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THE EFFECT OF VARIATION OF ELECTRIC CURRENT IN FLASH BUTT WELDING FOR CONNECTING THE RESULTS OF THE WIRE DRAWING PROCESS USING AISI 1080 MATERIAL ON TENSILE STRENGTH AND MICRO STRUCTURE

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Abstract (Tahoma, 9pt Bold)
This study aims to determine the effect of variations in electric current in SMAW welding on tensile strength and microstructure. One of the factors that affect the strength of a material is the mechanical strength of the material properties. if the material is welded, it can affect the tensile strength and structure of the material. This research uses AISI 1080 steel material with a diameter of 1.24mm which contains C = 0.083%, Si = 0.21%, Mn = 0.5%, P = 0.008%, S = 0.007%, Cu = 0.03%, Cr = 0.03%, Ni = 0.02%, B = 0.013%, Alt = 0.025%, As = 0.06%, N = 0.0038%, and O = 0.1%. Specimens were welded with varying electric currents at intervals of 25mA, starting from 700mA, 725mA, 750mA, 775mA, and 800mA using the splicing method. The tensile strength results from flash butt welding with a current of 700mA were 853.6N/mm², at a current of 725mA it was 867.7N/mm², at a current of 750mA it was 847.4N/mm², at a current of 775mA it was 881.8mA, and at a current of 800mA it was 805.3mA.

Keywords: *Welding electric current, AISI 1080 steel, microstructure, tensile strength.*

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Introduction

Controlling the welding current greatly affects the characteristics of the results of the weld because this control affects the quality of the results of the weld, such as shear strength, hardness and strength against external influences. Selection of welding current will affect the results of the weld. If the welding current used is too low, the heat that occurs is not enough to melt the material, resulting in a small area of weld metal and lack of penetration, conversely if the welding current is too high, the melting of the base metal is too fast and produces a wide area of weld metal. as well as deep penetration resulting in low tensile strength and increased brittleness.

In the wire drawing manufacturing industry, the flash butt welding connection method is very necessary to connect the wire that will be carried out by the wire drawing process. The addition of the length of the material greatly affects the results of the product that will be processed further, for example reducing products that have many joints. Because it produces type c products, or it needs to be reprocessed in order to add lengths as needed, which causes additional time and costs in the production process. And it is often found that there are hollow joints or porosity in the weld zone, charred and broken. So that in this final project the variation of electric current in flash butt welding joints needs to be tested for tensile and microstructure for each ampere.

Study of literature

Welding is a permanent metal joining technique, by melting some of the base metal with the addition of filler metal or without additional metal so that metallurgical bonding occurs. Either by applying pressure or not using pressure. Welding is a local connection between two or more pieces of metal by utilizing heat energy. in the joining process is accompanied by pressure and there is additional metal (filler material). Welding (welding) is a metal joining technique by melting some of the base metal and filler metal with or without additional metal and produces continuous metal [2]. Welding can be done by heating without pressure, heating with pressure, and pressure without providing

heat from the outside (heat is obtained from within the material itself). Besides that, welding can be done without filler metal and with filler metal [3].

Flash Welding

Flash welding connection is a metal connection that does not use metal additions. Flash welding connection by utilizing an electric current that is flowed to the object to be welded by pressing it so that an electric jump occurs at the end of the object being joined, which will generate heat and melt the two ends of the metal. When the two ends of the metal are fused, detention is carried out with the aim of maximizing the results of the connection. Flash welding, often called flash butt welding, is a type of resistance welding that does not use filler metal. The metal pieces to be welded or connected are adjusted according to the distance, diameter, material composition and desired properties of the weld [3].

Figure 1. Flash Butt Welding Machine

How Flash Butt Welding Works The workpiece is clamped on the machine and the parts to be joined are brought together with the lowest possible pressure so that there is still a gap between the two contact surfaces. By using an electric voltage, a spark occurs between the contact surfaces so that the temperature rises, when it reaches the forging temperature because the two metals are pressed together, it effectively forms a weld (connection).

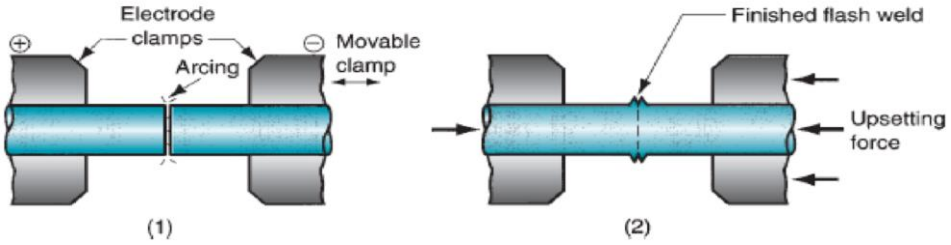

Figure 2. Flash Butt Welding Process

Heat Input

In The Welding Area In principle, the material or workpiece to be joined using the flash butt welding method is stressed and a high current flows. The heat generated due to the difference in electrical resistance between the materials being connected or the electrodes.[4] Then the heat generated can be written by the equation:

$Q = I^2.R.\ t$

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Q = Heat generated (Joule)
I = electric current supplied (Ampere)
R = Electrical resistance of the workpiece (Ohm)
t = time (Seconds)

Flash Butt Welding Splicing Period

The wire rods to be connected are leveled by cutting them and attaching them to the two clamps (electrodes) according to the diameter of the wire. By applying pressure to the two workpieces and flowing an electric current. For splicing to occur, there are four cycles in the splicing process using the flash butt welding splicing method, the four splicing cycles include: pressing time, welding time, holding time, and finishing time. As illustrated in the following figure'

Figure 3. Connection Period

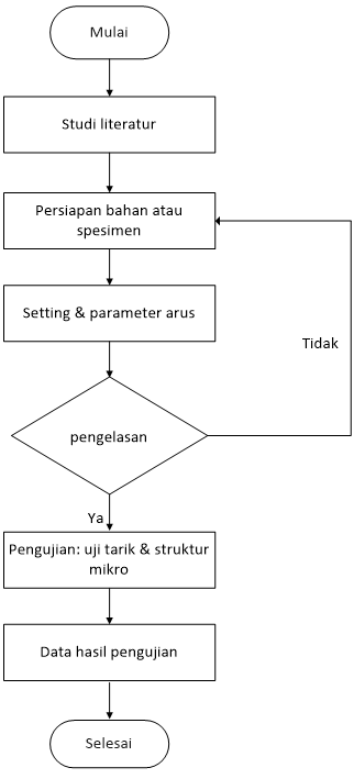
Flash Butt Welding

Splicing Parameters There are several factors that affect the strength of the weld in the flash butt welding process, including:

1. Effect of electric current
2. Effect of connection time
3. Electrical resistance
4. Electrode pressure force

Research Method

Research Flowchart



Work Steps

The following are the work steps in researching the effect of variations in electric current in flash butt welding on tensile strength and microstructure, including:

Research Flow In conducting research materials and tools are needed to support the research process, the following materials and tools are used:

AISI 1080 steel In this joining process using AISI 1080 steel, and the following material composition used in the joining process using the flash butt welding method:

Table 1. Material Composition of AISI 1080 Steel

No	Komposisi Material								*T.S* *Rm* *MPa*
	Grade	C	Si	Mn	P	S	Cu	Cr	
1	NLX82C-B	0.83	0.21	0.50	0.008	0.007	0.03	0.03	1180 – 1190
		Ni	B	AIt	As	N	O		
		0.02	0.013	0.002	0.06	0.0038	0.10		

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Research Methods

The several testing implementation processes are as follows:

1. The testing process is fully carried out regarding the variation of electric current to the connection of AISI 1080 steel, using the flash butt welding method of joining. In this connection, tensile testing and microstructure testing are carried out.
2. The data collection technique obtained from the connection process was carried out from the results of tensile testing and microstructure testing of the test objects, as many as 25 specimens where 27 specimens were connected with variations of electric current 700mA, 725mA, 750mA, 775mA, and 800mA. And 3 specimens without grafting. Then all specimens were subjected to tensile testing and microstructure testing.
3. The method of analysis and evaluation of the data obtained from tests conducted in the laboratory on each specimen is qualitative. It is from this data that the price for the tensile test of each specimen will be sought.

Preparation of Tensile Test Specimens Prior to testing, the specimen is cut as needed approximately +/- 50cm, so that the tensile test can be carried out. And the steps are as follows:

1. Specimens were cut with 27 pcs of 25cm in size, and 3 pcs of 60cm in size.
2. After the specimen is cut, the material is straightened with the aim that the material when connected is parallel.
3. Flatten the surface of the two wires to be connected and clean the couting on the part to be pressed (clamp) using the electrode using sandpaper with the aim of maximizing the electric current flowing in the connection process
4. Connections were made using the flash butt welding connection method with variations in electric current used, including 700mA, 725mA, 750mA, 775mA, and 800mA,

5 samples were made, and 3 samples were made without splicing.

Results and Discussion

Tensile Test Test Results The following are the results of the average values obtained in the tensile test using AISI 1080 steel wire with a diameter of 1.24 mm at the joints using the flash butt welding connection method.

Table 2. Average tensile test results

No	Arus (A)	Breaking Load (N)	Elongation (mm)	Tensile Strength (N/mm²)
1	700	1029.2	3.57	853.6
2	725	1040.1	2.51	867.7
3	750	1084.6	2.69	847.4
4	775	1056.3	3.39	881.8
5	800	964.2	2.36	805.3

The Relationship between Electric Current and Breaking Load

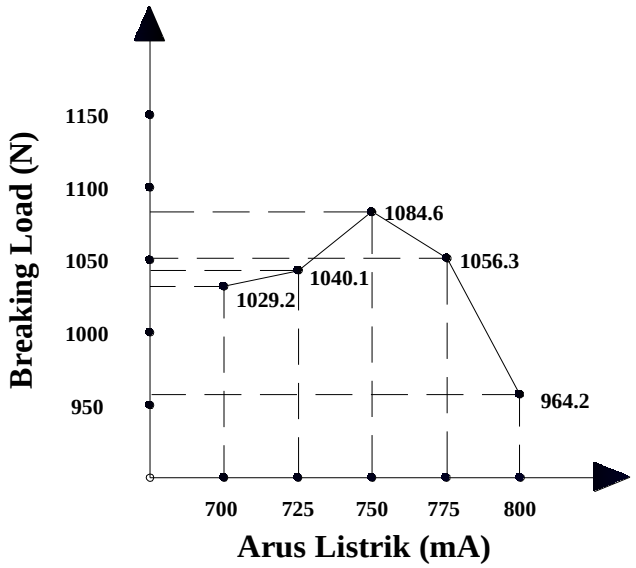

Figure 4. Graphical image of the relationship between electric current and breaking load

From the graph above the relationship between the electric current and the breaking load, it can be seen that there was an increase in the breaking load of the electric current of 700mA to 725mA and 750mA but a decrease in the breaking load of the electric current of 775mA and 800mA in the connection using the flash butt welding method. This shows that the variation of the electric current to the connection affects the value of the resulting breaking load. From this tensile test, the highest breaking load value is at 750mA of (1084.6 N), and the lowest breaking load is at 800mA of (964.2 N), from several varied electric currents.

The Relationship between Electric Current and Tensile Strength

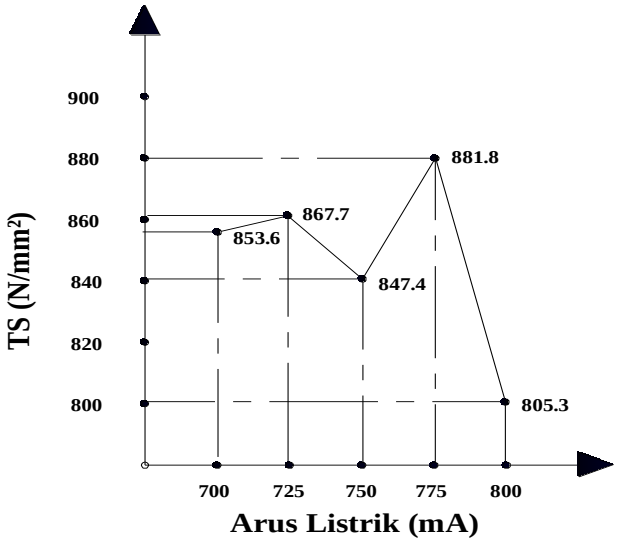

Figure 5. Graphic image of the relationship between electric current and TS

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From the graph above in the image of the relationship between electric current and Tensile Strength, it shows that there is an increase in the value of tensile strength at currents of 700mA, to 725mA and 775mA, and there is a decrease in Tensile Strength towards electric currents of 750mA and 800mA. From these data it can be concluded that the highest tensile strength value is found in an electric current of 775mA (881.8N/mm²) and the lowest tensile strength value is found in an electric current of 800mA (805.3N/mm²) from several varying electric currents.

Conclusion

From the results of research and analysis conducted on the effect of variations in electric current in flash butt welding on tensile strength and its microstructure, the conclusions and suggestions are as follows: Conclusion

1. Know that from tests that have been carried out, an increase in electric current in the welding process using the flash butt welding method affects the strength of the materials being joined. From the allowable electric current of 700mA to 800mA in the process of connecting a wire with a diameter of 1.24mm. Do 5 variations of electric current each of 700mA, 725mA, 750mA, 775mA and 800mA. And the average of the 5 variations of the electric current is 750mA (1084.6N)

2. Knowing from the results of the tensile test test on welding using the flash butt welding connection method at an electric current of 700mA, an elongation value of 14% is obtained with a TS value of 853.6 N/mm², an electric current of 725mA is 10% with a TS value of 867.7 N/mm², a current 750mA electricity is 11% with a TS value of 847.4 N/m²), 775mA electric current is 14% with a TS value of 881.8 N/mm², and at 800mA electric current is 9% with a TS value of 805.

3 N/mm². the higher the elongation, the more ductile the steel is, the smaller the elongation, the higher the ductility. to get steel that is ductile and has a high tensile strength value so that an electric current of 750mA is used. 3. Find out from the variations in the electric current that was carried out on the connection of AISI 1080 steel wire with a diameter of 1.24Ma using the flash butt welding method after observing the welding area. There is a change in the microstructure in the welding area and HAZ due to the welding process. A less ductile structure exists at a current of 775mA.

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