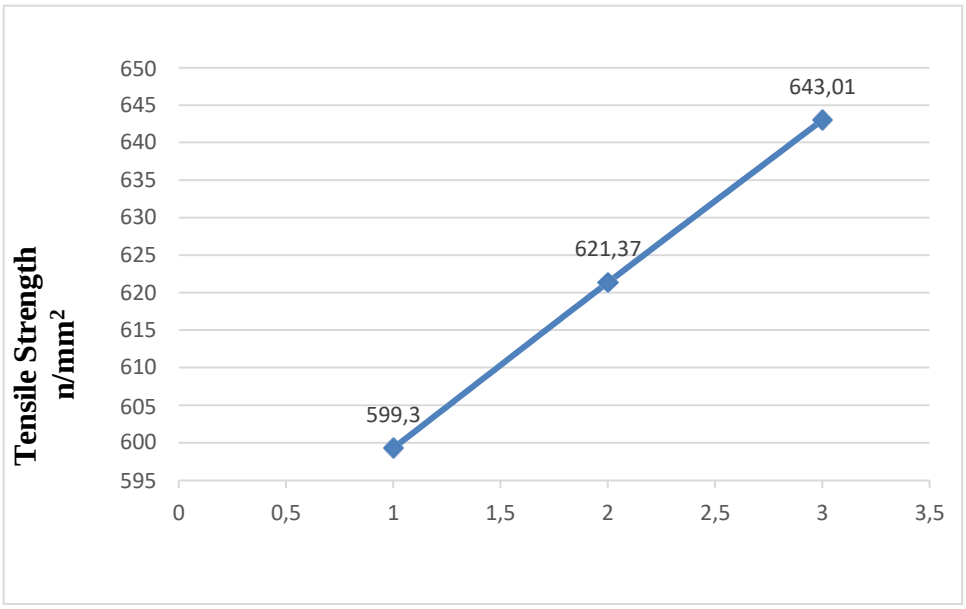

Figure 3.1 Current with Tensile Stress

From the tensile stress graph above it can be described as follows:

1. A current of 60 Ampere has a tensile stress value of 599.30 N/mm2
2. A current of 80 Amperes has a tensile stress value of 621.37 N/mm2
3. A current of 100 Ampere has a tensile stress value of 643.01 N/mm2

From the description of the tensile stress above, it can be concluded that AISI 1050steel using E7018 electrodes with a current of 100 amperes has the highest average tensile stress value, namely 643.01 N/mm2. Meanwhile, the lowest average value of tensile stress is found at a current of 60 amperes with a value of 599.30 N/mm2.This shows that there is an influence of current strength on welding AISI 1050 steelfor tensile tests, the greater the welding current strength, the higher the average stress.

3.2.2 Strain Value Graph**.**

A graph of strain values of 60, 80, and 100 Ampere can be seen in the following image:

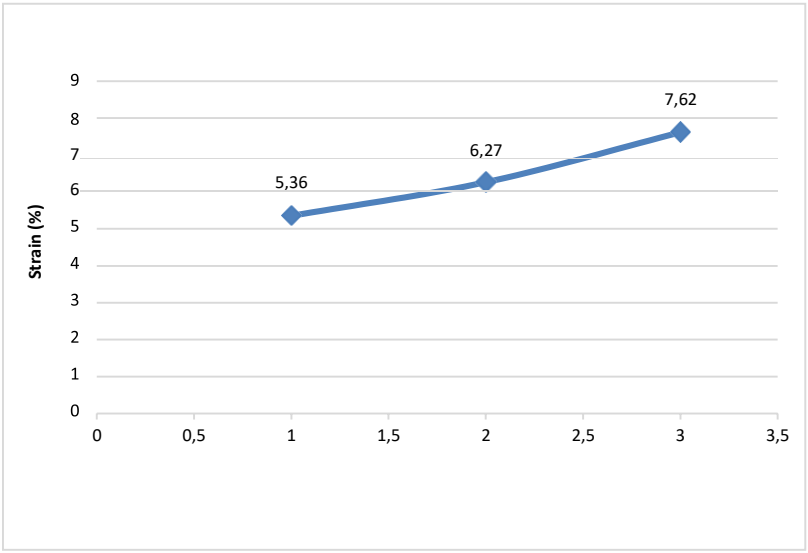

Figure 3.2 Strain Value

From the tensile stress graph above it can be described as follows:

1. A current of 60 amperes has a strain value of 5.36%
2. A current of 80 amperes has a strain value of 6.27%
3. A current of 100 amperes has a strain value of 7.62%

From the description of the strain above, it can be concluded that AISI 1050 steelusing E7018 electrodes with a current of 100 amperes has the highest average strain value, namely 7.62%. Meanwhile, the lowest average strain value is found ata current of 60 amperes with a value of 5.36%. The greater the current used in welding AISI 1050 steel, the strain will continue to decrease as the current increasesin welding.

3.2.3 Elasticity Modulus Graph

The elastic modulus graph can be seen in the following image:

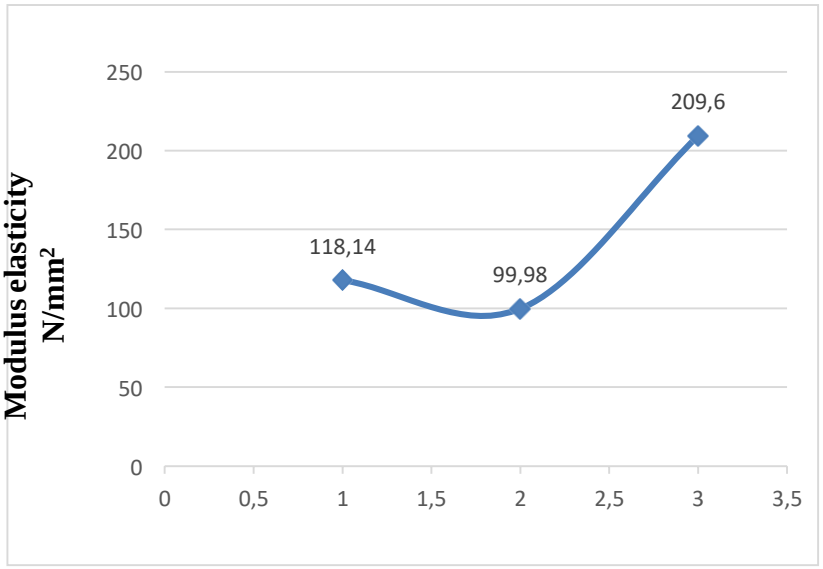

Figure 3.3 Flow with Modulus of Elasticity

From the tensile stress graph above it can be described as follows:

1. A current of 60 amperes has a modulus of elasticity value of 118.14 N/mm2
2. A current of 80 amperes has an elastic modulus value of 99.98 N/mm2

A current of 100 amperes has an elastic modulus value of 209.6 N?mm2 From the description of the modulus of elasticity above, it can be concluded that the highest value of the modulus of elasticity is found in welding with a current strength of 100 amperes, amounting to 209.6 N/mm2. Meanwhile, the lowest elastic modulus value was found in welding with a current strength of 80 amperes, amounting to 209.6 N/mm2.

3. CONCLUSIONS AND RECOMMENDATIONS

3.1 Conclusion

From the results of the research carried out on Aisi 1050 steel using the E7018 electrode, it can be concluded that the temperature in the welding test process hasa great influence on the tensile strength value of the specimen resulting from welding with heat treatment.

1. Based on the results, the average tensile strength at a current of 60 A has the largest average value of 599.30 N/mm2, with an average strain of 5.36% and anaverage elastic modulus value of 118.14 N/mm2.
2. Based on the tensile strength results at a current of 80 A, it has an average tensilestrength value of 621.37N/mm2, with an average strain value of 6.27% and an average elastic modulus value of 99.98 N/mm2.
3. Based on the tensile strength results at a current of 100 A, the average tensile strength value is 643.01N/mm2, with an average strain value of 7.62% and an average elastic modulus value of 209.6 N/mm2.
4. Based on the results, the tensile strength of Aisi 1050 steel before welding is equal to 680 N/mm2 means a decrease in tensile strength after experiencing Welding.

3.2 Suggestion

Based on the conclusions above, the following are some suggestions that can begiven from the results of research on Aisi 1050 steel with currents of 60 A, 80 A, 100A, namely

1. It is best to warm up the electrode first before welding to remove the hydrogenin the flux, because hydrogen will cause the welds to be of poor quality.
2. The tensile test analysis should be carried out more carefully.
3. It is hoped that future researchers will be able to look for tensile and toughness test results on welding results in the comparison group

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