CHAPTER I

PRELIMINARY

1.1 Background

Indonesia is a country that uses and produces a lot of steel. Based on data obtained from the Ministry of Industry, the Indonesian iron and steel industry grew by 12.74% in 2012. Our country now consumes 12.53 million ton of steel.

The sector that uses the most steel is around 80% is one of the construction sector, from the pipe circuit manufacturing sector as much as 8%, from the manufacturing sector as much as 3%, from iron-making factories as much as 2%, from factories related to automotive 1%, and the rest for the needs of other factories. [1]

According to its chemical composition, steel can be classified into two, namely carbon steel and alloy steel. Carbon steel is composed of iron and carbon elements, carbon steel is classified into three, namely low carbon steel, medium carbon steel and high carbon steel. Meanwhile, alloy steel is classified according to its alloy content and is divided into three, namely low alloy steel, medium alloy steel and high alloy steel. In this study, ASTM A 36 is used where the steel includes steel that has a low carbon steel composition.[2]

SS 400 (Structural Steel) is a low carbon steel (mild steel) that conforms to

ASTM (American Society for Testing Metals) A 36 or JIS (Japanese Industrial Standard) G3101. This steel is often applied in the field of bridge construction, plates used on ships and others. ASTM A 36 is included in low steel alloys because its alloy composition is less than 8% with a carbon (C) composition of 0.17%, composition of manganese (Mn) 1.4%, composition of phosphorus (P) 0.045%, and elemental sulfur (S) 0.045%[3]. JIS G3101 - SS 400 structural steel is similar in composition to the A 36 and is included in Mild Steels. The composition of Mild Steel generally consists of 0.25% C, (0.4%% - 0.7) Mn, 0.5% Si and a little sulfur, phosphorus, and other trace elements. The manganese in this steel functions as sulfur stability, silicon has a de-oxidation function, and carbon serves as reinforcement in this type of steel. Mild Steel is generally used in as-roller, forged, or annealed products. In today's industrial world, JIS G3101 - SS 400 is widely used to replace ASTM A 36 because it is cheaper to find[4].

Because of its importance in metal manufacturing and engineering, welding has become an important aspect of industrial technology development. The region around the weld metal undergoes metallurgical change, residual stress amplification, and thermal deformation when thermal energy is used. To reduce these disadvantage effects, the correct and optimal of both welding procedure and parameter were highly needed. Flux core arc welding is one of the most extensively utilized welding methods. Because of its advantages, such as higher deposition rate, less affected on rust, simpler and highly flexible, less skilled operator required, and higher productivity, this method is most commonly used in the metal fabrication business. For many years, the repair industries used FCAW instead of MMAW due to their superiority.[5]

In the welding process, heat comes from an electric arc, and / or the friction generated during the welding process. In the welding process, the part being welded will receive local welding heat, causing an uneven temperature distribution of the metal being welded. The uneven distribution of heat in the welding process causes the temperature of the weld pool to be higher than the surrounding area. The result of the uneven heat distribution during the heating and cooling cycle that occurs in the welding process will leave a residual stress after the welding process ends. Residual stresses occurring at welded joints can be reduced not only through heat treatment, but also through mechanical stress relief methods such as peening, hammering, surface rolling of the weld bead area, and small amounts of structural plastic deformation.

Post-weld heat treatment is also beneficial because it softens or tempers any hard martensite or bainite that has formed in the heat affected zone (HAZ), as well as improving hydrogen diffusion out of the weld metal. After the fabrication of welded structures, post weld heat treatment (PWHT) is commonly used to relieve stress, control hardness, and increase material strength.[6]

Changes in heat can result in the structure of the material from pearlite to martensitic. Structural changes can occur in the base metal, HAZ area and weld metal. The same topic was done by Ahmad (2018), it was explained that ASTM A36 material with a thickness of 6 mm was obtained tensile stress greater than the welding using FCAW with heat treatment preheat and post weld heat treatment. Effect of preheat on the plate that was welded ASTM A36 is its appeal to a higher voltage compared with a gain of specimens heat treatment. The purpose of this study was to compare the effect of temperature without post weld heat treatment versus temperature with post weld heat treatment at temperatures of 450˚ C and 750˚C with a thickness of 20 mm using a test method that included microstructure, SEM EDS and hardness tests.

1.2 Problem Formulation

Based on the formulated background, the formulation of the problem is as follows:

1. How is the effect of post weld heat treatment temperature on the hardness of ASTM A36 material with FCAW welding process?
2. How is the comparison between the microstructure without the influence of post weld heat treatment and using post weld heat treatment?
3. How is the effect of doing post weld heat treatment and without doing post weld heat treatment seen from the results of the scanning electron microscope and energy dispersive X-Ray spectroscopy tests?

1.3 Research Objectives

The objectives to be achieved from this study are as follows:

1. To analyze the effect of post weld heat treatment temperature on the hardness test of ASTM A 36 material with FCAW welding
2. To analyze the best comparison of without post weld heat treatment with the effect of post weld heat treatment using microstructure
3. To analyze the SEM and the EDS structure of the welding process with the influence of post weld heat treatment or without using post weld heat treatment

1.4 Problem Limitation

So that the problems carried out do not deviate from the specified scope, this research is limited to:

1. The material is using ASTM A36 material with a thickness of 20 mm
2. The welding process is using FCAW with the wire used E71T-1M
3. . Gas protection is using carbon dioxide 99.9%
4. Welding position used 2G
5. The type of connection used is a V butt join with an angle 60˚C
6. The FCAW welding process will get post weld heat treatment with temperature variations of 450˚C and 750˚C

1.5 Research Benefits

The benefits of research are:

1. Get an understanding of the effect of the material used on the welding results
2. Get an understanding of whether or not PWHT is needed in the FCAW welding process of ASTM A36 material
3. Get an understanding of the best results from welding for the industrial world.

1.6 Writing Systematics

The systematics of writing this of final projects is as follows:

1. CHAPTER I PRELIMINARY

   This chapter consists of background, problem formulation, problem limitation, research purpose, benefits of research, and writing system.

2. CHAPTER II THEORY BASIS

   Contains a literature review related to the research to be carried out. Explain the basic theory of solar energy and solar cells.

3. CHAPTER III RESEARCH METHODOLOGY

The research methodology explains the place of research, tools and materials, and a research flow chart.

4. CHAPTER IV RESULTS AND DISCUSSION

This chapter contains results and discussion

5. CHAPTER V CLOSING

This chapter contains conclusions and suggestions.