Effect Of Heat Welding GTAW *(Gas Tungsten Arc Welding)* In *Grade 316L Stainless Steel*material Properties Of Violence *(Hardness)* And Composition Material

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Abstract. Welding on the type of welding *(welding)* using the GTAW *(Gas Tungsten Arc Welding).* It is one of the most widely used method for connecting a material, especially on the pipe. Splicing by welding is one way to provide heat to the material so that the material melted and fused. In *stainless steel* material will be very easily distracted from the heat during the welding.So it can affect the properties of *the stainless steel* material especially for the nature of the corrosion resistance. This study aims to understand and minimize the effect of heat from the weld on the composition of the metal alloy *stainless steel (SS),*especially for atomic *Chromium (Cr)* and violence *(Hardness).* Experiments were carried out by testing the hardness*(Hardness test)* and PMI Test on area *base material, HAZ (Heat Affected Zone) and the weld metal.* The results obtained in the form of data in tabular form to inform a large percentage of the value of the level of violence and in this case the percentage composition of the chromium material to the readings of test points that have been determined from the test material. **Keywords.** GTAW *(Gas Tungsten Arc Welding), stainless steel (SS),* hardness testing *(Hardness test).*

1. Intoduction

Welding types of GTAW (Gas Tungsten Arc Welding) is widely used for welding instainless steel material (ss). In materials *Stainless steel (SS)* temperature in the parent material *(Base Metal)* should be maintained. If the parent material received a lot of heat will affect the properties of corrosion resistance and affect the mechanical properties of the material. This happens because the element *Chromium (Cr)* in the alloy reacts with the element*Carbon (C)* so as to form chromium *carbide (CrC).* This reaction will occur at temperatures above 800F. Moreover, at this temperature will change the atomic structure of the material. At *316Lgrade stainless steel* will turn into *Ferritic Stainless Steels.* By changing the *grade of* the mechanical properties of the material will also change that is going to be harder *(Hand Book of American Iron and Steels Institute, Welding Of Stainless Steels and Others Joining Methods).* Las GTAW *(Gas Tungsten Arc Welding)* is an arc welding process using a flame *(arc)* as a producer of heat to melt the workpiece from the electric current. Flame arc *(arc)* is generated between the *tungsten electrode* to the workpiece. In GTAW welding shielding gas used in the form of inert gas is argon (Ar) or helium (He). The function of this gas is to protect the welds that do not react with air or oxidized. The heat generated in the welding process can be regulated by adjusting welding speed*(travel speed).* The higher the heat generated, the greater the influence on the material pangelasan. In the process of welding *stainless steel* material kept to a minimum given heat to the workpiece so little to influence on the properties of the workpiece *(The Welding Institute Welding inspector CSWIP 3.1, TWI Ltd. 2006).*

1.1Stainless Steel (SS)

Stainless Steel (SS) is the nature of the steel with high corrosion resistance in various environmental conditions, especially in the *ambient* atmosphere (environment). The nature of the corrosion resistance of the alloy elements produced by the presence of chromium (Cr) with a concentration of at least 11% that forms a protective oxide layer on the surface. The corrosion resistance can also be improved by the addition of nickel (Ni) and molybdenum (Mo).

1.2 Las GTAW (Gas Tungsten Arc Welding)

Las GTAW (Gas Tungsten Arc Welding) or commonly called TIG welding (Tungsten Inert Gas) welding process is one of the heat generated from the arc flame coming from the electric current between the *tungsten* electrode *nonconsumable* with the material to be welded. The area of influence

of heat or HAZ *(heat affected zone)*, which melted metal and *tungsten*e lectrode shielded from environmental contamination by means coated by a protective gas where the gas is *inert* (does not react chemically with other gases) flowing from the welding *torch.*

1.3Test Hardness (Hardness Test)

Violence is defined as the resistance of an object (workpiece) to penetration /permeability of other materials harder*(penetrator).* The violence is a property of a material that is largely influenced by elements of the alloy and the hardness of a material can be changed when it is done with *cold worked* like rolling, withdrawal and others as well as hardness can be achieved as required by heat treatment Factors that affect the outcome of violence in the heat treatment, among others;Chemical composition, Heat treatment step, the flow of cooling, heating temperature, etc. The process *of hardening* is quite widely used in the metal industry or other metal workshops. Machining tools or machine components to be hardened so much resistant to puncture or pressure and friction than other metals, such as gears, shafts, etc. are widely used on moving objects.Hardness of a material (steel) can be determined by wear testing machine hardness test hardness *(hardness tester)* used three ways / methods that have been widely / commonly done is the method of Brinell, Vickers and Rockwell.

2. Method

In testing the hardness *(Hardness test)* and Test PMI. Tests were conducted at three points where the point of the whole test is expected to present the test material. Three points are that the test material is not affected heat of welding, the test material in which areas affected by the heat of welding (HAZ) and the metal from *welding (weld metal).* On the hardness testing of data taken from three individual dots. Here's illustrations capture location data from the test material.

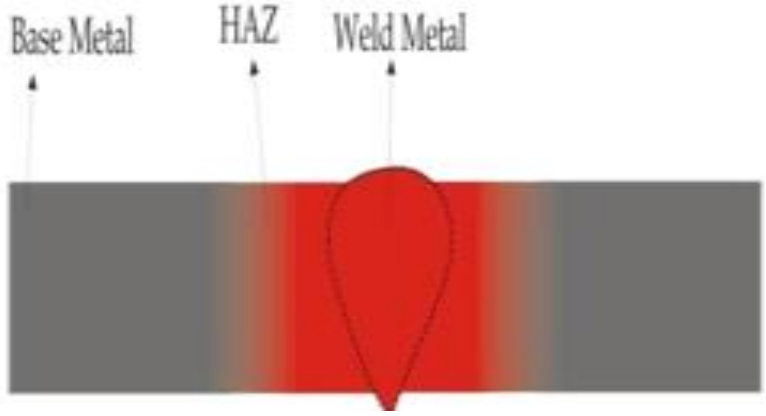

Figure 1. Decision Point Data

From the data obtained, the quantitative data in the form of hardness test results and test results PMI will then be compared to any location data retrieval. In summary, the implementation of the research data retrieval chart can be made as follows:

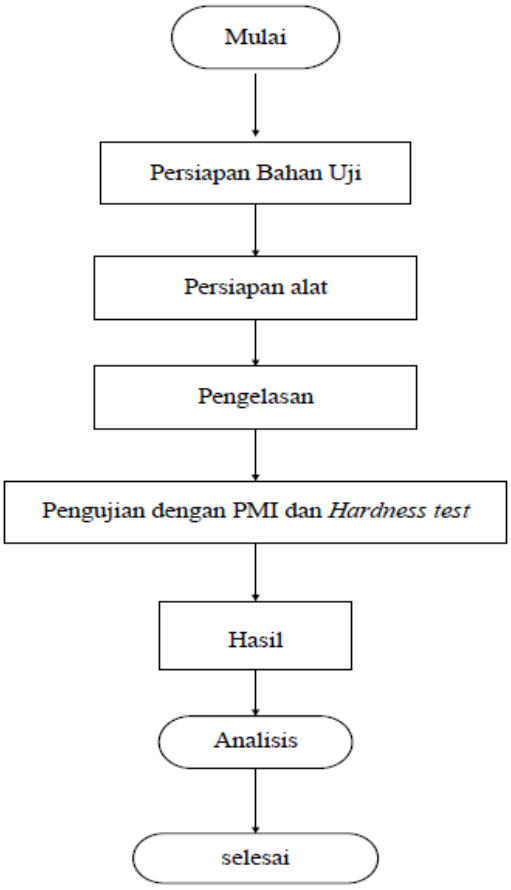

Figure 2. Flow Diagram of Content Research

3. Results and Discussion

The data obtained in the study, are presented in tabular form. The table on the results of such studies to inform a large percentage of the value of the level of violence and in this case the percentage composition of the chromium material to the readings of test points that have been determined from the test material. Testing is done by means of a calibrated and operated by a certified operator. To obtain research data, work order performed are the first which mark the points of the test material to be tested. The point is that the base material, HAZ region *(Heat Affected Zone)* and the *weld metal.* Having determined these points then the surface be cleaned of impurities such as dust, etc. by using acetone and a rag .

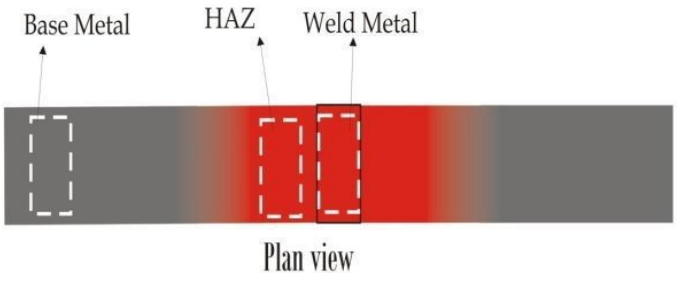

Figure 3. Discussion of test point

3.1 To test PMI (Positive Material Identification)

For the results of the tests on test materials with PMI testing of the points test are presented in the following tablel :

A. Chromium Carbide

At the moment before reacting, the levels of chromium in the alloy that is 16.73%, this can be seen in the levels of chromium in the base metal chromium percentages assuming the same for all the materials. After reacting with the carbon, chromium content in the alloy becomes 16.62%. The chromium atoms react with carbon atoms during the cooling process and the cooling process is not isolated or not covered by a protective gas. This is due to the protected areas is always on the move following the movement direction of *the torch* where the gas during the process especially protecting penggerasan *(solidification process).*The influence of the reaction is material to the reduced ability of rust resistance *(corosi)* mainly grain boundary corrosion. In the *stainless steel* material is not contaminated mainly by carbon, the surface form a protective layer of chromium reaction products with air or oxygen. These layers are passive.

Table 1. PMI test results

Item	**Material**			
Description	**Description**	**% Of Cr**	**Standard**	**Result**
Weld Metal	ER 316L	17.73%	16.2-22.0	Pass
HAZ Metal	316L	16.62%	16.2-22.0	Pass
Base Metal	316L	16.73%	16.2-22.0	Pass

PMI Test results showed that there was no significant change in the composition of the test area.Lowest levels of chromium atoms are in the HAZ region. However, the chromium levels can still be said to enter the tolerance value allowed under ASME CODE Section.

B. Levels of chromium in the HAZ is smaller due to some chromium atoms react chemically with the carbon atoms to form.

3.2 Discussion For Testing Hardness Testing (Hardness Test)

For the results of the tests on test materials with hardness testing *(Hardness test)* of the points test are presented in the following table :

Table 2. Results of hardness test *(Hardness Test)*

Item	**Result (LD)**				**HB**
	Reading Value				
Description	**One**	**2**	**3**	**Average**	**VALUE**
Weld Metal	351	437	358	382	135
HAZ Metal	392	403	389	395	141
Base Metal	339	359	342	347	110

Results of testing hardness test *(hardness test)* as table V.2 shows that there has been a change in violence in areas of heat treatment during the welding process. It can be seen in the value of testing on the HAZ region is 141 HB *(Hardness Brinnel)*compared with the value of testing in *the base metal* with a value of 110 HB. For the results of tests on *weld metal* can not be used as a comparison because the hardness value can be set as desired depending on the weld-weld filler *metal.* In the HAZ area hardness changes due to cooling that occurred after a heat treatment of the weld occurs faster than the cooling at the time of manufacture of the pipe. At the time of manufacture of the pipe, cooling occurs

in the conditioned space with a long process of cooling and refrigeration or cooling rate can be set. The process of cooling of the welding results are very different from the process of making a pipe. In the cooling process weld cooling rate can not be set. Moreover, in another section of the pipe at the time of welding is not undergo a heating process so that when the cooling process gets a lot of heat which propagate faster than the propagation of heat by the ambient air. In certain cases, if the cooling process occurs suddenly and very quickly, the nature of the material will have a very high hardness. This process is called *quenching.* In *stainless steel material*, the nature of the violence is not the main purpose of the making of this *alloy.*

The main purpose of this *alloy* is corrosion resistance. If you want to get a metal with a high hardness properties, the main ingredient used metal with carbon elements or so-called steel. However, the nature of the alloy is very corrosive so required protective coating to reduce or protect from rust. To solve this problem, in industrial applications that want materials having high mechanical strength but has high corrosion resistance, the steel coating *carbon steel* made with *stainless steel* or commonly called the *cladding* or *overlay.*

4 Conclusion

1. Stainless steel alloy composition changes as a result of heat treatment of welding, especially on the chromium atoms(Cr).
2. Changes in the composition of the alloy occurs in the outermost layer of the metal alloy of *stainless steel* is the chromium atoms react to carbon atoms either from the air or contaminants that form a layer of chromium carbide and chromium oxide blocking layer formation.
3. There was an increase in the hardness *of stainless steel* after a heat treatment of the weld.
4. To restore the level of violence as desired, then do the heat treatment *(Heat treatment)* with a cooling rate that can be set and adjusted.

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