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Research Paper

Variety of Current Power Welding Using Electrode 6013 on Tensile Force of Lower Carbon Metal

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Abstract

The objective of this study is to determine the outstanding tensile value on welding of little carbonate steel electrode 6013/ Ɵ 2.5 x 350 mm in tensile test. Specimen in tested is a lower carbon steel found in market or sometimes available on welding workshops of plate form. This plate is made refer to Standard Tensile Test specimen ASTM E-8M in thick 5 mm and made plot V 45^0 in twelve pieces. In welding specimen, inflow current varieties with 60, 80, 100, 120 Ampere and constant power of 20 volt and welding position tilted ranges $60^0 – 70^0$. In the test found data the lowest tensile strength is 160.62 Mpa of welding current power 60 Ampere and the greatest tensile force 438.80 Mpa with welding power 120 Ampere whereas welding most adaptable is on 80 Ampere 325.96 Mpa. The power force of welding determined to tensile force due electrode fluid completed and influenced to that lower carbon steel mechanical property.

Keywords: *welding, electrode, lower carbon steel, tensile force*

1. Introduction

In responding with advanced industries today, perhaps it always hold along the essential uses of metal as main component for manufacturing[1], either required in the most simple need on household appliances through construction need, to construction of bridges and machining. This requirement cause uses of metal material such as steel, cast iron, aluminum and so forth become more increased. High need on metal is indication of advanced in human civilization.

With intelligence capability, human may explore metal become an aid tool and vital for living. There are many kinds of machining construction, for building and others may be created by metal. The metal itself drive needs up to technology and engineering - manufacturing and to joining. One of the joining technology is by welding[2], [3].

In generally, the industries or welding workshop found on towns available operated in Sumatra Utara province level middle small scale as usual used welding wires in economic price lower quality, for instance welding wires E 6013 to fulfill order as required consumers such as construction of Beca-motor, home straws, fences, canopy and so forth purposes, carbon steel plate available in market-place in generally have no manufactured specification, that almost public do not know the differences and uses of that steel properly, so it is valuable to conduct a research about the tensile force of welding with wires and mostly uses with metal plate applicable, it is to assure the force of welding construction[4]–[6].

In welding, the current power highly influenced energy produce to, in a highly force current to conductor of energy original from electric power can change into heat energy. The heat produced as long as a welding process is applied to melt down sources metal, the energy as produced is a force to use during a certain time[7], [8].

The current to a welding plays vital role, for instance if situation of current so lower, transform liquid flakes over electrode tip in use highly difficult and electric arcs is not stable. The heat available is not sufficient to smelt base metal over so there produced s very small serration form and rough and go leak into depth near only, whereby if the current too power up it may produce its beads wider up, then granules sparkle up and the forcing of beads to weld is high. Igniting to electric arcs is easy to make but when the arcs lights up resulted in gas be trapped within weld and it cause produce pores may reduce down the strength of welding. The factors influencing quality of works such as; procedures of welding, tool and work object, whereas to setting current and select safety tool is included into procedure. Evaluation the quality of welding there are two methods, they are damaging the work object and allow available. For not damaged test to object work means allow one to observe visually, particle magnetic, ultrasonic, radiography, and penetration liquid. In order to know physical property in weld with a damaged test namely known as impacted test, arch test, tensile test and hardness test[9]–[11].

It is highly important to make research on metal while melding, because the welding itself is one of ways to connect the metal and most frequently used in *manufacturing*. Quality with forceful of connected in welded is absolutely need to know close to assure the safety in process of technical, either in transportation or other technical instruments such as construction for *Beca-motor*, house-fences, canopy and so on.

At very high heat treatment in welding process is certainly resulting in change of micro structure influencing mechanical property of metal, parameter force of current, speed of welding, tensile and other matters certainly it has value influencing to mechanical property of metal[12]–[14].

2. Methodology

In conducting this research, the writer has gathered data either library research, took place at Library Universitas Sumatera Utara, internet and journals correlated with welding. Examination of its chemical property in metal was done at *Growth Asia Kawasan Industri Medan*. Provided specimen was conducted at UD. Bahari, still the welding was done on CV. Katio. Testing on tensile force was conducted at Politeknik Negeri Medan College. Testing of hardness and Magrography and Metallographic at Serpong Jakarta. The material used in this research such as metal plat lower carbon sold commercial in market place, then examine its chemical content aimed at knowing carbon content and other elements. On the examination to chemical content done by PT. Growth Asia over the metal plat to test, the data specifications of material test can be known as lower carbon plat. The specimen as to test its tensile force are twelve pieces and without process of welding existed one specimen only as comparative. The instruments provided in this research to testing are as followings:

a. Welding machine SMAW, AC Arc Welder, used to weld as testing. This weld machine can be variety either type of current and the voltage. The welding machine used can be seen on Figure 1. As below.

Fig 1: Welding Machine SMAW

b. Milling machine is used for filling of specimen as to test. The milling machine as used in the specimen can be seen on figure 2 as below.

Fig 2: Milling Machine

c. Universal Tensile Test Machine is used of measuring the tensile force of specimen, the machine can be seen on Figure 3 as below.

Fig 3: Universal Tensile Test Machine

d. The type and size of specimen in tensile test meets to standard ASTM E-8M, as seen on Figure 4.

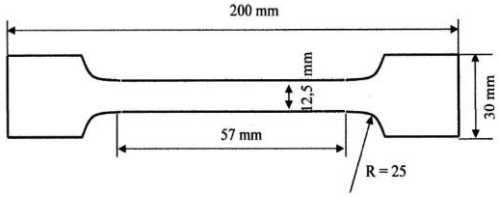

Fig 4: Specimen Tensile Test ASTM E-18

e. In provide specimen, the material that has been obtained in market-place as specimen has no precisely 5 mm sized. One requires a plat with 6 mm sized but when measured its thickness averagely 5.8 mm, so the plat 5.8 mm then be lathed into thick 5 mm. The plat that has been lathed into one 5 mm thickness then, is processed by a milling machine to produce 25 mm radius. After specimen formed on milling machine and the specimen has been made in standard ASTM E-8M further the process of producing V plot of welding as figure 5.

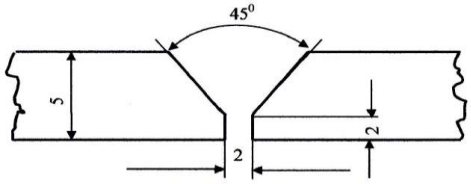

Fig 5: Plot V for welding in mm sized

f. After made V plot finished using Scrap machine then, the specimen is arranged orderly on based plate and welded points, for the welding specimen no crooked if heat of welding, after finished the specimen then cooled in air, then the specimen is released from holder support plate in the basic of specimen, then the output on V plot be screwed by machine done be smoothly, then after finished the specimen be ready to test.

g. The welding process should be done by skill worker having *Welder Instructor* certificate, with capability to handle it safety.

Data of welding are as the followings:

Material of specimen	: Metal Plate in lower carbon
Thick of specimen	: 5 mm
Type of welding machine	: Electricity AC
Type of Electrode	: E 6013/Ø 2.5 x 350 mm
Position of welding	: flatted
Direction of welding	: set back
Torch angle to weld axis	: $60^0 – 70^0$

The welding of specimen is done with variety in current force, flatted and angle of welding is $60^0 – 70^0$

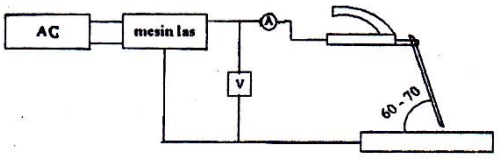

Fig 6: Set-up instrument of welding

3. Results and Discussion

Tensile testing is done to determine a mechanical properties of material plate in lower carbon as tested material in the research. The result of testing in generally is parameter of forces (tensile forces and yield strength), parameter of plasticity or brittle as shown, seen after available extended and percentage of contraction or reduced section, the testing is done of using *Universal Tensile Test machine*.

The specimen testing comprising of Raw specimen namely specimen for specification or properties on test material as comparative with welding specimen.

Table 1: The Results on Testing Tensile Forces of Welding

Current forces	Specimen	Maximum stress	Yield stress	Prop. limit	Elastic modul	Elengation
60 A	A1 A2 A3	180,62 195,24 208,14	137,62 194,04 180,14	132,45 191,80 205,56	205894,57 207209,00 207454,77	1,25 1,88 2,00
80 A	B1 B2 B3	316,24 311,96 349,67	211,69 235,68 340,67	198,83 228,83 341,10	205782,74 204146,19 207167,07	4,00 3,75 3,75
100 A	C1 C2 C3	347,48 352,54 367,66	260,75 267,39 277,68	252,65 261,39 270,82	205497,19 206689,24 206728,12	4,13 3,38 3,00
120 A	D1 D2 D3	438,80 409,75 400,03	331,67 268,04 301,24	320,53 259,94 292,33	207158,69 206956,46 206223,11	2,13 4,00 3,75

Table 2: The Results Average Maximal Tensile

Current forces	Specimen	Maximum stress	Average (Mpa)
60 A	A1 A2 A3	180,62 195,24 208,14	188.00
80 A	B1 B2 B3	316,24 311,96 349,67	325,96
100 A	C1 C2 C3	347,48 352,54 367,66	355,89
120 A	D1 D2 D3	438,80 409,75 400,03	416,19

Table 3: The Results Average Percentage of Extension *(stretch)*

Current forces	Specimen	Elengation %	Average %
60 A	A1 A2 A3	1,25 1,88 2,00	1,71
80 A	B1 B2 B3	4,00 3,75 3,75	3.85
100 A	C1 C2 C3	4,13 3,38 3,00	3,50
120 A	D1 D2 D3	2,13 4,00 3,75	3,31

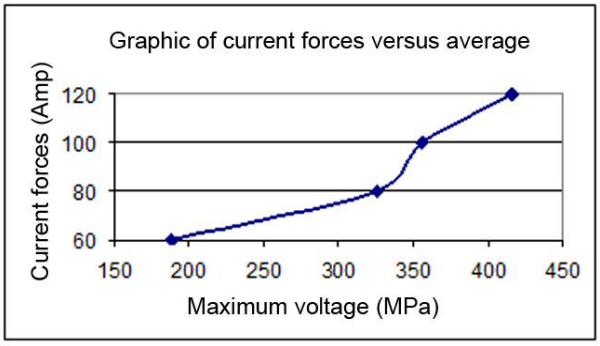

Fig 7: Is graphic of current forces versus average

Maximal stress or specimen without any welding as a comparative object material, from thence it is obtained graphic of Strain stress as seen on Figure 3.2 as below.

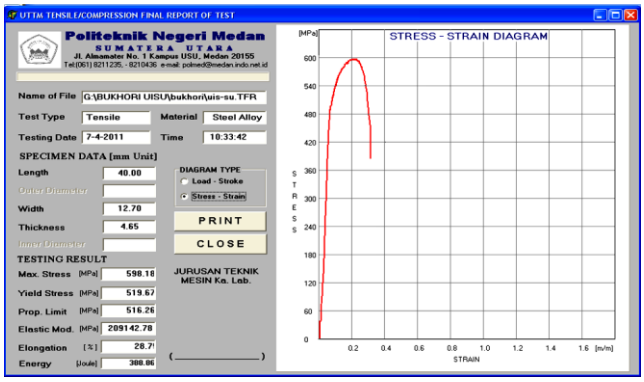

Fig 8: Graphic Strain Stress of raw material

Data (s) as required are followings:

1 Maximal Tensile 598.18 MPa
2 Yield Stress 519.67 MPa
3 Proportional limit 516.26 MPa
4 Elasticity Modules 209142.78 MPa
5 Extension 28.7%.

The results of hardness test as showed on figure 3.3 below.

Fig 9: Hardness testing

Remarks: 1

1. 1 and 2 : Based material of plate (BM)
2. 3 to 6 : HAZ
3. 7 to 10 : Welding Material (WM)

Table 3: The Results of Hardness Test

No	Hardness Rate HV		
	Sample B1	Sample B2	Sample B3
1	145	123	138
2	140	127	141
3	195	170	172
4	193	172	169
5	190	173	173
6	188	169	172
7	225	220	225
8	227	223	223
9	224	223	227
10	223	220	223

The Results of Macro-graphic and Metallu-graphic test.

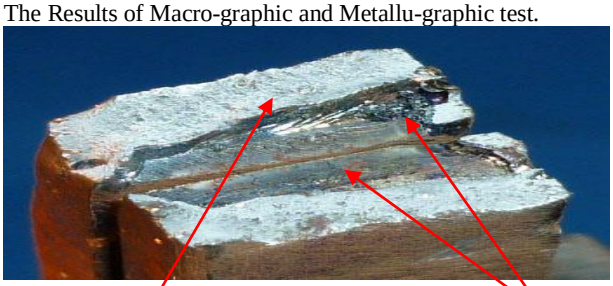

Fig 9:Results of connecting tensile test of plate showed available brittle pieces, cut off on welding material

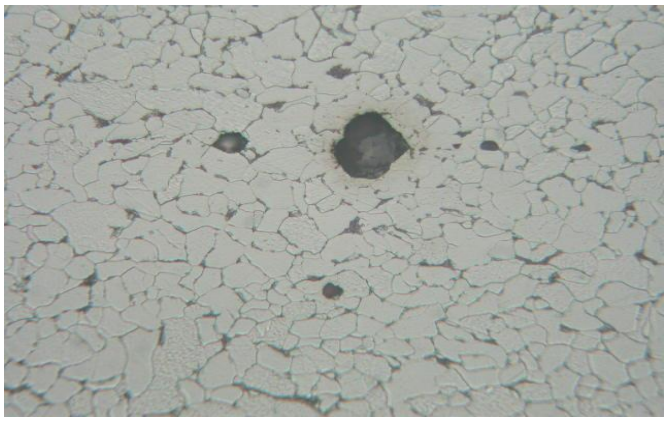

Fig 10: Structure Micro material of metal low carbon

4. Conclusion

The comparative between tensile force in plate tested to the plat without any welding is too far namely 598.18 Mpa with 438.80 Mpa. Comparative of tensile force between a welding with current force of 60,80,100 and 120 Amper is a welding with 120 Ampere in the most forces, whereas the force of welding current high influencing to the mechanical property of welding connected. By the macro photo indicated that fractured surface the result of tensile testing is available on weld material due to the welding work is not perfect. Its macro structure of weld metal (WM) in form of bainit-widmanstatten with pro-eutektoid ferit, there is found stuck air defect (arrow). Etsa : nital 2%. Micro structure of zone Heat-affected zone (HAZ) with matrix bainit-ferit is inclusion defect impurities (FeS), so Etsa : nital 2%

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