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The Influence of SMAW Welding Current Variation on Tensile Strength, Corrosion Rate, and Microstructure of ST 42 Steel for Inner Bottom Plate Material in Ships

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***Abstract*— Steel is currently widely used in the industrial world. Due to its versatile uses, the development of steel science has also broadened, leading to improved steel processing methods. Welding is a process of joining two pieces of metal using heat. Steel, containing carbon, is prone to oxidation and rust. The aim of this study is to determine the influence of welding current variations on tensile strength, corrosion rate, and the micrographic structure of ST 42 steel. The research method employed is experimental. The welding current variations used are 70 A, 85 A, 100 A, 115 A, and 130 A. In this study, the highest average tensile stress was found at 130 A, measuring 519.20 MPa. For tensile strain, the highest values of 7% were observed at 115 A and 130 A. The highest modulus of elasticity was obtained at 115 A, with a value of 102.18 GPa. The highest corrosion rate occurred in specimens with 70 A, with a value of 0.19 mm/year (good), and the lowest corrosion rate was at 130 A, with a value of 0.10 mm/year (excellent). The micrographic structure testing results showed a decrease in the ferrite phase with each increase in current, while the pearlite phase increased. It can be concluded that the best welding current for ST 42 steel is at 130 A, due to its high tensile strength and low corrosion rate.**

Keywords— ST 42 Steel, SMAW Welding, Welding Current Variation, Tensile Strength, Corrosion Rate, Microstructure

I. INTRODUCTION

Steel is currently extensively used in the industrial sector. Given its vast applications, the field of steel science has expanded significantly, resulting in improved steel processing methods. The technological advancement in steel production has been remarkable since steel is a crucial material in the construction of buildings, bridges, vehicles, and everyday tools. Steel is considered superior to other materials, like wood, due to its greater strength, making it suitable for shipbuilding. ST 42 steel, in particular, is typically used in ship construction and is welded using Shielded Metal Arc Welding (SMAW) in appropriate areas.

Steel is a crucial metal used in construction, especially in shipbuilding, as it is the primary material for building ships. Steel comprises several components including iron (Fe) and carbon, along with other elements such as sulfur (S), phosphorus (P), silicon, and so on. Steel is categorized based on its carbon content into low carbon steel, medium carbon steel, high carbon steel, and alloy steel, stainless steel. Low carbon steel contains 0.1% - 0.3% carbon, medium carbon steel contains 0.3% - 0.6% carbon, and high carbon steel contains 0.7% - 1.3% carbon [1].

Welding is a process of joining two or more pieces of metal using heat energy, where the metal surrounding the welding area undergoes metallurgical structure changes, deformation, and thermal stress. One way to mitigate these negative effects is by carrying out precise and accurate welding procedures, or by finding the optimal welding current, speed, and heat input.[2].

Shielded Metal Arc Welding (SMAW) is a welding process that is operationally straightforward and is widely used in the shipbuilding industry. This is because SMAW welding can be performed on plates of any thickness, and it offers a low investment cost, with work capable of being carried out in all welding positions [3].

In previous research where a study was conducted to understand the influence of SMAW welding on the corrosion behavior of ST 37 steel with current variations of 120A, 160A, and 200A, using the immersion method in a NaCl solution for 48 hours, results indicated that the larger the current used, the lower the corrosion rate [4].

In another study, the welding current was found to affect the tensile strength of two different metals, namely, stainless steel 304 and low carbon steel ST 37, welded together. This test used currents of 60A, 70A, and 80A. From these treatments, the optimal tensile strength value was obtained at 70A, measuring 51.656 kg/mm² [5].

Research conducted by Shofwan showed that the SMAW welding current greatly affects the tensile strength and corrosion rate of ST 40 steel. In these tests, welding currents of 80A, 90A, 100A, and 110A were used. From these treatments, the most optimal tensile strength result was obtained at a current of 100A, measuring 470.11 MPa. Meanwhile, the lowest corrosion rate was found at

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a welding current of 110 A, with a value of 0.0785 mm/year [6].

In addition, research conducted by Agung demonstrated that SMAW welding greatly affects the phase content in specimens. The researcher used welding current variations of 110A, 130A, and 150A. The results showed that with each increase in welding current, the ferrite content decreased, and the pearlite content increased [7].

The differences in characteristics, such as steel content, strength, hardness between ST 37, ST 40, and ST 42 steels, albeit all three types of steel are considered low carbon due to their carbon content being less than 0.30%, have sparked interest in investigating the tensile strength, corrosion rate, and micrographic structure of ST 42 steel in welded joints using SMAW and varying welding currents. The welding current variations used range from the smallest, 70 A, to the largest, 130 A. This aims to understand how significant the addition of welding current is to tensile strength, corrosion rate, and micrographic structure.

Based on the above background, the research problem can be formulated as follows: how does the variation in SMAW welding current affect the tensile strength, corrosion rate, and micrographic structure of ST 42 steel. The aim and benefit of this study are to understand the differences in tensile strength, corrosion rate, and micrographic structure in ST 42 steel after undergoing SMAW welding treatment with varying welding currents.

II. METHOD

A. Data Collection

The data obtained is based on journals, books, internet sources, modules, steel certificates, and primary data from research. ST 42 steel is classified as low carbon steel because its carbon content is less than 0.30%.

The object of the study is ST 42 steel. ST 42 steel is a type of low carbon steel that possesses good strength properties. ST 42 steel has a tensile strength of 415 MPa, yield strength of 290 MPa, hardness of 123 Hb, and an elongation of 20%. According to the steel certificate, the contents of ST 42 steel are as follows.[8]

TABLE 1.
COMPOSITION OF ST 42 STEEL

Element		Content
Fe	*Steel*	98,65%
Mn	*Mangan*	0,80%
Si	*Silicon*	0,30%
C	*Carbon*	0,25%

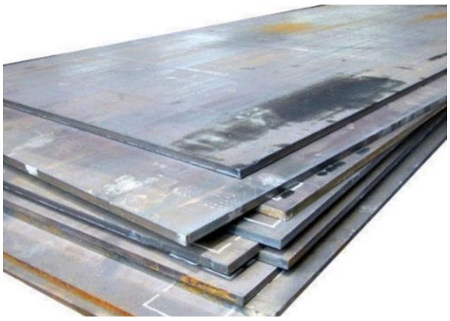

Figure 1. Steel ST 42

B. Research Parameters

- Fixed Parameters

The fixed parameters used in this research are :

a. Type of steel : Steel ST 42
b. Plate thickness : 10 mm
c. Type of welding : SMAW
d. Elektrode : E7016
e. Welding position : 1G
f. Weld groove : Single V butt Joint
g. Bevel angle : 60º
h. Welding Travel Speed : 12 cm/minute
i. Dimensions of tensile test specimen with ASTM E8 standard ASTM E8
j. Dimensions of corrosion test specimen with standard ASTM G102
k. Dimensions of micrographic structure test specimen with standard ASTM E3

- Change Parameters

The change parameters in this study are the variations in welding current strength used, namely 70 A, 85 A, 100 A, 115 A and 130 A.”.

C. Steel Plate Cutting

Before the welding process is carried out, the steel is cut into sizes of 100 mm x 100 mm, with a total of 12 pieces. After the steel is cut, a single v butt joint groove is provided with an angle 60º.

Figure 2. Plate Cutting Process

D. Steel Welding

SMAW welding is a process of joining two metals by melting the metal using an electrode as a heat conductor. The strength of the welding process is determined by many factors, among others, the type of filler material used according to its parent material, the correct heat input parameters in the welding process, and the type of welding process performed. [9].

$$HI = \frac{60 \times E \times I}{v} \quad (1)$$

Where :

HI = *Heat Input* (Joule/cm)
I = Current Strength (Ampere)
E = Arc Voltage (Volt)
v = Welding Speed (cm/Minute)

The welding process conducted in this research uses SMAW (Shielded Metal Arc Welding) with a welding current of 70 A, 85 A, 100 A, 115 A, and 130 A, a voltage of 25 volts, and a welding speed of 12 cm/minute. The type of electrode used is E7016.

Figure 3. Welding Process

E. Preparation of Tensile Test Specimens

After the steel undergoes welding treatment with a variation of current strength, the steel is shaped into tensile test specimens based on the standard dimensions of ASTM E8 using a grinder. The specimen details for each current are raw material, 70 A, 85 A, 100 A, 115 A and 130 A each with 3 tensile test specimens. So the total number of tensile test specimens is 18.

F. Preparation of Corrosion Test Specimens

After the steel undergoes welding treatment with a variation of current strength, the steel is shaped into corrosion test specimens based on the standard dimensions of ASTM G102 using a grinder. The specimen details for each current are raw material, 70 A, 85 A, 100 A, 115 A, and 130 A, each with 1 corrosion test specimen. So the total number of corrosion test specimens is 6.

G. Preparation of Micrograph Structure Test Specimens

After the steel undergoes welding treatment with a variation of current strength, the steel is shaped into micrograph structure test specimens based on the standard dimensions of ASTM E3. The steel is cut using a grinder with a size of 10 mm x 10 mm x 10 mm. The specimen details for each current are raw material, 70 A, 85 A, 100 A, 115 A, and 130 A, each with 1 micrograph structure test specimen. So the total number of micrograph structure test specimens is 6.

H. Tensile Test

The tensile test is a test conducted on a material to determine the mechanical properties of a material, particularly its strength and resistance to tensile loads by applying a tensile force to the material. The result obtained in this test is a curve that shows the relationship between the increase in the length of the object and the force received by the object. [10].

The properties resulting from tensile testing are:

1. Maximum Tensile Stress The maximum load that a material can withstand before it fractures. The equation for maximum stress is :

$$\sigma u = \frac{Pmax}{Ao} \quad (2)$$

Where :
σu : maximum Stress (N/mm2)
Pmax : Maximum Load, (N)
Ao : Original Cross-Sectional Area (mm2)

2. Maximum Strain (ε) The increase in length of a material after it fractures compared to its original length. The equation for maximum strain is:

$$\varepsilon\ max = \frac{\Delta L}{Lo} \quad (3)$$

Where :
ε max : is the maximum strain, (%)
ΔL : the change in length (mm)
Lo : the original length (mm)

This value represents the maximum deformation or elongation that a material undergoes before fracture. It is a measure of the material's ability to undergo plastic deformation under load. The maximum strain is typically expressed as a decimal or percentage.

3. Modulus of Elasticity (E)

The stiffness or rigidity of a material can be calculated from the slope of the linear elastic reion on the stress-strain curve.

The equaion for the modulus of elasticity is :

$$E = \frac{\sigma}{e} \quad (4)$$

Where :
E : Modulus of elasticity (MPa)
σ : Stress (KN/mm^2)
e : Strain (%)

The modulus of elasticity represents the material's ability to resist deformation under an applied load within the elastic region. It is a measure of the material's stiffness and is expressed in units of force per unit area (such as psi or pascals). A higher modulus of elasticity indicates a stiffer material, while a lower modulus indicates a more flexible or less stiff material.

I. Corrosion Test

The corrosion test in this research is conducted to calculate the corrosion rate using the potentiodynamic electrochemical method, where the Icorr value of a metal is determined using a 3.5% saltwater solution as the electrolyte. The corrosion rate test in this study follows the ASTM G102 standard.

The testing process begins by preparing the electrolyte solution as the corrosion medium and turning on the corrosion test machine. Then, the three electrodes, namely the working electrode (test specimen), reference electrode, and auxiliary electrode, are connected and immersed in the electrolyte solution. Once all connections are properly established, the corrosion test is initiated on the corrosion test machine, which serves as the potential source. The corrosion test machine, integrated with CS Studio 5 software, automatically reads the corrosion rate for each specimen.

To calculate the corrosion rate of a steel, it can be determined using equation 5, followed by equation 6.

$$EW = \frac{\sum Element}{100} x\ Atomic\ Mass\ /2 \quad (5)$$

$$CR = 3{,}27x10^{-3}\ \frac{Icorr(EW)}{\rho} \quad (6)$$

Where :
EW : Equivalent Weight
CR : Corrosion Rate (mm/year)
Icorr : Corrosion Current (A)
P : Density (g/cm^3)

Equation 5 calculates the equivalent weight of the steel, which is the weight of a particular element in the steel divided by its atomic mass, and then divided by 2.

Equation 6 uses the equivalent weight (EW), corrosion current (Icorr), and density (ρ) to determine the corrosion rate (CR) of the steel. The corrosion rate is expressed in units of millimeters per year (mm/year).

J. Micrographic Test

Micrograph structure testing is used to understand the properties of metals. Metals of different types always have different microstructures. The purpose of micrograph structure testing is to determine the arrangement, shape, and grain size of the material [11].

The testing process starts by mounting the specimen using resin, then grinding the specimen with a 2000-grit abrasive paper until a smooth surface is achieved. After that, the specimen is polished with autosol until it becomes shiny and free from scratches. Next, prepare an etching solution for the test specimen (2 ml HNO3 and 98 ml ethyl alcohol), and immerse the mounted surface of the test specimen in the etching solution for 5 seconds. Rinse the test specimen with running water and soap, then dry it. Observe the specimen under a microscope. Once the phases are visible, process the images using software such as Image-J to determine the phase content of each specimen.

K. Research Location

The steel welding process is conducted at the Inlastek Welding Institute in Surakarta City. Subsequently, specimen preparation is carried out at YN Production in Klaten Regency. The tensile testing is conducted at the Ship Structure and Construction Laboratory, Department of Naval Architecture and Shipbuilding Engineering, Universitas Diponegoro. The corrosion rate and micrograph structure testing are conducted at the Material Laboratory, Department of Mechanical Engineering, Universitas Diponegoro.

III. Results and Discussion

A. Heat input

The result of the heat input is influenced by several factors, including the welding current, arc voltage, and welding speed. In this research, the following results were obtained:

TABLE 2.
HEAT INPUT VALUES

Current (A)	Voltage (Volt)	Speed (cm/menit)	HI (J/cm)
70	25	12	8750
85	25	12	10625
100	25	12	12500
115	25	12	14375
130	25	12	16250

From the results in Table 2, it can be observed that the highest heat input value is obtained at a current of 130 A, with a value of 16250 J/cm.

B. Tensile test result

The tensile test was conducted following the ASTM E8 standard at the Ship Structure and Construction Laboratory, Department of Naval Architecture and Shipbuilding Engineering, Universitas Diponegoro on March 7, 2023. The test results include values of stress, strain, and modulus of elasticity. These results provide information about the tensile strength of the ST 42 steel with varying SMAW welding currents.

1. Tensile Stress

TABLE 3.
TENSILE STRESS STATISTICAL TEST RESULTS

Variation	σ Max (MPA)	Average σ Max (MPA)	Standard Deviation	Range Deviasi	Deviation Range Mean (Mpa)
70 A	385,93 405,26 392,54	394,58	9,82	384,74-404,4	389,23
85 A	435,21 454,35 487,05	458,87	26,21	432,65-485,08	444,78
100 A	488,24 477,30 444,78	470,11	22,6	447,49-492,71	482,77
115 A	495,07 492,96 481,82	489,95	7,12	482,82-497,06	494,01
130 A	518,98 519,42 482,98	507,13	20,91	486,21-528,04	519,20
Raw Material	531,34 535,29 551,85	539,50	10,88	528,61-550,37	533,32

2. Tensile Strain

TABLE 4.
TENSILE STRAIN STATISTICAL TEST RESULTS

Variation	ΔL	Lo	Strain (%)	e Strain (%)	Standar Deviation	Range Deviation	Average%)
70 A	12 11 11	200 200 200	6,00 5,50 5,50	5,67	0,29	5,38-5,96	5,50
85 A	13 10 13	200 200 200	6,50 5,00 6,50	6,00	0,87	5,13-6,87	6,50
100 A	11 13 13	200 200 200	5,50 6,50 6,50	6,17	0,58	5,59-6,74	6,50
115 A	13 14 14	200 200 200	6,50 7,00 7,00	6,83	0,29	6,54-7,12	7,00
130 A	12 14 14	200 200 200	6,00 7,00 7,00	6,67	0,58	6,09-7,24	7,00
Raw Material	20 18 17	200 200 200	10,00 9,00 8,50	9,17	0,76	8,40-9,93	8,75

3. Elastic Modulus

TABLE 5.
STATISTICAL TEST RESULTS OF MODULUS OF ELASTICITY

Variation	E (Gpa)	E Average(Gpa)	Standar Deviation	Range Deviation	Average(Gpa)	Average(Gpa)
70 A	64,85 63,96 71,65	68,25	4,20	62,62-71,02	66,82	64,41
85 A	87,55 87,07 101,19	94,37	8,02	83,92-99,95	91,94	87,31
100 A	100,93 98,55 90,96	95,94	5,21	91,60-102,02	96,81	99,74
115 A	101,80 102,56 96,04	98,92	3,56	96,57-103,70	100,13	102,18
130 A	96,40 89,33 96,98	96,69	4,26	89,98-98,50	94,24	96,69
Raw Material	103,08 121,76 97,20	100,14	12,82	94,52-120,17	107,35	100,14

The highest average tensile strength was obtained at 130 A welding current with a value of 519.20 MPa. The highest strain values were observed at 115 A and 130 A with a value of 7.00%, while the highest modulus of elasticity was obtained at 115 A with an average value of 102.18 GPa. The tensile strength of ST 42 steel increased with higher welding currents.

Based on the test results, it shows that each additional variation of the welding current increases the welding current, the tensile strength also increases. This is compared to previous research by Agung, with welding currents of 110 A, 130 A and 150 A. the highest tensile stress was obtained at the welding current of 150 A with a value of 699,65 MPa. The highest tensile strain was obtained at the welding current of 150 A with a value of 8,92% and the highest elastic modulus was obtained at the welding current of 130 A with a value of 113,23 GPa. in a large study showed a current of 150 A which has the highest tensile strength[12].

C. Corrosion Rate Result

The corrosion rate test for ST 42 steel was conducted according to ASTM G102 standard at the Material Laboratory, Department of Mechanical Engineering, Universitas Diponegoro on March 21, 2023. From the test, the corrosion rate values for each current variation can be determined.

The first step is to calculate the EW (Equivalent Weight) value of the highest content in ST 42 steel as shown in the table below:

TABLE 6.
STEEL CONTENT

Element	Content	Atomic Mass
Fe	98,65%	55,091
Mn	0,80%	54,938
Si	0,30%	28,085
C	0,25%	12,001

Next, calculate each element's EW using equation 5 :

$$\mathrm{EW} = \frac{\mathrm{Element}}{100} x\ Atomic\ Mass\ /2$$

- Fe : $\frac{98,65}{100} x\ 55{,}091\ /2$ = 27,545
- Mn : $\frac{0,80}{100} x\ 54{,}938\ /2$ = 0,219
- Si : $\frac{0,30}{100} x\ 28{,}085\ /2$ = 0,042
- C : $\frac{0,25}{100} x\ 12{,}001/2$ = 0,015
- ∑EW = 27,545+0,219+0,042+0,015
- ∑EW = 27,82

After obtaining the EW value of 27.82, the next step is to calculate the corrosion rate for each welding current variation using equation 6

$$\mathrm{CR} = 3{,}27\mathrm{x}10^{-3}\ \frac{\mathrm{Icorr(EW)}}{\rho}$$

- Raw Material
  $3{,}27\mathrm{x}10^{-3}\ \frac{6{,}45(27{,}82)}{7{,}85}$ = 0,07 mm/*year*
- Current 70 A
  $3{,}27\mathrm{x}10^{-3}\ \frac{16{,}88(27{,}82)}{7{,}85}$ = 0,19 mm/*year*
- Current 85 A

$3{,}27\text{x}10^{-3}\ \frac{15{,}72(27{,}82)}{7{,}85} = 0{,}18\ \text{mm}/\textit{year}$

- Current 100 A

  $3{,}27\text{x}10^{-3}\ \frac{11{,}82(27{,}82)}{7{,}85} = 0{,}13\ \text{mm}/\textit{year}$

- Current 115 A

  $3{,}27\text{x}10^{-3}\ \frac{9{,}67(27{,}82)}{7{,}85} = 0{,}11\ \text{mm}/\textit{year}$

- Current 130 A

  $3{,}27\text{x}10^{-3}\ \frac{9{,}33(27{,}82)}{7{,}85} = 0{,}10\ \text{mm}/\textit{year}$

TABLE 7.
CORROSION TEST RESULT

Current Variation	CR (mm/year)
70	0,19
85	0,18
100	0,13
115	0,11
130	0,10
RAW	0,07

From Table 7, the highest corrosion rate is obtained for the specimen with a current of 70 A, with a value of 0.19 mm/year. The specimen with a current of 85 A has a corrosion rate of 0.18 mm/year. The specimen with a current of 100 A exhibits a corrosion rate of 0.13 mm/year. The specimen with a current of 115 A shows a corrosion rate of 0.11 mm/year. Lastly, the specimen with a current of 130 A has a corrosion rate of 0.10 mm/year. The lowest corrosion rate is observed in the RAW material specimen, with a corrosion rate of 0.07 mm/year.

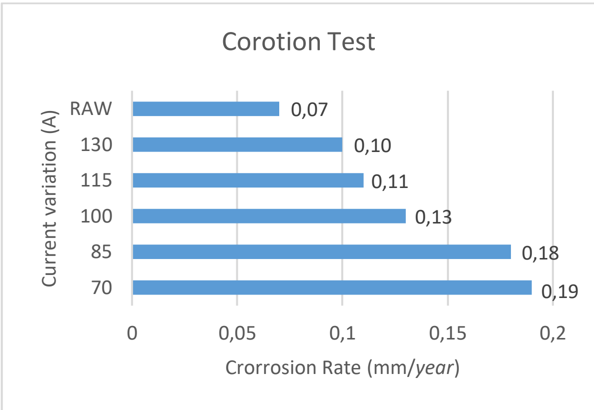

Figure 4. ST Steel Corrosion Rate 42

According to D.A Jones, the corrosion rate can becategorized as follows: [14]

TABLE 8.
CORROSION RESISTANCE TABLE

Relative Corrosion Resistance	mm/year
Outstanding	<0,02
Excellent	0,02-0,10
Good	0,10-0,50
Fair	0,50-1,00

Based on the corrosion rate table and the corrosion resistance table above, it is found that welding currents of 70 A, 85 A, 100 A and 115 A are included in the good category. Meanwhile, Raw material and Welding current of 130 A are included in the excellent category.

Based on the test results, it shows that each addition of the variation of the welding current, the slower the corrosion rate. This is compared to previous research by Shofwan, with welding currents of 80 A, 90 A, 100 A and 110 A. The welding currents of 80 A and 90 A were included in the good category while the welding currents of 100 A and 110 A were included in the excellent category. in shofwan research shows the current of 110 A which has the best corrosion rate[13].

D. Micrographic Structure Test Result

In this study, the microstructure examination was conducted using ASTM E3 standard. The examination was performed at a magnification of 200 µm for each current variation.

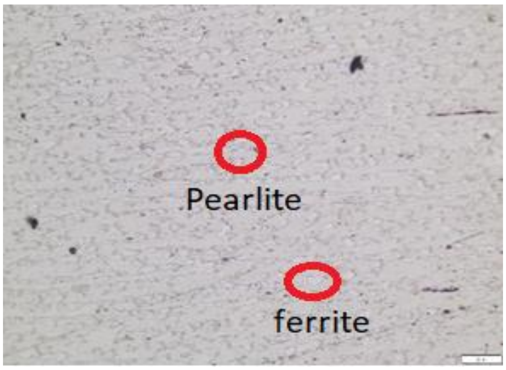

Figure 5. Raw Material Microstructure

From Figure 5 it can be seen that there are ferrite and pearlite phases. On Raw material contained 59,64% ferrite and 40,36% pearlite

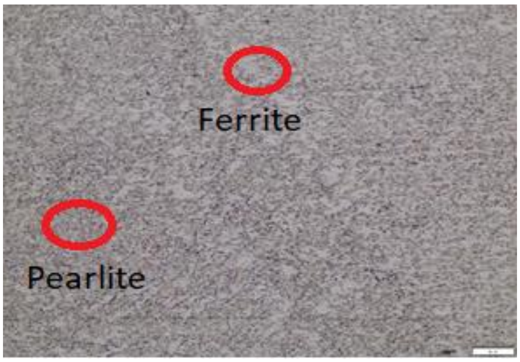

Figure 6. Microstructure 70 A

From Figure 6 it can be seen that there are ferrite and pearlite phases. On 70 A welding current contained 81,28% ferrite and 18,72% pearlite

Figure 7. Microstructure 85 A

From Figure 7 it can be seen that there are ferrite and pearlite phases. On 85 A welding current contained 77,35% ferrite and 22,65% pearlite

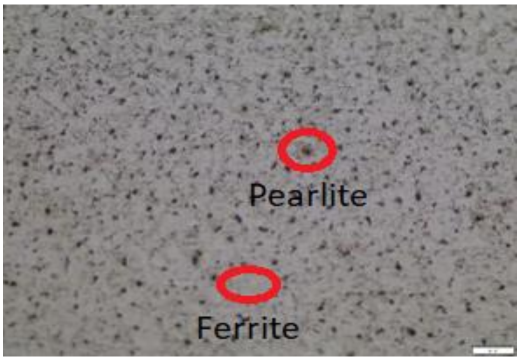

Figure 8. Microstructure 100 A

From Figure 8 it can be seen that there are ferrite and pearlite phases. On 100 A welding current contained 73,78% ferrite and 26,22% pearlite

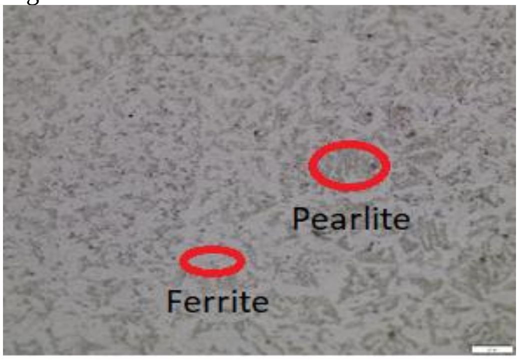

Figure 9. Microstructure 115 A

From Figure 9 it can be seen that there are ferrite and pearlite phases. On 115 A welding current contained 67,65% ferrite and 32,35% pearlite

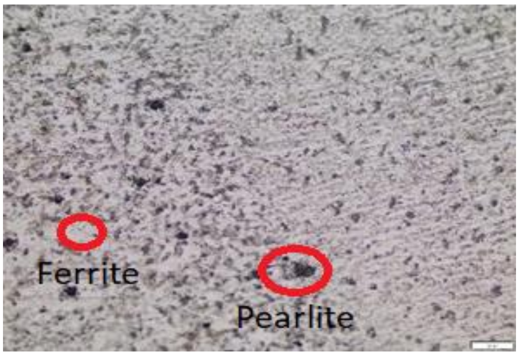

Figure 10. Microstructure 130 A

From Figure 10 it can be seen that there are ferrite and pearlite phases. On 85 A welding current contained 65,90% ferrite and 34,10% pearlite

From the microstructure examination of ST 42 steel, two phases can be observed: ferrite and pearlite. The ferrite phase appears as white and has lower strength but higher ductility. On the other hand, the pearlite phase appears as black and exhibits higher strength and hardness.

TABLE 9.
PHASE CONTENT

Current Variation	Content	
	Ferrite	Pearlite
Raw	59,64%	40,36%
70 A	81,28%	18,72%
85 A	77,35%	22,65%
100 A	73,78%	26,22%
115 A	67,65%	32,35%
130 A	65,90%	34,10%

The microstructure examination results, after processing using Image-J software, show that the ferrite phase decreases with each increase in welding current, while the pearlite phase increases. This indicates that higher welding currents result in increased strength and hardness of the welded steel. Additionally, a lower ferrite content in the microstructure correlates with a lower corrosion rate.

Based on the test results, it shows that each addition of the variation of the welding current, the more pearlite content and the less ferrite content. This is compared to previous research by Fajar, with currents of 100 A, 120 A, and 140 A. The welding current of 140 A has the lowest ferrite content and the highest pearlite among all the welding currents used[15].

IV. Conclusion

Based on the conducted tests on tensile strength, corrosion rate, and microstructure analysis, the following conclusions can be drawn:

1. The highest average tensile strength was obtained at 130 A welding current with a value of 519.20 MPa. The highest strain values were observed at 115 A and 130 A with a value of 7.00%, while the highest modulus of elasticity was obtained at 115 A with an average value of 102.18 GPa. The tensile strength of ST 42 steel increased with higher welding currents.
2. The corrosion rate of ST 42 steel decreased with increasing welding currents. This indicates that SMAW welding current has an effect on the corrosion rate of the material. A higher welding current resulted in a lower corrosion rate, indicating improved corrosion resistance. The lowest corrosion rate was observed at 130 A with a value of 0.10 mm/year. According to the corrosion resistance categories, the 130 A welding current falls into the "excellent" category.
3. The microstructure analysis of ST 42 steel using different welding currents revealed that the ferrite content decreased, while the pearlite content increased with increasing welding current. This observation has a significant impact on the tensile strength and corrosion rate of the steel.

Overall, the results indicate that higher welding currents in SMAW have a positive influence on the tensile strength, corrosion resistance, and microstructure of ST 42 steel. The findings highlight the importance of selecting appropriate welding parameters to achieve desired mechanical properties and corrosion resistance in steel structures.

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