IMPACT OF ELECTRIC CURRENT ON SMAW WELDING STRENGTH

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IMPACT OF ELECTRIC CURRENT ON SMAW WELDING STRENGTH

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Abstract: Welding Shield Metal Arc Welding is a process of joining two metals by utilizing heat from jumping electrodes at two different poles. In this welding technique, the connecting material or metal material (electrode) is metal that has been coated with flux (welding slag). This study aims to determine whether current variations affect the impact strength in the SMAW welding process. In this study, welding was carried out on the ST 41 material using the E 6013 electrode with electric current variants on the SMAW welding machine, namely: 60 A and 85 A, followed by the Charphy impact test used to determine the strength of the ST 41 steel connection. The results obtained with the ST41 200A material were 0.566 J/mm^2 and for the ST41 210A material, it was obtained 1.662 J/mm^2. With research showing that the greater the amperage, the greater the effort required in the Charphy impact test and the greater the amperage, the greater the value of the Charphy impact test.

Keywords: Current, Impact Charphy, SMAW, Welding

INTRODUCTION

The development of technology in the field of advanced construction cannot be separated from welding because it has an important role in metal engineering and repair. The development of construction with metal at this time involves a lot of welding elements, especially in the field of design and construction because the welding connection is one of the connections making that technically requires high skills for the welders to obtain a good quality connection. The scope of use of welding techniques in construction is very broad, including shipping, bridges, steel frames, pressure vessels, transportation facilities, rails, pipelines and so on.

Welding Shield Metal Arc Welding is a process of joining two metals by utilizing heat from jumping electrodes at two different poles. In this welding technique, the connecting material or metal material (electrode) is metal that has been coated with flux (welding slag). This layer serves to protect the metal from external oxidation gas. In the metal welding process with the Shield metal arc welding (SMAW) welding technique, the electric current used in the metal joining process is an important indicator that needs to be considered, this is because the electric current determines the amount of heat generated from the electric arc on the flame at the end of the electrode used. The greater the strength of the electric current that is given, the greater the heat (heat input) that is produced to melt the base metal and connecting metal (electrodes), and conversely the smaller the current strength that is given, the less heat is generated to melt the base metal and connecting metal or electrodes. (Joko Santoso, 2006). The discussion focuses on the effect of current variation on impact strength in the SMAW welding process. The following is the purpose of writing which aims to find out whether current variations affect the impact strength in the SMAW welding process.

RESEARCH METHOD

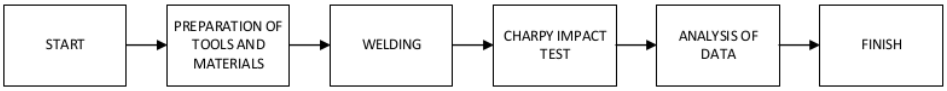

Figure 1. Research Methods

Materials

The materials used in this research are:

ST 41

ST 41 steel is a type of medium carbon metal, meaning that this metal consists of of a mixture of ferrite and pearlite whose content is equally large or equivalent to S 40 C steel (JIS, G4051), with a guide composition of 0.37-0.43 % C, 0.5-0.35% Si, 0.60-0.90% Mn. The durability of ST 41 steel has good strength and ductility are quite good.

Figure 2. ST41 Steel

Electrode E 6013

Electrode E 6013 is a coated electrode designed for maintenance welding of aluminum and aluminum alloys, The deposited metal has a good resistance to thermal cracking and also to ensure a a certain degree of mechanical properties, Welding can produce brittle Mg^2Si in the welding of aluminum-magnesium alloy, which reduces the plasticity and corrosion resistance of the joint.

Figure 3. E 6013 Electrode

A hard coating electrode that aims to give a hard coating to the material being welded. hard coating on the material being welded. E 6013 can be described as E = Electrode for SMAW welding type, 60 = tensile strength, meaning the tensile strength is 60 Ksi, 1 = Code for all welding positions, 3 = type of welding, and 3 = type of welding. tensile strength of 60 Ksi, 1 = Code for all welding positions, 3 = type of salutation

SMAW Welding Machine

Figure 4. SMAW Welding Machine

SMAW Welding Machine (Shield Metal Arc Welding) is the process of metal joining process that uses heat energy to melt the workpiece and electrode.

Welding Mask

A welding mask is a device used to protect the eyes from the rays generated in the welding process.

Figure 5. Welding Mask

Welding ST 41

After preparing the tools and materials, welding was carried out on ST 41 material using E 6013 electrodes with variants of electric current on SMAW welding machines, namely: 60 A, and 85 A, welding is done with 3 layers.

Figure 5. Welding on ST 41 steel material

Chaphy Impact Test

Charphy impact testing is used to determine the strength of the ST 41 steel connection, the strength to be reviewed is brittle fracture and ductile fracture. Impact testing steps
Charphy is as follows:

1. Prepare two specimens that have been welded with different current (60 A, and 85 A). different currents (60 A, and 85 A)
2. Smooth the surface of the specimen with rubbing paper rubbing paper, to avoid dirt on the specimens during testing
3. Installing the specimens one by one on the test equipment Impact Charphy and perform the test

Figure 6. Impact charpy Test

Data Collection and Calculation

After carrying out the charphy impact test, data collection is carried out charphy impact test results from ST41 steel material with variations of 60 A, and 85 A.

Charphy Impact Test Equipment Specifications

Specifications for charpy impact test equipment in the laboratory, advanced Mechanical Engineering Gunadarma University are as follows table 1:

Table 1. Specification Impact Charphy Test

Description	Value
Test Equipment Type	Impact Charpy
Capacity	215 Joule
Pendulum Weight	16 kg
The distance between the swing point and the hitting point	1200 mm = 1.2 m
Starting position for beating	140°
Beating blade angle	45°
Test equipment dimensions	1150 x 800 x 500 (mm)

RESULT AND DISCUSSION

The results of the calculation of the impact charphy test of SMAW ST welding joints. The purpose of this impact chart is to compare the size of the effort (W) and the impact charphy value (K) on the material SMAW welded with current difference (60 A, 65 A, 70 A, 75 A, 85 A). For an example calculation i.e., current:

$$W = G \times \lambda(\cos\beta - \cos\alpha) \times g \text{ (Joule)}$$

$$W = 16 \times 1{,}2\ (\cos 60° - \cos 90°) \times 9{,}8$$

$$W = 16 \times 1{,}2\ (0{,}5\text{-}0) \times 9{,}8$$

$$W = 16 \times 1{,}2 \times 0{,}5 \times 9{,}8$$

$$W = 1{,}76\ J$$

$$K = \frac{W}{A_o}$$

$$K = \frac{1{,}76\ J}{80}$$

$$K = 1{,}18 J/mm^2$$

Table 2. Impact Charphy Test Results of SMAW Welded Joints of ST 41

Description	Result				
Start Angle	90°	90°	90°	90°	90°
End Angle	60°	50°	45°	40°	35°
Work required (W)	94,08 J	120,80 J	133,02 J	144,13 J	154,10 J
Impact Charpy Value	1,18 J/mm^2	1,51 J/mm^2	1,60 J/mm^2	1,80 J/mm^2	1,92 J/mm^2

Graph Of Required Work And Value Graph Impact Charphy Test

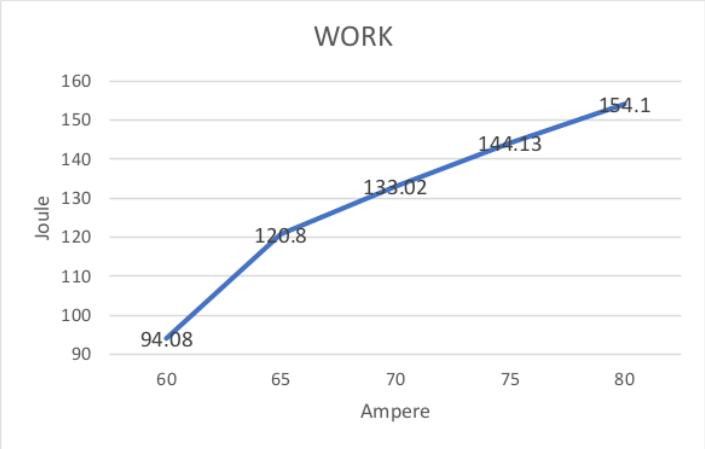

Figure 7. Effect Current to Work

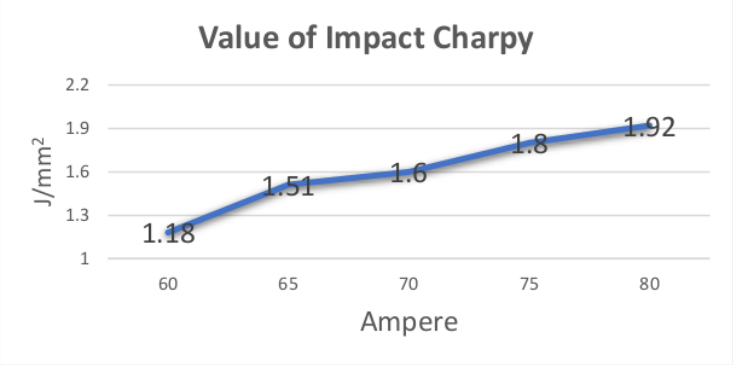

Figure 8. Effect Current to Value of Impact Charphy

After the process of data collection and processing big data big business value, obtained by increasing amperage used, the greater the business value obtained, such as in the graph above where with an electric current of 60 A the value is obtained is 94.08 J while with an electric current of 80 A value obtained is 154.10 J.

CONCLUSION

The amount of welding current required depends on the diameter of the electrode, the thickness of the welded material, the type of electrode used, the geometry of the joint, the diameter of the electrode core, the welding position. When the weld area has a high heat capacity, a high current is required. Welding current is a welding parameter that directly affects the penetration and melting speed of the parent metal. The higher the welding current the greater the penetration and melting speed. The amount of current in welding affects the welding results if the current is too low, the transfer of liquid from the tip of the electrode used is very difficult and the electric arc that occurs is unstable. The process of processing data on the value of the charpy impact test, the results of the graph indicate that the greater the amperage the greater the value of the charphy impact test.

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