Conference Paper

The Influence of Drying Temperature of E7018 Electrode on the Hardness Value and Porosity Parameters on the SMAW of A36 Steel

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Abstract

Drying of electrodes on the mechanical properties of ASTM A36 steel concerns toughness and hardness value. This research used the experimental method. The tests conducted include a test without damage using radiography and a destructive test using hardness test. As many as 12 samples were divided into four variations in the temperature of drying electrodes, using low carbon steel, ASTM A36. The results showed that the electrode drying of the E 7018 without being opened had many welding defects on the inside in the form of *Porosity* Ø 1mm, elongated 5 mm. The highest hardness test results on a metal base found on ASTM A36 steel plate SMAW joints which was carried out by electrode drying process with a drying temperature of 230°C, with a hardness value of 158 VHN. Violence test on the highest weld metal found in the ASTM A36 steel plate *SMAW* joins the electrode drying process with drying temperatures of 260°C, with a hardness value of 162.6 VHN.

Keywords: drying temperature, E 7018, radiography, hardness

1. Introduction

In today's industrial world, welding activities processes that always related to industrial activities. At first welding activities widely used for repair and maintenance of all tools made of metal, whether it the process of patching cracks, splicing, or cutting the parts that removed or repaired [1].

Technological advancements increasingly fast as it today, it necessary to have proper welding techniques in order to get maximum welding results. The development of technology can be seen from the increasingly complex method of metal connection with the welding process. Good results a scientific challenge in welding techniques to ensure the connection functioning properly [2, 3].

To guarantee the results of a metal connection, of course, the results of the connection must tested before selling products that commonly used in daily life. This to ensure the safety of users from things that can harm humans. In connection testing, the most commonly performed mainstay testing the mechanical properties of metals such as strength tests, toughness tests, and hardness tests [2].

The welding method that often used in general usually welding with a protected metal flame arc method or commonly called Shielded Metal Arc Welding (SMAW). The SMAW method considered more practical and efficient in its use and can use for all welding positions [4].

Electrode selection and treatment very important in supporting the results of welding. Electrodes divided into carbon steel electrodes, alloy steel electrodes, and nonferrous electrodes. However, the electrode based on its function about the ethnic relationship that used up due to an electric arc jump due to a predetermined distance and maintained its size determination between the electrode and the object [5, 6].

For low hydrogen electrodes (E7015, E7016, E7018, E7028 and E7048) it very sensitive to the absorption of inorganic layer water designed to contain very little moisture so that the storage must very thorough. If it turns out that the electrode has absorbed more water than the allowable limit, then it can reused so that the electrode must heated to remove the water content [2].

The parameters examined by the Las Work Manual, Sri Widharto, 2008, the type E 7018 electrode must dry using an oven before use, with a drying temperature of 475 ± 25°F (245± 15°C) for 2 hours of soaking time [3]. Therefore the author wants to know the temperature more optimal electrode drying from the specified tolerance.

2. Methods and Equipment

2.1. Methods

Cut the plate with a size of 100mm x 300mm x 10mm. After being cut, then proceed with making welding seam. Then do the electrode drying process in the oven for ±120 minutes with a temperature variation of 230°C, 245°C, and 260°C. During the oven process, it monitored using a temperature measuring device. They also prepare the electrode without an oven. The next process the specimen welding process using SMAW welding and DC + current with a current of 90 A for a primary 120 A charge for main charging.

After completion, do radiographic testing and proceed with making hardness test specimens. After the preparation complete, then do a hardness test to determine the level of hardness in the welding area, the parent metal area and the HAZ area in the welding results. This violence test uses the Vickers method.

2.2. Equipment

The materials prepared in this study are: ASTM A36 material with chemical composition 98.9% (Fe), 0.158% (C), 0.013% (Si), 0.86% (Mn); 0.015% (P); 0.016% (S) and E 7018

Electrodes. While the tools used for the welding process consist of: A set of *SMAW* welding machines, a set of furnace machines and a temperature measuring device with accuracy ±1.5°C

3. Results

3.1. Radiographic observation

Radiographic observations performed to determine weld defects that not visible on the welded specimen. Radiographic observation done using x-rays. The following the radiographic observation data of the welding results

TABLE 1: Comparison of Las Defects Based on Radiographic Test Results.

Specimen Code	Electrode Drying Temperature	Information
A1	230°C	Ok
A2	230°C	Ok
A3	230°C	Ok
B1	245°C	Ok
B2	245°C	Ok
B3	245°C	Ok
C1	260°C	Ok
C2	260°C	Ok
C3	260°C	Ok
D1	Without oven	Porosity Ø 1 mm
D2	Without oven	Elongated < 5 mm
D3	Without oven	Elongated < 5 mm

3.2. Comparative analysis of welding results with temperature variations of electrode drying based on hardness testing

Product quality welding results can see by looking at the ability and strength of the material. The ability and strength of the material can know by testing the hardness of the welding results. The violence of a material a measure of the material's ability to resist plastic deformation. The hardness factor of the material also the resistance of the material to penetration on its surface. So it can concluded that there a relationship between violence and strength of the material.

Hardness testing welding one of the many testing processes used in welding, because it can carried out on small test objects without difficulty regarding specifications. By giving a load using the indenter to the surface to find out the hardness material of metal measured.

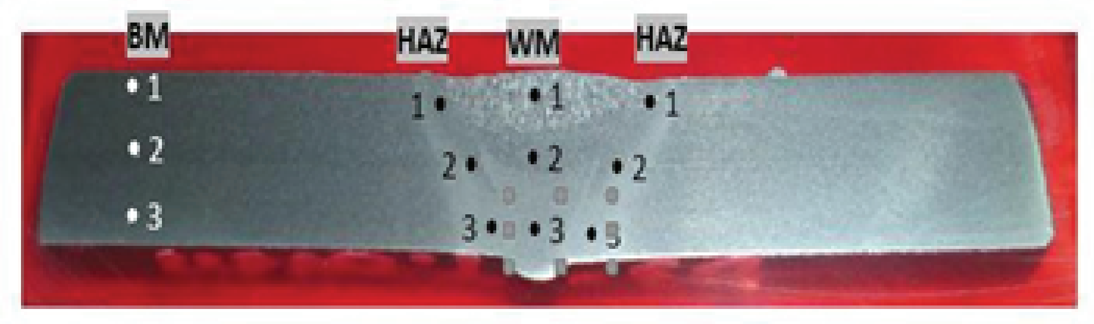

Figure 1: Vickers hardness test location.

The following a diagram drawing a comparison of hardness test results (VHN) from each specimen.

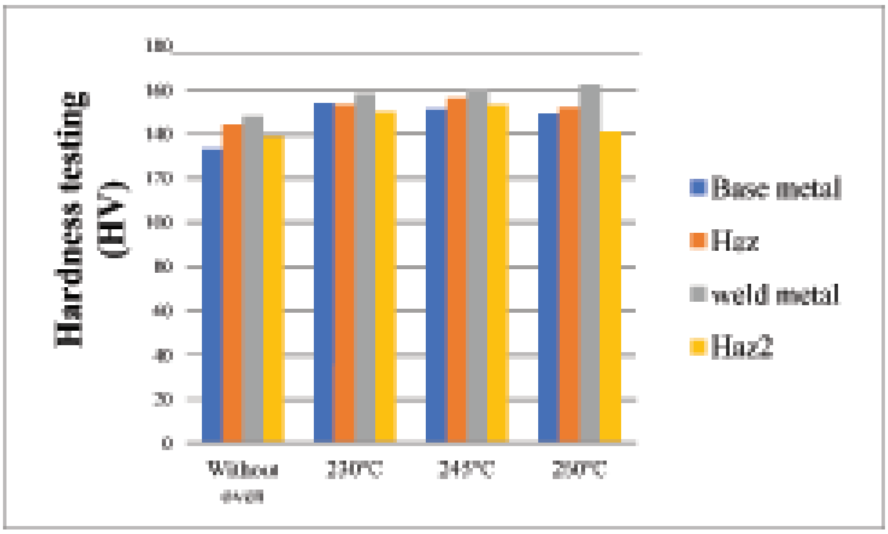

Figure 2: Graph of the Result of Hardness Test (VHN).

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Figure 2 explains that the results of the welding of SMAW specimen C (with an electrode drying temperature of 260°C) had the highest hardness value in the weld metal area of 162 VHN. The welding results of SMAW specimen D (with electrodes without oven) had the lowest hardness level in the weld metal section of 148 VHN, in the base metal 140 VHN, in the HAZ area in 144 VHN, and the HAZ part outside the 139 VHN.

4. Discussion

On the result of radiographic observation was found imperfections of specimens welded with electrodes without oven, whereas the specimens welded with electrodes were not defective. Accurate testing shows that the higher the drying temperature, the higher the hardening weight in the weld metal area.

5. Conclusion

From the welding process using E 7018 electrodes and ASTM 36 materials by changing the drying temperature variations electrodes of 230 °C, 245 °C, 260 °C and without drying electrodes, As well as observations in the form of radiographic observations, etching macro photo observations and mechanical testing in the form of hardness. Then obtained the following conclusions:

1. NDT (nondestructive testing) test results in the form of etched macro radiographs and photos resulting from without drying electrodes showing the presence of weld defects on the inside there porosity and elongated.

2. The test results of DT (destructive testing) in the form of a hardness test explained that the results of welding SMAW specimen C (with an electrode drying temperature of 260°C) had the highest hardness value in the weld metal area of 162 VHN, in the base metal area 149 VHN, in the HAZ region in 152 VHN and the HAZ area outside 151 VHN. The welding results of SMAW specimen D (with electrodes without oven) had the lowest hardness level in the weld metal section of 148 VHN, in the base metal 140 VHN, in the HAZ area in 144 VHN, and the HAZ part outside the 139 VHN.

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Conflict of Interest

The authors have no conflict of interest to declare.

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