ABSTRACT

Carbonation of reinforced concrete may cause premature deterioration and shortening of the service life. Carbonation is a physicochemical process, that consists of the reaction of atmospheric carbon dioxide with cement hydrates and unhydrated cement compounds. Carbonation lowers the alkalinity of concrete, leading to reinforcing steel depassivation and subsequently carbonation-induced corrosion in reinforced concrete. Furthermore, carbonation may also lead to changes of the concrete microstructure and mechanical properties. These changes in properties depend on the initial concrete properties which are influenced by the binder type and w/b ratio. The high carbon footprint of ordinary Portland cement concrete has led to the increased use of supplementary cementitious materials as partial replacements for cement in concrete. Thus, the carbonation of these blended concretes and their subsequent changes in properties need to be investigated further. Hydrophobic impregnation treatment has been theorised to mitigate steel corrosion in concrete as corrosion cannot occur without the presence of moisture. A higher hydrophobic impregnation depth is associated with a more effective protection of the substrate concrete, thus obtaining a higher efficacy and durability of the treatment. In this study, carbonation was accelerated (20°C, 65% relative humidity and 2% carbon dioxide gas) for concretes with ordinary Portland cement (PC) CEM I 52.5N, PC blended with 30% fly ash (FA), PC blended with 50% ground granulated blast-furnace slag (GGBS) and CEM II/A-L 52.5N. The oxygen permeability and water sorptivity indexes were determined (84 and 168 days after casting) in carbonated and uncarbonated specimens to determine the change in these durability parameters due to carbonation on the different concrete mixes. The gas permeability of concrete remained the same even after carbonation, while the porosity decreased. The sorptivity of concrete increased or remained the same after carbonation, which can be justified by the porosity of the mixes. Hydrophobic impregnation depths were determined for all specimens; however no correlation was found between the hydrophobic impregnation depth and concrete durability properties. The minimum hydrophobic impregnation depth, as specified by the material supplier, was achieved for all mixes, regardless of binder type, w/b ratio and depth of carbonation.