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# THE EFFECT OF ELECTRIC CURRENT ON SMAW WELDING RESULT WITH E-7024 ELECTRODE IN S45C MEDIUM CARBON STEEL

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**Abstract.** Several factors affect the results of welding strength, including welding position. Welding positions will give different results to the strength of the welding results. The type of welding electrode also greatly affects the characteristics of the welding result. For this reason, research will be conducted on SMAW welding for butt joints with current variations of 80 A, 90 A, 100A, 110 A and 120A. The current draw of 80 A is intended as the lowest current limit and 120 A as the highest current limit. The specimen used is a construction medium carbon steel plate (S45C) with an E-7024 electrode and a size of 100 x 60 x 10. The type of seam or welding connection used is V seam welding position 2F (Fillet). Each current variation uses 5 samples. Specimen testing using visual test and bending test. Based on the results of the research conducted, it can be concluded as follows: The use of a current of 120 A produces a relatively good redemption when compared to a current smaller than 120

A. The minimum current is 80 A, the arc flame is slightly inhibited so that when welding the electrode and object are melted work does not occur optimally.

**Keywords:** Smaw Welding, Bending Test, S45c Medium Carbon Steel.

## INTRODUCTION

Factory or industry is a place to make and produce a product or goods. With the existence of industry, so many goods are produced or produced to be traded or traded to consumers. In producing an item can not be separated from technology, one of these technologies is welding. Welding is a process of joining two metals together by melting them through heating.

Currently, the use of welding in the industrial world is increasingly advanced and has experienced significant developments. The electric arc welding technique with encased electrodes has been widely used in joining bars in steel building construction and machine construction. This is because not all of the construction can be printed or through the casting process. In order to reduce manufacturing costs, the construction is designed with welded joints, which facilitates the manufacturing process of assembling a product.

In SMAW welding, the electrode has an important role as a connecting material between the two metals to be welded and these electrodes consist of many sizes, types and are sold in various brands. In order to get good welding results, the electrodes used must be adjusted to the material that has been welded and the selection of the right welding parameters will also improve the quality of the welding results.

The most likely result of the welding process is that weld cracks occur due to hydrogen diffusion and residual stresses. Hydrogen diffusion is caused when the weld metal melts, the metal absorbs a large amount of hydrogen which is released by diffusion at low temperatures because at that temperature the solubility of hydrogen decreases. The source of the absorbed hydrogen is water and organic matter contained in the flux and the base metal. While the residual stress is the emergence of a larger voltage spike due to a change in the properties of the material at the joint, especially in the heat affected area or HAZ (Heat Affected Zone), because the area is a metal area adjacent to the weld metal area which during the welding process undergoes a thermal cycle. fast heating and cooling. This causes the tensile strength and hardness of the weld joint to decrease.

## METHODS

In this study using primary data, the material used is S45C medium carbon steel with a size of 100 x 60 x 10mm. and carried out as many as 25 tests where each test variable is five samples. The type of welding that has been carried out is a butt joint using variations of electric currents of 80, 90, 100, 110, 120 amperes using the E-7024 electrode, then a bending test is carried out to determine the quality of the welding results.

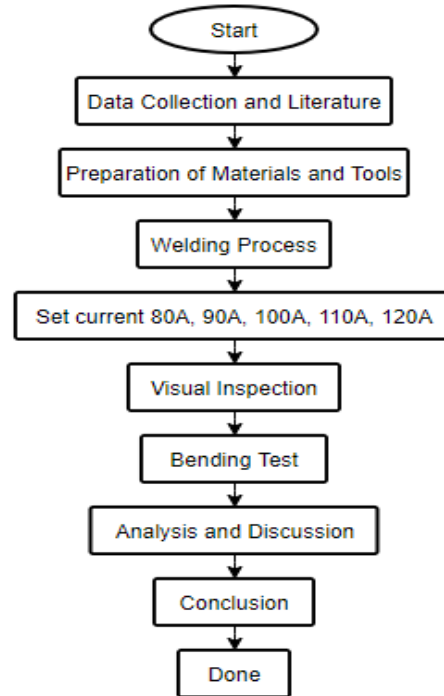


FIGURE 1. Flowchart

The explanation of the research workflow is as follows:

1. Preparation of Materials and Tools

Preparation of materials and tools includes preparing specimens that have been welded for later testing. The specimen used is a construction steel plate (S45C) with a size of 100 x 60 x 10 mm. To get valid test results, the researchers used a sample of 25 pieces, in other words one test variable was five samples.

2. Specimen Data Collection

The type of seam or welded joint used is a butt joint, the plate thickness is 10 mm. preparation of materials using an automatic cutting torch so that specimen preparation can be fast and precise in time and dimensions. The current variations used are 80, 90, 100, 110 and 120 amperes. The type of polarity used is reverse polarity DC+.

3. Specimen testing

Specimen testing using bending test.

4. Data Analysis

Data analysis is in the form of bending test results and looking for the most appropriate welding parameters to get the most suitable welding results.

## TOOLS AND MATERIALS

This research uses tools and materials in the welding process and bending test. Here are the tools and materials used.

Tools and materials used:

The specimen used is a construction medium carbon steel plate (S45C) with an E-7024 electrode and a size of 100 x 60 x 10. The type of seam or welding connection used is a butt joint, a plate thickness of 10 mm with a welding position of 2F (Fillet). Specimen testing using SMAW electric welding machine and bending test equipment.



Figure 2. Bending Test



Figure 3. SMAW Electric Welding Machine



Figure 4. Electrode E-7024

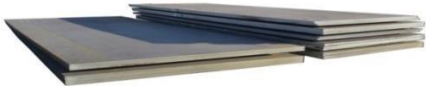


Figure 5. Medium Carbon Steel S45C

**RESULTS AND DISCUSSION**

From the results that have been obtained and carried out the welding process and bending test. The following are the results obtained after doing the welding process and bending test.

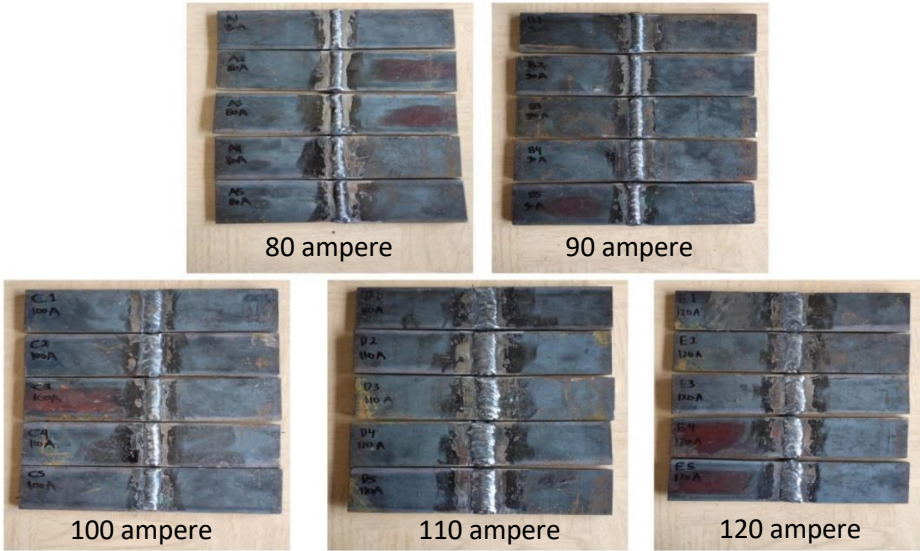
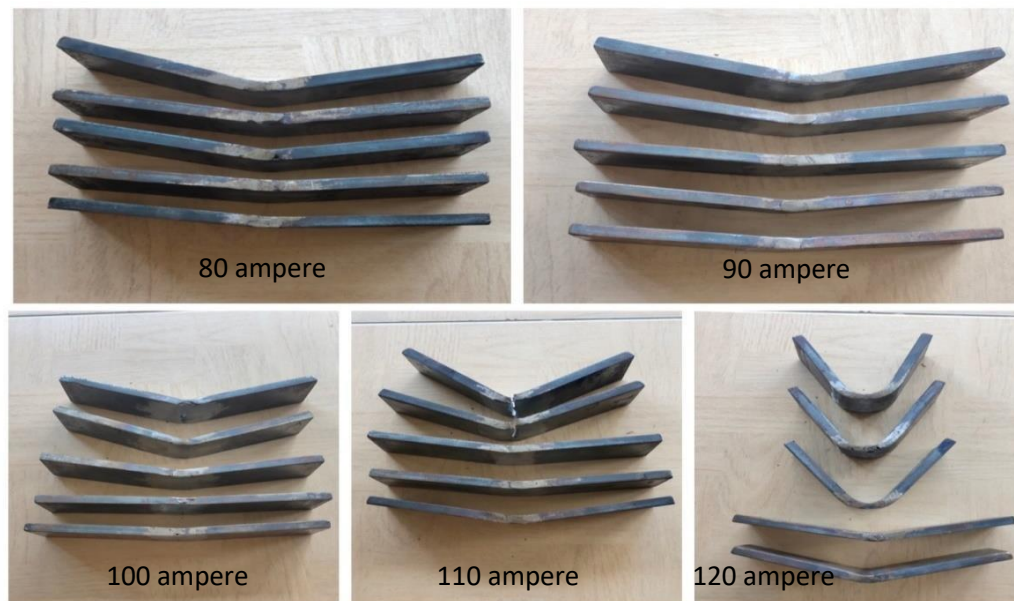


Figure 6. Visual observations of SMAW welding with currents of 80, 90, 100, 110, 120 Ampere

From the results of the surface of the S45C steel plate, it can be seen that there are no significant visual defects. The results of the weld bead produced are also very good according to the movement of the electrode when the welding process is carried out. So that according to the standard acceptance criteria for the visual test according to the AWS D1.2 standard for S45C steel plate, it is accepted.

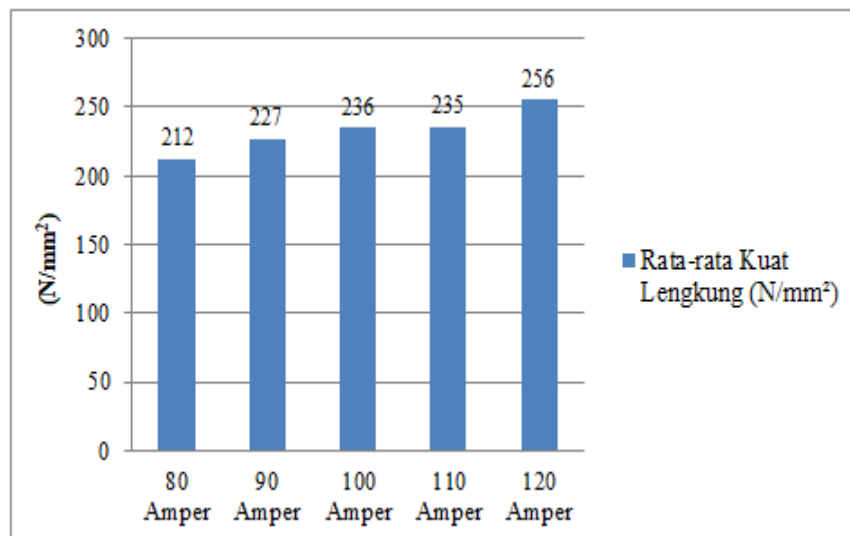
The results of the bending test with the SMAW welding method can be seen in the following figure:



**Figure 7.** Bending test results with SMAW welding method

From the results of the bending test, it can be analyzed, based on the acceptance criteria mentioned in ASME Sect IX QW-163 in the bending test. Based on the bending test, namely the face bend and root bend, it was found that there were defects in the specimens that had been subjected to the bending test.

The results of the bending test above show that the current that has the highest bending strength is 120 ampere, followed by 100 ampere and 110 ampere and 90 ampere and 80 ampere. the variation of the welding current to the bending strength, which can be seen in graph 1. below:



**Figure 8.** Effect of current variation on bending strength



From Figure 8 the results of the tests carried out show that a current of 80 ampere has a bending strength of  $212 \text{ N/mm}^2$ , a current of 90 ampere has a bending strength of  $227 \text{ N/mm}^2$ , a current of 100 ampere has a bending strength of  $236 \text{ N/mm}^2$ , a current of 110 ampere has a bending strength of  $235 \text{ N/mm}^2$  and a current of 120 ampere has the highest bending value of  $256 \text{ N/mm}^2$ . In this study, the best current bending strength in SMAW welding is at 120 ampere with a bending strength of  $256 \text{ N/mm}^2$  because it does not experience fatal cracks.

## CONCLUSION

From the results of the study, it can be concluded that from the visual test results on the surface of the S45C steel plate, it can be seen that there are no significant visual defects. The results of the weld bead produced are also very good according to the movement of the electrode when the welding process is carried out.

From the results of bending tests carried out that 80 ampere current has a bending strength of  $212 \text{ N/mm}^2$ , 90 ampere current has a bending strength of  $227 \text{ N/mm}^2$ , a 100 ampere current has a bending strength of  $236 \text{ N/mm}^2$ , a 110 ampere current has a bending strength of  $235 \text{ N/mm}^2$  and a current of 120 ampere have the highest bending value of  $256 \text{ N/mm}^2$ . In this study, the best current bending strength in SMAW welding is at 120 ampere with a bending strength of  $256 \text{ N/mm}^2$  because it does not experience fatal cracks.

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