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ANALYSIS OF THE MECHANICAL PROPERTIES OF OXY-ACETYLENE WELDING USING BORAX

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ABSTRACT

Aluminum AA 1100 is an alloy of Al 99.05%, Si 0.24%, Fe 0.43%, Cu 0.17%, Zn 0.11%. The oxy-acetylene welding is a manual gluing without pressing where the surface to be joined is heated until it melts by the flame of acetylene gas with or without filler. The method used in this study is an experimental method with the process of joining specimens using oxy aceteline welding (C_2H_2 combustion with O_2) and for the process of measuring the mechanical properties of the welding results using a bending test and tensile test. The measurement results on the oxy-acetylene welding process of AA 1100 aluminum plate using borax showed that the average tensile strength value was 74.43 MPa and the average bending strength of the specimen was 38.75 Kgf.

Keywords: borax, tensile test, bending test, AA 1100, flux.

INTRODUCTION

The oxy-acetylene welding is a manual connection without pressing where the surface to be joined is heated until it melts by the flame of acetylene gas, combustion of C_2H_2 with O_2) with or without a filler.

Aluminum has favorable properties such as resistance to corrosion, a fairly good conductor of heat and electricity and light weight because aluminum is a nonferrous metal but when compared to steel, aluminum has less good welding properties. To obtain an increase in mechanical strength, usually aluminum metal is combined with elements of Zn, Mn, Ni, Cu, Si, Mg, and other elements [5].

Welding

Welding (welding) is a metal joining technique where part of the main metal and filler metal are melted with or without pressure [6]. The definition of welding according to DIN (Deutsche Industrie Norman) is a metal or metal alloy connection that is carried out in a melted or liquid state. In other words, welding is a metallurgical bond in the local joints of several metal rods using heat energy [4].

The oxy-acetylene welding process in aluminum joining can affect different weld areas to the parent metal and the microstructure arrangement, especially the HAZ (Heat Affected Zone) area, changes in the microstructure arrangement due to the thermal cycle that occurs during the welding process. In addition, other factors that may influence the strength of the aluminum weld joint with acetylene welding include the tendency of porosity due to hydrogen gas (H2) in the weld metal area. When the microstructure changes, the mechanical properties of aluminum automatically change, which affects the strength of the aluminum welded joint. This will result in weld defects and cause a decrease in the strength of the aluminum welded joint.

Oxy-Acetylene welding uses a mixture of oxygen and gas fuel to create a fire as a heat source to melt hard objects. Gas and oxygen are mixed in a device with a certain composition so that the resulting flame can reach its maximum temperature. The fire is located at the muzzle of the combustion tool so that it can be directed effectively towards the part of the workpiece to be joined. Only a small part (the tip) of the workpiece melts and fuses so that after freezing it makes a strong connection, if possible match the strength of the object. The following is an overview of the welding process (Hazledine, 2007) [3].

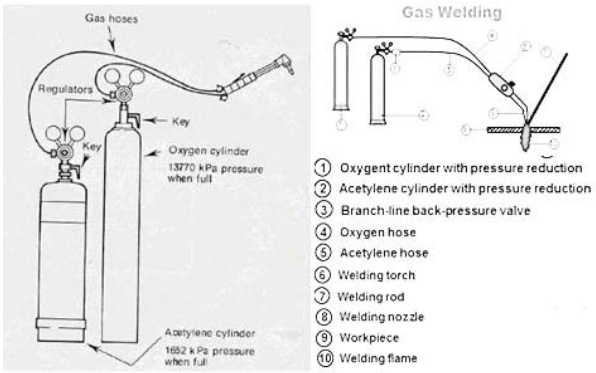

Figure-1. An overview of the OAW welding process.

Borax

Borax is a white, non-lustrous crystalline compound and is stable for normal temperatures and pressures. Borax is a chemical compound and has the name sodium tertraborate, and will become boric acid and hydroxide when dissolved in water. Borax is commonly used as a pharmaceutical base, food preservative, used as a weak bactericide and moderate astrigent and as a flux substitute. Borax has a chemical formula, namely Na4B2O7.10H2O. The reaction between borax sodium tetraborate dakahydrate and acids such as hydrochloric acid produces boric acid.

Properties of Borax

a) Borax contains boron and has a molecular weight of 381.43.

b) Borax Is water soluble

c) Borax is generally alkaline at pH 9.17 - 9.25

d) Borax is insoluble in alcohol

Benefits of Borax for Welding

Borax is used as a flux when welding iron, steel and aluminum. The use of borax can lower the melting point of iron oxide compounds (iron rust), which allows these compounds to separate from the surface of the iron. Borax is also used as a flux when melting and making gold and silver metal jewellery. Basically, borax is an oxidizing agent, which is capable of oxidizing base metals into their compounds.

Figure-2. Borax.

RESEARCH METHOD

The experimental method is the method used in this research where the specimens are formed according to the ASTM E8 standard for tensile tests and ASTM D790 for bending tests.

A. Welding Design

a) Welding design for bending test

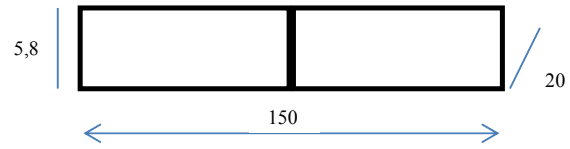

Figure-3. Bending test specimens.

b) Welding Design for Tensile Test

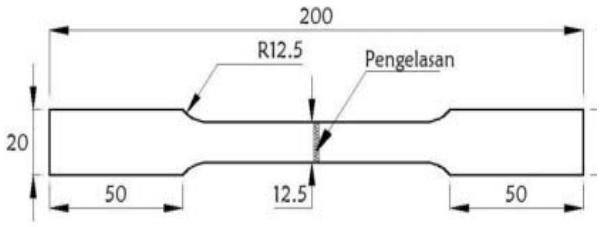

Figure-4. Tensile test specimen.

Figure-3 and Figure-4 show the design of the research specimen before welding with a tensile test specimen size of 5.8 mm plate thickness, 20 mm width and 200 mm length while for bending the plate thickness is 5.8 mm, 20 mm wide and 150 mm long after the object. The work is then carried out by welding OAW using a filler from drum brake shoe waste.

DISCUSSIONS

Table-1. Tensile and bending normal test results.

Specimen	Tensile test		Bending test	
	σ (Mpa)	Ɛ (%)	Pmax (kgf)	Ymax (mm)
Raw	94.73	3.71	25.44	32.12

Tensile test

Figure-5. Fracture of the specimen after the tensile test.

Table-2. The results of the AA1100 aluminum welding tensile test using borax.

Spesimen	L (mm)	b (mm)	t (mm)	σ Mpa)	Ɛ (%)
1	130	5.8	20	73.65	2.15
2	130	5.8	20	73.35	2.11
3	130	5.8	20	76.59	2.07
4	130	5.8	20	74.53	2.21
5	130	5.8	20	74.33	2.16
Rata-rata	130	5.8	20	74.43	2.13

From the data Table-2 shows that the tensile strength value of the oxy-axetelin welding has an average tensile strength of 74.43 MPa, the graph of the stress-strain relationship can be shown in Figure-6.

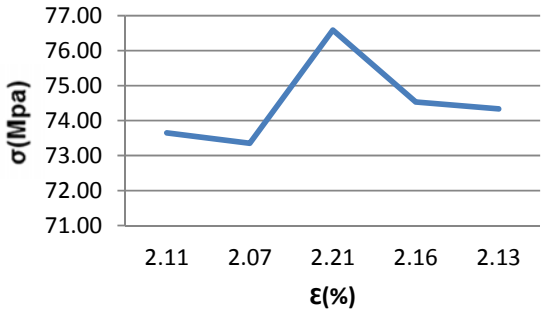

Figure-6. Stress vs strain.

Bending Test

Figure-7. Surface bending test results.

Table-3. The results of the AA110 aluminum welding bending test results using borax.

Spesimen	L (mm)	b (mm)	t (mm)	Pmax (Mpa)
1	130	5.8	20	38.56
2	130	5.8	20	39.22
3	130	5.8	20	38.75
4	130	5.8	20	39.12
5	130	5.8	20	38.75
Rata-rata	130	5.8	20	38.75

Table-3 shows that the value of bending strength for welding oxi-acetylene aluminum AA 1100 is an increase from the normal test. Where for the raw on the bending test with a value of 25.44 Kgf. The results of the bending test on welding using yellow salt with 5 specimens showed the average value of bending strength in the use of yellow salt as a flux was 38.75 kgf.

CONCLUSIONS

a) The test results show that the average bending strength value of the aluminum oxy-acetylene welded joint against the AA1100 aluminum plate material using boraks shows the bending strength is 38.75 Kgf
b) The test results of the average tensile strength of the aluminum oxy acetylene welded joints against the AA 1100 plate material show that the average tensile strength value in the use of boraks is 74.43 Mpa.

REFERENCES

[1] American Society for Testing and Materials. 2001. Standard Guide for Preparation of Metallographic Specimens. ASTM, E3-01.

[2] Daryanto. 2012. Teknik Las. Bandung: Alfabeta.

[3] Hazledine F. 2007. Oxy-Acetylene Welding. Proceedings of the Institution of Mechanical Engineers, 96(1): 99-189. https://doi.org/ 0.1243/pime_proc_ 1919_096_010_02

[4] Wiryosumarto, Harsono dan Okumura T. 1996. Teknologi pengelasan Logam. Jakarta: pradnya paramita.

[5] Surdia T. 1987. Pengetahuan Bahan Teknik. Jakarta, Pradnya Paramit.

[6] Sonawan H., Sutratman R. 2006. Pengantar Untuk Memahami Pengelasan Logam. Alfa Beta.