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Effect of Welding Using Electrodes with Certain Treatment on Stainless Steel 304 Using SMAW Welding

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Abstract- This paper will discuss how the influence of welding electrodes which before being used in the welding process is given a certain treatment first. The treatment is given to the welding electrode before the welding process is by dipping the welding electrode into the oil and dipping the welding electrode into the coolant. The effect of the welding electrode treatment on the SMAW welding results seen from the tensile strength. The specimen used is stainless steel type 304 with four welding variations. First, welding is carried out on type 304 stainless steel by using welding electrodes of type E308 Gutwelt. Second, welding using Nikko Steel type E308 welding electrodes. Third, welding using Nikko Steel type E308 welding electrodes that are oil dipped. Fourth, welding uses Nikko Steel type E308 welding electrodes which are dyed coolant. After tensile testing of the welding results, the results are obtained: welding using Gutwelt type E308 welding electrodes has greater tensile strength compared to using Nikko Steel type E308 welding electrodes. While welding using Nikko Steel type E308 welding electrodes that have been carried out certain treatments, namely by dipped coolant, produce greater tensile strength compared to using the Gutwelt type E308 welding electrodes. However, in welding using Nikko Steel type E308 welding electrodes that are oil dipped, the tensile strength is still lower than using a Gutwelt type E308 welding electrodes.

Keywords: Stainless steel type 304, Welding electrodes, SMAW welding, Certain treatment

1. INTRODUCTION

Stainless steel is a type of metal that is widely used in everyday life. Stainless steel has various types, one of which is stainless steel type 304 [1]. Stainless steel 304 is the most versatile stainless steel and is most widely used for various needs. With its special properties, 304 stainless steel is widely used both in the household and industrial sectors [2]. Its uses include, among others, household material, building industry, medical and laboratory equipment, piping systems and others [3]. This type has excellent forming and welding characteristics [4,5]. In the fabrication process, metal fusion is the most important process for fabrication components. To combine metals, the welding process is most widely used due to various considerations [6]. Welding is a metallurgical bond in an alloy metal connection which is carried out in a melted or liquid state [7,8]. In the scope of welding there are various kinds of welding that occur, one out of various welding method is shielded metal arc welding (SMAW). This type of welding is included in the category of liquid welding with arc media (electrodes) as filling fluid [9,10].

SMAW welding is a method of the fusion welding process to combine two pieces of metal by melting the edges with an electric arc between two conductors. The electrode is one conductor and the workpiece is another conductor [11]. In arc welding, shielded metal arc welding (SMAW) is usually used in the welding process in most industries, because it is economical and easy to carry [6,12]. In the welding process using an electric arc, required electrodes or better known as welding wires. Electrodes consist of a single core, which is metal and is coated by a layer that is mixed with chemicals [4,13]. types of electrodes on the market are

numerous and have different prices and quality of welding results. Usually between price and quality are directly proportional, the more expensive the price of electrodes, the better the quality of welding results. No exception to the electrodes used for stainless steel welding. For small welding shops the difference in price of welding electrodes is very calculated, because it will affect the price of the products they make. Electrodes are usually chosen at low prices, although the quality of welding results is not good [14]. Therefore, it is necessary to do research on how the welding electrodes which have poor quality become better by means of specific treatments.

Previous studies have tested the effect of oil dipped AWS 5.1 E 6013 electrodes flux on FC 25 gray cast iron welding on tensile strength. And the result is that, welding electrodes dipped in oil before the welding process is able to increase the tensile strength of welding results [14]. Here will be discussed about the comparison between the results of welding using Gutwelt welding electrodes type E308 with welding results using Nikko Steel type E308 electrodes on stainless steel type 304in terms of tensile strength.

As well as whether there is an influence of the oil immersion and coolant treatment on the Nikko Steel E308 welding electrodes used in welding stainless steel type 304 seen from the results of the tensile test.

2. MATERIALS AND METHODS

The material used in this study is stainless steel type 304 and the welding machine used is AC welding machine Lakoni MMA Inverter model FALCON 141 GE. In the welding process using Gutwelt type 308 welding electrodes and Nikko Steel type 308 welding electrodes. while for the Nikko Steel electrode type E308 before being used for the welding process plus two treatments namely: first dipped in oil and second dyed coolant. The welding process uses a strong current of 90 Amperes. Welding seam used is type seam V, angle 60 with a gap width of 2 mm.

After the welding process using four different types of welding electrodes is completed, then testing the results of welding. Testing of welding results is divided into two, non-destructive testing and destructive testing [15]. For non-destructive testing, in this study using the dye penetrant test method. The working principle of the dye penetrant test is that a penetrant liquid of a certain color (red) permeates the discontinuity, then the liquid penetrant is removed from the discontinuity by using a developer fluid whose color contrasts with the penetrant (white). Detection of discontinuity is by the appearance of red spots (liquid penetrant) that come out of the discontinuity [7]. Testing is carried out with the aim to find out the quality of the welding process whether it meets the requirements or not. After the welding results are declared to have met the requirements, the next step is to do destructive testing. The destructive test chosen is the tensile test of the specimen that has been made. Tensile testing is a destructive testing method that aims to determine the strength of the material by giving a linear load [16]. For tensile testing in accordance with ASTM (American Society for Testing and Materials) A 240 standards on welding workpieces. There are mainly two types of standard dimensions, one for plates and one for rod type specimens [11]. So the selection of standard tensile test specimens in this study is plate type.

3. RESULTS AND DISCUSSION

3.1 Dye Penetrant Test

Dye penetrant tests were carried out in order to find out the quality of the welding process using different welding electrodes, whether or not they met the requirements. The results of welding using Gutwelt type E308 welding electrodes, after the dye penetrant test is performed looks like in Figure 1.

Figure 1: Dye penetrant test results welding proses using gutwelt welding electrodes

From Figure 1 shows that SMAW welding using Gutwelt type E308 welding electrodes only slightly experienced welding defects, namely in the specimen (AII). Welding defects that occur due to the welding operator expertise. Welding using the Nikko Steel type E308 welding electrode after dye penetrant test results are shown in Figure 2.

Figure 2: Dye penetrant test results welding process using nikko steel welding electrodes

From Figure 2 it can be seen that the SMAW welding using the Nikko Steel type E308 welding electrode occurs only slightly welding defects, namely in the specimen (BIII). The defect is caused by the expertise of the welding operator. Welding results using welding electrodes Nikko Steel type E308 oil dipped, after the dye penetrant test can be seen in Figure 3.

Figure 3: Dye penetrant test results welding process using welding electrodes nikko steel with dipped in oil

Figure 3 shows that the SMAW welding using weld electrode Nikko Steel type E308 with dipped in oil only slightly occurred welding defects, namely in the specimen (CI), even that is caused by the operator expertise. Welding using welding electrodes Nikko Steel type E308 dipped in coolant, after the dye penetrant test is done the results look like in Figure 4.

Figure 4: Dye penetrant test results welding process using nikko steel electrodes which are coolant dipped

From Figure 4, it can be seen that SMAW welding using Nikko Steel type E308 weld electrodes that are dyed with coolant only slightly causes welding defects, but evenly on all specimens. This is also caused by the operator expertise factor. Dye penetrant tests that have been carried out on all the results of the welding process with various treatments, indicate that the welding results meet the requirements and subsequently carried out tensile test.

3.2 Tensile Test

From the tensile test conducted on the specimens of each welding treatment, among others: First, welding is carried out on type 304 stainless steel by using welding electrodes of type E308 Gutwelt. Second, welding using Nikko Steel type E308 welding electrodes. Third, welding using Nikko Steel type E308 welding electrodes that are oil dipped. Fourth, welding uses Nikko Steel type E308 welding electrodes which are dyed coolant. From the test results obtained data as in table 1. Each

welding treatment was to tensile test three times to obtain more accurate data. To make it easier to compare the results of tensile testing of each welding treatment, then from Table 1 can be made a graph as presented in Figure 5.

Table1: Tensile test result

Welding Process	Tensile Strength (N/mm^2)	Yield strength (N/mm^2)	Strain (%)
Gutwelt electrodes	119.73	96.03	28.27
Nikko Steel electrodes	117.60	85.76	27.00
Nikko Steel electrodes dipped in oil	115.68	76.04	40.27
Nikko Steel electrodes dipped in coolant	121.39	75.1	41.03

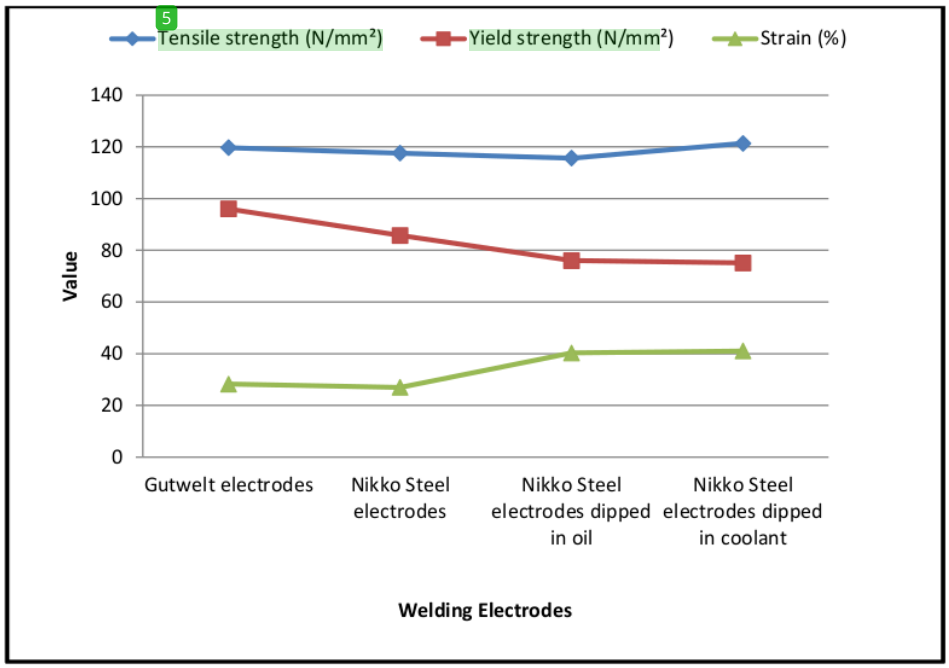

Figure 5 Graph of the tensile test results of each welding treatment

From Table 1 and Figure 5 it can be seen that welding stainless steel type 304 using welding electrodes Gutwelt type E308 has higher tensile strength compared to welding using Nikko Steel type E308 weld electrodes or using Nikko Steel type E308 weld electrodes dipped in oil. However, welding using Gutwelt E308 welding electrodes has a smaller tensile strength when compared to welding using Nikko Steel E308 welding electrodes that are dyed coolant first before being used for the welding process.

The results of the welding process stainless steel type 304 using welding electrode Gutwelt type E308 produce greater yield strength when compared to welding results using Nikko steel type E308 welding electrode and welding results using Nikko steel type E308 welding electrode that were previously dipped in oil or dipped in coolant.

The welding process using Gutwelt type E308 welding electrodes has a greater strain when compared to welding using Nikko Steel type E308 welding electrodes. But welding using Gutwelt type E308 welding electrodes has a lower strain when compared to welding using Nikko Stell type E308 welding electrodes that are oil dipped or Nikko Stell type E308 welding electrodes that are dyed coolant.

The lowest tensile strength is obtained from the welding process using an oil dipped Nikko Steel type E308 welding electrode, which is 115.68 N/mm^2. While the highest tensile strength is generated from the welding process using Nikko Steel type E308 welding electrodes dipped in coolant, which is 121.39 N/mm^2.

From the results of the welding process using Gutwelt type E308 welding electrodes has the highest yield strength value, which is 96.03 N/mm^2. The lowest yield strength value is produced from a welding process that uses Nikko Steel type E308 welding electrodes with coolant dipped, amounting to 75.1 N/mm^2.

The smallest strain is produced from welding using Nikko Steel type E308 welding electrodes, valued at 27%. The biggest strain obtained from the welding process with Nikko Steel type E308 welding electrodes dipped in coolant, which is 41.03%.

4. CONCLUSIONS

Based on the analysis of the results of tensile testing on each welding treatment, it can be concluded that:

i. Certain treatment on Nikko steel type E308 weld electrodes, in this case the treatment of the welding electrode is by dipped in oil and dipped coolant before being used for the welding process, affecting the tensile strength of welding result stainless steel type 304. Where, if the welding electrode Nikko steel type E308 is dipped in oil the tensile strength of the welding results decreases and vice versa, if the welding electrode Nikko steel type E308 is dyed coolant the tensile strength of the welding results is higher.

ii. Certain treatment of Nikko steel type E308 welding electrode affects the value of the yield strength of stainless steel type 304 welding results. The value of yield strength decreases when before it is used for the welding process, Nikko steel type E308 weld electrode dipped in oil or coolant dipped.

iii. Certain treatment of Nikko steel electrode type E308 also affects the value of the strain of results welding stainless steel type 304. Which, from the two treatments of Nikko steel type E308 weld electrodes, results in higher strain values. And the highest strain value was obtained in the Nikko steel type E308 welding electrodes which were dyed coolant.

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