Chapter 9
Corrosion of Aluminium Alloy in Seawater and Development of Green Corrosion Inhibitor for Marine Applications

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ABSTRACT

Aluminium and its alloys are widely used in marine applications. Recently many studies are being carried out to use natural resources as natural corrosion inhibitors. In the present study, the aluminium alloys were tested for their corrosion performance in seawater containing a natural product as a corrosion inhibitor at room temperature. The effect of honey on the corrosion of AA6064 was researched using the weight loss, potentiodynamic polarization, and SEM methods. Electrochemical measurements and metallurgical characteristics have been made to quantify the potential of honey to be used to retard metal corrosion. Surface morphology of aluminium coupon after exposure was examined by Scanning Electron Microscopy (SEM). A good inhibition efficiency is observed which increases with an increase in inhibitor efficiency. Polarization plots indicate that honey acts as a natural corrosion inhibitor, preventing the alloys from suffering severe pitting attacks. The weight loss results show low corrosion rates for the alloy in higher honey content.

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INTRODUCTION

Aluminium and its alloys are widely used in marine engineering applications because of their low density, favorable mechanical properties, good surface finish and relatively good corrosion resistance. Research efforts in some maritime industries have focused on the study of Al–Cu and Al–Zn alloys. The electrochemical behaviour of Al and its alloys has attracted the attention of many investigators. The natural oxide film on aluminium does not offer sufficient protection against aggressive anions. In this context, inhibitors are used to improve protective features of the surface (Mishra and Balasubramaniam, 2007).

Aluminium alloys are mixtures of aluminium with other metals (called an alloy), often with copper, zinc, manganese, silicon, or magnesium. They are much lighter and more corrosion resistant than plain carbon steel, but not as corrosion resistant as pure aluminium. Bare aluminium alloy surfaces will keep their apparent shine in a dry environment due to the formation of a clear, protective oxide layer. Galvanic corrosion can be rapid when aluminium alloy is placed in electrical contact with stainless steel, or other metals with a more negative corrosion potential than the aluminium alloy, in a wet environment. Aluminium alloy and stainless steel parts should only be used together in water containing systems or outdoor installations if provision is made for either electrical or electrolytic isolation between the two metals (wikipedia.org).

Aluminium and its alloys exhibit corrosion resistance in many environments. This feature made them important materials with wide ranges of industrial and marine applications. The most popular aluminium alloys for use in corrosive environments such as seawater are the 5xxx and 6xxx series alloys, which demonstrate adequate strength and excellent corrosion resistance (Rosliza and Wan Nik, 2010).

Aluminium alloys have been used as structural materials in maritime applications for several decades. The alloys are produced as sheet, plate, forgings, or extrusions. They are also used for stringers, and bulkheads, as well as for panels and covers (Immarigeon et al., 1995). 7xxx series Aluminium alloys have been widely used as structural materials in aeronautical industries due to their attractive comprehensive properties, such as low density, high strength, ductility, toughness and resistance to fatigue (LI Jin-Feng et al., 2007).

High strength Al–Zn–Mg–Cu alloys are widely used in aerospace applications due to the unique combination of high strength-to-density ratio and excellent mechanical properties. However, the alloys are vulnerable to localized corrosion along grain boundaries because of continuous anodic precipitate on grain boundaries (Yang et al., 2010).

Corrosion Study

Corrosion is degradation of materials' properties due to interactions with their environments, and corrosion of most metals is inevitable. Nowadays, corrosion studies are particularly important, since it is known that corrosion problems cause problems and it also a wasteful process.

According to Shaw et al. (2006), corrosion is a costly and wasteful process. There are several studies over the past 30 years that have shown the annual direct cost of corrosion to an industrial economy approximately 3.1% of the country's Gross National Product (GNP) where the highest segments of the corrosion are associated with utilities, transportation and infrastructure (Shaw et al. (2006).

Corrosion Process

According to Moshier et al. (1987), corrosion is a nature process and is a result of inherent tendency of metal to revert to their more stable compounds which is usually oxides. Besides, corrosion can be defined as a chemical or electrochemical reaction between material and its environment that produces deterioration of a material and its