ABSTRACT

Chloride-induced corrosion of steel reinforcement is the main cause of the deterioration of concrete structures exposed to sea water or cast from chloride contaminated materials. Various rehabilitation techniques were introduced and developed in the recent years for tackling such problem. Some of these techniques are the use of corrosion inhibiting admixtures (CIA), corrosion inhibitors as remedial surface treatment, steel coating and electro-chemical chloride extraction (ECE).

The effectiveness and mechanisms of corrosion inhibiting admixtures (namely calcium nitrite and sodium benzoate) on fresh parameters, microstructure related properties, corrosion activity of reinforcement and mechanical properties of OPC mortar were extensively investigated. The roles of sodium monofluro phosphate (MFP) and calcium nitrite (CN) as remedial surface treatment and zinc rich as steel coating in controlling the corrosion activity of corroded reinforcement embedded in OPC mortar made with or without cement replacement materials were also studied The factors controlling such treatment were determined. Finally, the short and long-term effects of ECE treatment on corrosion activity of corroded reinforcement due to chlorides were assessed. The factors controlling ECE treatment were also critically reviewed and signified. Moreover, the effects of these treatments on microstructure of the hardened cement paste around reinforcement were clarified.

The study reported here in was divided into three phases , the first phase included the investigation of CIA and steel coating for new structures , while the second phase of study dealt with corrosion inhibitors as remedial surface treatment and the last phase of study dealt with ECE treatment.

Various mortars made with different contents of both calcium nitrite and sodium benzoate were accordingly prepared and then assessed using mortar flow table, thermo-gravimetric analysis de-sorption, initial surface absorption and sorptivity tests and half-cell and zero resistance ammeter apparatus. The rate of corrosion and corrosion potential of different corroded reinforced mortar specimens (OPC, OPC/silica fume and OPC/fly ash) contaminated with different chloride contents during their exposure to various concentrations of MFP and CN were regularly monitored every two weeks. For ECE treatment study contaminated reinforced mortar specimens with 1 or 2 % NaCl were prepared, cured and then subjected to aggressive solutions (3 or 5% NaCl) for one year. These specimens were finally treated with ECE using various impressed current densities and electrolytes for different periods. The state of corrosion of reinforcement was monitored immediately and every 2 weeks from halting of ECE treatment up to 52 weeks, using zero-ammeter device and half- cell apparatus. Selected samples were taken from the cover zone of the untreated and treated specimens to measure their chloride profiles for ECE treatment. Other selected samples from the zone around reinforcement were taken and examined by scanned electron microscopy and X-ray diffraction.

KEYWORDS: Corrosion inhibiting admixtures, Remedial surface treatment, Microstructure, Chlorides, Electro-chemical chloride extraction, Reinforcement corrosion