ABSTRACT

Utilization of industrial by-products has been intensively studied in improving the properties of fresh and hardened concrete. Copper slag fine aggregate (CUS) is an industrial by-product produced through the process of manufacturing copper. It has been reported that bleeding water tends to increase in fresh concrete cast with CUS because of its high density. This led to less resistance against the ingress of corrosive substances especially in upper parts of concrete column specimens. In addition, the corrosion of horizontal steel bars in those locations was adversely affected by bleeding water even in the case of OPC concretes with typical amount of bleeding water. It was partly accounted for by the presence of gap between steel bars and the surrounding concrete. However, it has been reported that the corrosion observed in concrete specimens cast with CUS with higher amount of bleeding water was not necessarily severe especially in the upper parts. The corrosion processes of steel bars in concrete with the presence of pores modified by the bleeding water and the addition of CUS may have a large influence on the durability. In particular, this study aims at investigating the effects of CUS with lower water absorption capacity on the ingress of corrosive substances including chloride ions and water containing dissolved oxygen. The experimental study was carried out using electro-chemical measurements on concrete specimens subjected to dry and wet (NaCl 10%) cycles. The results show that the partial replacement of fine aggregate with CUS (30 vol%) in reinforced concrete column specimen can be generally used as a replacement material for natural sand since it does not adversely affect hardened concrete properties with respect to the composition of minerals of reinforced concrete. In addition to this, CUS replacement led to lower rate of oxygen permeability on the cathodic reactions, which could be illustrated by changes of cathodic polarization properties in prism and column specimens. Although macrocell corrosion is partly pronounced in CUS concrete

due to cracking caused by segregation, the microcell corrosion current density observed in CUS concrete specimens is generally less severe compared to those observed in OPC concrete specimens. This beneficial effect of the addition of copper slag fine aggregate could contribute to good durability performance in concrete as a solution to the environmental problem of disposal industrial waste and copper slag concrete has a wide application in the structures constructed in marine environment.