Abstract

The initiation time of chloride induced reinforcement corrosion in concrete needs to be anticipated so that appropriate maintenance program can be applied before corrosion occurs. The interpretation of half-cell potential measurement on reinforced concrete structures can be a major challenge in the field of civil engineering. The main reason for this is that half-cell potential mapping provides information to predict the probability of corrosion in concrete. But it does not give clear insight on the rate and the nature of corrosion. Typically for general uniform corrosion, half-cell potential data can provide valuable information about the probability of corrosion. In case of localized corrosion, the interpretation of half-cell measurement can be misleading. This thesis is aimed to study the effect of concrete properties and deterioration on effectiveness of the half-cell potential measurement for monitoring corrosion of steel bars in concrete.

In this experiment, concrete specimens were prepared with different fly ash replacement ratios (FA=0%, 20%, 30%, 50%) and different limestone powder replacement ratios (LP=0%, 5%, 10%, 15%). In addition, some mix proportions were prepared by combination of two binders (20% fly ash and 10% limestone powder). Specimens both of plain concrete and reinforced concrete ware submerged in sodium chloride (NaCl) solution, exposed to carbon dioxide (CO_2), and combined cyclic exposure to NaCl solution and CO_2. The corrosion activities of steel bar in concrete were investigated by half-cell potential measurement for interpretation of initial corrosion. Although, half-cell potential measurement can be used to investigate probability of corrosion of reinforcement, corrosion current density was also measured to be compared with half-cell potential data for corrosion activity interpretation. Carbonation depth measurement and chloride content measurements of concrete specimens were also conducted for verification. The findings in this study are useful for improving the understanding and efficiency of the half-cell potential measurement to investigate probability of corrosion of reinforcement in the reinforced concrete structures.

Results exhibited that half-cell potential reading can be effectively used to investigate probability of steel corrosion in case of chloride environment. This summary is supported by the results of chloride content and corrosion current density. However, half-cell potential reading may not well interpret corrosion due to carbonation, when it is compared by carbonation depth results and corrosion current density value. In addition, corrosion starting times of concrete specimens exposed to combined environment between chloride attack and carbonation were faster than those of chloride only and carbonation only, respectively. This study clearly shows that half-cell potential is much more effective for detecting the corrosion of steel bars in concrete exposed to chloride than carbonation. Moreover, half-cell potential method is better than corrosion current density method for investigating corrosion starting time in laboratory.