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Study of Spot Welding Tensile and Shear Strength Comparison on Aluminium and Low Carbon Steel Using Filler

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Abstract. *Alumunium and low carbon steel are some of many materials that are commonly used in machining process. One of the reasons is that Stainless steel has a high resistance towards rust, followed by a maximum shear strength of approximately 124-290 MPa. On the other hand, low carbon steel has a higher shear strength of approximately 500 MPa. In this study, spot welding process on these dissimilar materials is using filler and then analyzed using linear regression analysis, by varying voltage towards the shear strength results based on the parameters used in this research. The research was carried out using an experimental method by processing secondary data. The secondary data was then reprocessed by linear regression analysis using IBM SPSS software, The use of filler in spot welding using Aluminium 6061 and Low Carbon Steel SS400 has a positive effect on the shear tensile strength, resulting in a shear tensile strength of 923MPa with a stress of 3.5 V and a pressing time of 5 seconds.*

Keywords: *Spot welding, voltage, aluminium ,low carbon steel*

INTRODUCTION

In the current era, welding is a method of joining a material that is often encountered, one of the welding methods is Resistance Spot Welding (RSW) is a method of electrical resistance welding, where two or more metal sheets are clamped between two metal electrodes, then a current A strong force is flowed through the copper electrode, so that the point between the metal plates under the electrodes that are in contact with each other becomes hot due to electrical resistance until it reaches the welding temperature, resulting in the two plates being fused.

Aluminium and low carbon steel are two types of materials that are widely used in industry, one of the uses of these two materials is in the automotive sector..

However, in Aluminium alloys, welding defects (cracks) often occur in these alloys, due to the separation in the Resistance Spot Welding (RSW) welding process. Therefore, welding auxiliary media in the form of filler is needed. Filler is useful to be able to bridge between one metal with another metal can blend well. The type of filler affects the mechanical behavior of the welded joint. The choice of filler in welding is based on the composition of the base metal being welded, melting point, freezing, welding method and desired weld properties.

Referring to this, this study aims to examine the effect of spot welding strength with low carbon steel SS400 and Aluminium 6061. The data obtained were then analyzed using a linear regression approach.

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RESEARCH METHODS

The research was carried out using an experimental method by processing secondary data. The secondary data was then reprocessed by linear regression analysis using IBM SPSS software. After the secondary data is processed, the output obtained is then converted into a graphic form. The graphs that have been obtained are then analyzed and made into conclusions.

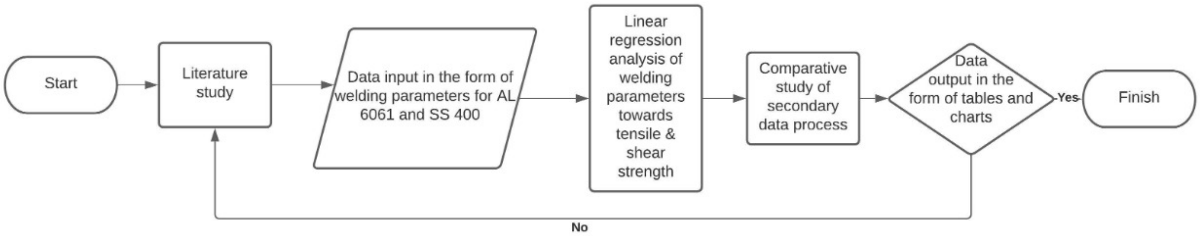


FIGURE 1. Research Flowchart

RESULT AND DISCUSSION

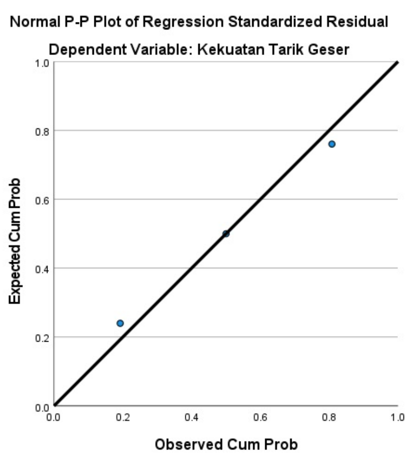
The secondary data that has been obtained is then entered into the table. Secondary data source 1 comes from the journal "Tensile and Shear Strength With Resistance Spot Welding (RSW) Between Low Carbon Steel and Aluminium" and secondary data 2 comes from the journal entitled "The Effect of Time Variations and Electric Current Voltage in the Spot Welding Process on Tensile Strength AA5083" Aluminium Plate Joint. Attached in the section below is the results of secondary data processing carried out according to the method used.

Table 1. Source 1

No	Voltage	Time(s)	Shear Tensile Strength(MPa)
1	1,75V	5s	794
2	2,2V	5s	833,45
3	2,208V	5s	834,162

`Source : Salim & Triyono 2012

In secondary data 1, welding is carried out using a current voltage of 1.75V, 2.2V, 2.208V with a constant time of 5 seconds.



Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	813.705	19.741		41.220	.015		
	Tegangan	.009	.015	.514	.598	.657	1.000	1.000

a. Dependent Variable: Kekuatan Tarik Geser

FIGURE 2. Result of Secondary Data Regression Analysis 1

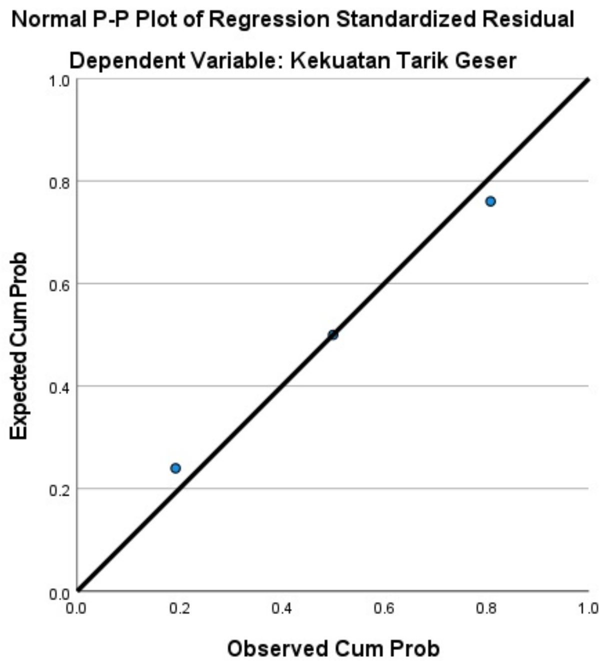
The results of linear regression in secondary data 1 above show that the regression coefficient X is 0.0657 so, for every 1% addition of welding electric current, there will be an increase in shear strength of 0.0657.

TABLE 2. Second Data

No	Voltage	Time(S)	Shear Tensile Strength (MPa)
1	1,75V	2	124,15
			126,12
			125,04
			126,5
			151,95
			151,66
2	2,20V	2	152,77
			153,15
			152,12
			505,46
			504,7
3	2,208V	2	506,8
			506,92
			505,87

Source: H.Anugrah 2019

In secondary data 2, welding is carried out using a voltage of 1.75V, 2.20V, 2.208V with a constant time of 2s



Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	813.705	19.741		41.220	.015		
	Tegangan	.009	.015	.514	.598	.657	1.000	1.000

a. Dependent Variable: Kekuatan Tarik Geser

FIGURE 3. Result of Secondary Data Linear Regression Analysis 2

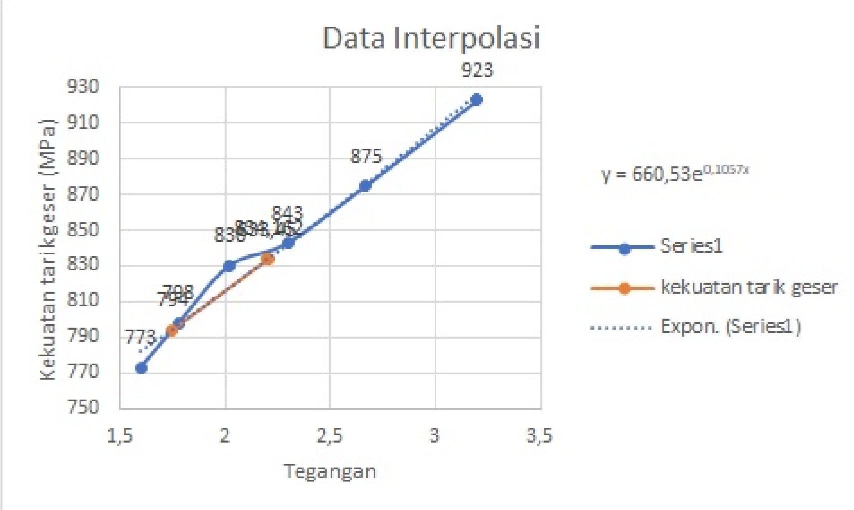
Based on the results of the linear regression above, it can be seen that the X regression coefficient is 0.0514. So, it can be explained that for every 1% addition of welding current stress, there will be a decrease in shear strength of 0.0514.

Because there are different parameters in the two data above, the secondary data used is processed again by interpolation to equalize the electric current parameters for secondary data 1 and 2, here are the results of the interpolation between the two secondary data:

TABLE 3. Interpolated Data

No	Voltage	Time(s)	Shear Tensile Strength(MPa)
1	1,75V	5s	794
2	2,2V	5s	833,45
3	2,208V	5s	834,162

CHART 1. Data Interpolasi



After interpolation with the logarithmic method to equalize the electric current parameters of secondary data 1 and 2, the following equation is obtained

$$y = 106.86\, ln(x) - 660{,}53$$

Where x = secondary data electric current 2

It can be seen in the graph above that the interpolated shear tensile strength values at 1.5V are 770 MPa, 830 MPa at 2 V and 875 MPa at 2.5V, 923 MPa at 3.5 V.

As can be seen in the data above, with a constant time variation of 5 seconds, the stress has an influence on the shear tensile strength in the resistance spot welding process. This happens because the higher the voltage used, the greater the nugget formation. This causes an increase in the shear tensile strength, yield strength, ductility and microstructure of a material. It is also known that the higher the heat input, the longer the cooling rate which affects the shear tensile strength.

CONCLUSIONS

Referring to secondary data that has been further processed, it can be explained that in this study it was concluded that the use of filler resulted in a high shear tensile strength with a stress of 3.5V having a shear tensile strength of 923Mpa.

Voltage affects 51.4% of its effect on the formation of nuggets which causes an increase in shear tensile strength, yield, ductility and microstructure.

The use of filler in spot welding using Aluminium 6061 and Low Carbon Steel SS400 has a positive effect on the shear tensile strength, resulting in a shear tensile strength of 923MPa with a stress of 3.5 V and a pressing time of 5 seconds.

The reason for the filler has a larger nugget diameter than the specimen without using filler, therefore the use of filler has an increase in shear tensile strength.

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The author realizes that the writing of this scientific article is far from perfect and has shortcomings, but the author hopes that this scientific article can be useful for readers and the general public.

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