

CHAPTER

3

SINGLE BATH BRASS ELECTROPLATING FOR STEEL CORDS

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3.1 INTRODUCTION IN BATH BRASS ELECTROPLATING

The wire rod for steel cord is designed for high tensile strength. The steel cord is typically used to reduce the weight of tires. Steel cord has also been used as saw wire to cut silicon ingots, the saw wire is highly tensile and has smaller diameter as shown in Figure 3.1. Steel cord is being used in various industrial applications such as reinforcing materials for tires due to its excellent strength and resilience. The main role of steel cord in the tire is its influence on the stiffness of the belt package and its protection from impacts from the road. There are few functions of steel cord in the tire such as generating handling forces, helping forming the desired tire profile, protecting against impacts and improves traction.

Hence, Figure 3.2 shows the typical manufacturing process of steel cord used for tire reinforcement. The tensile strength of tire cord wire with a diameter of 0.2 mm was 2800 MPa in the late 1970s, 3300 MPa in 1980s, 3600 MPa in the early 1990s and reached 4000 MPa in the late 1990s.

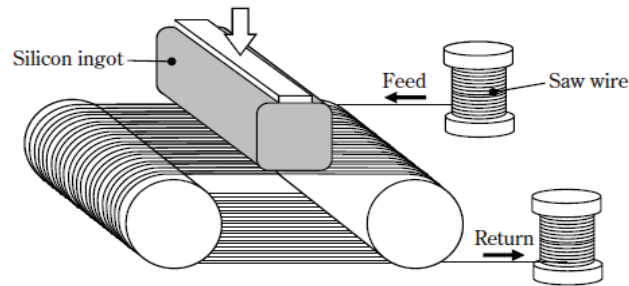


Figure 3.1 Schematic of cutting of silicon ingot (Source: Kirihaara, 2011)

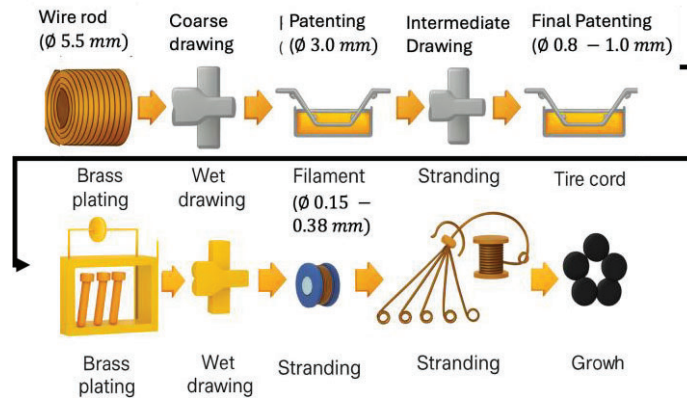


Figure 3.2 A typical manufacturing process of steel cord used for tire reinforcement

Traditionally, steel cord in tires has tensile strength about 2800 MPa where it is also known as normal tensile or regular tensile. Higher strength cords have been developed to reduce the amount of steel needed in tires. Lower tire weight decreases the rolling resistance, which means better fuel economy. On the other hand, high tensile and super high tensile bead wires are available today. The main reason why the brass is selected to be coated on the steel cord due to its strong bond is formed between the brass surface and the rubber during the vulcanization process of the rubber. The bond is very durable, and resistant to high temperature and dynamic loading (Ooij, 1983). Figure 3.3 shows the schematic of interfacial sulfide film in rubber-brass bonding.

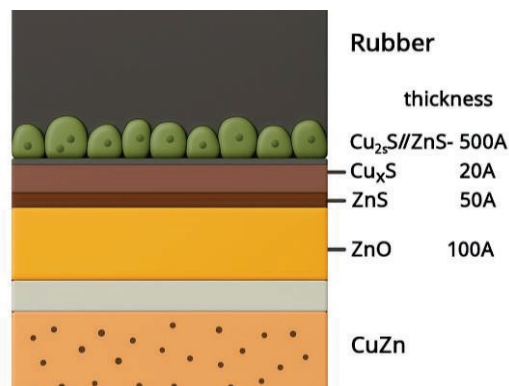


Figure 3.3 Schematic of interfacial sulfide film in rubber-brass bonding

3.2 PREPARATION OF STEEL CORD USING ELECTROPLATING

The substrate plate and wire provided are made up from low carbon steel. The plate samples have dimensions of 2.0 cm × 8.0 cm and thickness with 2.0 mm, whereas the dimensions of wire sample with the diameter of 0.1 cm and had been cut into 7.0 cm. The sample wire had been prepared for brass electroplating by using Field Emission Scanning Electron Microscopy and Energy Dispersive X-ray Spectroscopy (FESEM-EDX) to analyze the element present in the coating. At the same time, X-ray diffraction (XRD) is being used to investigate the coating crystallinity for plate samples. The pickling process is essential. This is because the pickling process tends to remove oxide layer and surface rust. In this project, low carbon steel plate and wire samples had been pickled in 3.0 mol/L hydrochloric acid solutions for 10 minutes. All the solutions had been prepared separately, before solutions mixed up together. First of foremost, the salts had been weighted based on the concentration required. Then, the distilled water had been added up to the volume. Therefore, each separate solution which is copper pyrophosphate, zinc pyrophosphate and potassium pyrophosphate salt has been mixed together, and the pH is set at 8.5 (Senna et al., 2005). All the plating parameters are necessary to be controlled to achieve brass