ABSTRACT

It is a well known fact that infrastructure in marine environments can suffer corrosion attack. The most severe corrosion will happen to the steel materials that are directly exposed in the marine environment, particularly for the portion exposed in the splash zone, where the air (oxygen) is embroiled with water and where there are wet-dry conditions. The infrastructure material, such as reinforced concrete, is also subjected to damage from the marine environment such as the neutralization of the concrete. This weakens the impermeability of the material so that the sea water is allowed to penetrate through the protection layer of the structural member and this can cause corrosion of the reinforced bar inside. In this study, tests were carried out to examine the feasibility of using bamboo charcoal to replace some of the aggregates in the mortar by taking advantage of the characteristics of bamboo charcoal. The goal is to improve the impermeability characteristics for infrastructure located in marine environments. By replacing the fine aggregate with bamboo charcoal and then applying various levels of water-cement ratio, the laboratory tests were performed. Tests including the compressive strength test and permeability relevant tests were carried out to investigate the influence of bamboo charcoal on the mechanical properties of the cement mortar. In addition, in order to know the blocking effect to the harmful chemical ingredients such as the chlorine to the hydrated cement paste, tests against chloride were also performed. It was found that the partial replacement of fine aggregate with bamboo charcoal has encouraging effects on the prevention of material deterioration of concrete in marine environments in terms of the improvement of impermeability and chloride blocking.

KEY WORDS: bamboo charcoal; cement mortar; marine concrete; concrete deterioration

INTRODUCTION

For construction located in marine environments, maintaining good durability for the structures always imposes severe challenges. The deterioration of the material, such as the neutralization of the concrete material, the corrosion in the ferro-material and some other erosive attack due to the presence of sulfate and acidic elements in the environment are always major problems for the engineer to deal with (Lee et. al. 2001, Lee 2002, Lee and Chang 2006). Reinforced concrete, due to its economic availability, ease of forming into all kinds of shapes, good resistance to water and high strength, is the material most widely used for However, the neutralization of concrete due to the permeation of chloride, which gradually deteriorates the concrete, damages the impermeability and then reduces the strength is quite common for harbor infrastructures (Midgley and Illston 1984, Cabrera and Claissen 1990, Mangat and Tu 1993). The corrosion in the reinforced steel bars embedded in the concrete is also very common. The corrosion of steel bars is mostly due to the intrusion of sea water, which penetrates through the small cracks or the deteriorated concrete. Other factors such as the sulfate, chloride and acidic elements can also worsen the problems. Therefore, a method to protect the reinforced concrete material in the marine environment from attack due to deterioration and corrosion is always a major concern when a marine infrastructure is being designed. The most effective way will be by improving the impermeability of the concrete material and at the same time ensuring that the other positive properties of the material will not be sacrificed. Infrastructure in marine environments, particularly for construction in the harbor area. Many types of wharf structural systems are designed based on the special properties of concrete such as the massive weight type of wharf structural system, the caisson type of wharf structural system and the bridge-type system.

To improve the impermeability of the concrete material, usually a pozzolanic material is used (Mehta 1983) because of its finely divided form and its ability to react with calcium hydroxide in the presence of moisture so that the larger capillary pores can be filled up. In that way, the impermeability can be enhanced. This study, by applying the bamboo charcoal in the concrete, will provide an alternative scheme to