CHAPTER V

DISCUSSION

5.1 Domestic Welding Electrode Development

The first step to make domestic welding electrode is conduct a spectrometer analysis to identify the chemical material in Japan made welding electrode. The result of spectrometer test is 98.37% Cu and 1.17% Cr. After literature study and consultation with supervisor, domestic welding electrode will be made of 98.9% of Cu, 1% of Cr and 0.1% of Zr. The process in alloying the electrode started by melting Cu rod at 1200°C. When all Cu rods melted completely, add Cr powder and mix the powder in the Cu alloy until all Cr powder dissolve in Cu liquid. After the Cu-Cr alloy reach homogeneous state, insert Zr powder and mix the alloy until all Zr powder dissolve in the Cu-Cr liquid and reach their homogeneous state. The homogeneous state of the alloy will depend on temperature, mixing time and the grains size of the elements. When Cu-Cr-Zr alloy liquid reach its homogeneous state, pour the liquid alloy into sand cast and wait until the alloy fully solidified. Next, take the alloy from sand cast, cut, machining, grinding and shape the Cu-Cr-Zr alloy like Japan made welding electrode and the domestic welding electrode is ready to be use.

5.2 Domestic Welding Electrode Analysis

Domestic welding electrode that made in this research is a Cu (copper) based alloy with addition of 1% of Cr (chromium) and 0.1% of Zr (zirconium) elements. The characteristic that needed for this welding electrode is a high strength and high electrical conductivity of the electrode. Cu has excellent thermal and electrical conductivities, but pure Cu is too soft to be use as an electrode, that is why the addition of Cr and Zr elements is needed. Cr elements will increase the hardness of the electrode and Zr elements will refine the grain structures, this statement also in line with Hall-Petch equation $\sigma_y = \sigma_o + kd^{-\frac{1}{2}}$ about grain size in an alloy. The alloying disperse Cr and Zr element in Cu matrix and refine the grain size and precipitation of the electrode to increase its properties and support its performance as a welding electrode. Finally the domestic electrode is made with a high strength and high electrical conductivity to be used in the welding machine at CGL machine, and could challenge the performance of import welding electrode.

5.3 Domestic Welding Electrode Performance Analysis

Based on the performance test that conducted, the performance of domestic welding electrode to weld the strip of coil in CGL machine is slightly lower than import welding electrode, because the technique in the making of domestic electrode is not as advance as the original welding electrode from Japan that use die casting and heat treatment process. However, the quality of the weld performed by domestic welding electrode still safe and fulfils the quality requirement in CGL machine that have high

tension strip of coil. Therefore, the domestic welding electrode is safe to be used and can substitute the import welding electrode.

5.4 Cost Analysis

On the cost side, domestic welding electrode is very cheap compare to original Japan made welding electrode. The total cost to purchase the original welding electrode from Japan is Rp. 110.000.000 whether the cost to produce domestic welding electrode is only Rp. 7.000.000. Domestic welding electrode is very cheap because it does not use heat treatment, die casting and delivery cost from Japan that is very expensive. Although the endurance time to use domestic welding electrode is lower than the original Japan made electrode because the domestic electrode erode faster than the Japan made electrode, but the difference is not high. Based on the explanation above, domestic electrode is very beneficial for PT. XYZ compared with original Japan made welding electrode.