CHAPTER 6

OPC and PPC: Carbonation Resistance of Concrete

6.1 Introduction

Concrete is one of the most preferred construction materials around the globe. Though ordinary Portland cement has excellent performance both in strength and durability, the use of PPC is more popular due to its economic aspect. PPC also manifests high strength and durability in the long run. However, the vulnerability of PPC to carbonation is a major area of concern which affects the durability of PPC concrete. Since the use of PPC in industrial construction works is widely preferred, it is the need of the hour to analyse the carbonation resistance of both OPC and PPC and to design adequate blending proportion of the two to enhance the durability of concrete structures.

In this chapter, the carbonation resistance of OPC and PPC concrete have been analysed from the experimental test results obtained in this study and necessary conclusions have been drawn.

6.2 Carbonation Resistance of OPC and PPC Concrete

It has been that the depths of carbonation in PPC concrete are higher than that of OPC concrete. This means that the resistance to carbonation of OPC is higher than that of PPC.

Experimental results are also indicative of the measures which may be adopted to increase the resistance of concrete to carbonation. It has been observed that carbonation decreases up to 10 % replacement of cement with fly ash in OPC concrete. Also, carbonation decreases up to 10 % replacement of cement with micro silica in OPC concrete. Further, the replacement

of cement with GGBS up to 30 % also results in decrease of carbonation in OPC concrete. Whilst the strength of OPC concrete slightly decreases in case of fly ash replacement of cement up to 10%, it has been found to increase in case of micro silica replacement of cement up to 10% as well as GGBS replacement of cement up to 30%. Thus, an optimum replacement of OPC cement with up to 10% fly ash, or 10% micro silica or 30% GGBS may be recommended for enhancing the carbonation resistance of concrete in industrial use.

In the case of PPC, it has been observed that carbonation decreases up to 10 % replacement of cement with fly ash. Also, carbonation decreases up to 10 % replacement of cement with micro silica in PPC concrete. Further, the replacement of cement with GGBS upto 30 % also results in the decrease of carbonation in PPC concrete. Whilst the strength of PPC concrete increase in the case of micro silica replacement of cement up to 10 %, the strength is found to substantially decreases with fly ash replacement of cement up to 10 % as well as GGBS replacement of cement up to 30 %. Since fly ash content of PPC is already 33 % and since a maximum blending percentage of around 35 % is recommended for industrial use, and optimum replacement of PPC cement with upto2.5 % micro silica may be recommended for enhanced carbonation resistance. However, as per codal provision a maximum replacement of 7.5 % of micro silica is permitted.

Experiments also reveal that fly ash replacement of fine aggregate yields higher resistance to carbonation in case of both OPC and PPC. However, the strength and workability require to be checked for onward recommendation of such replacement in concrete for industrial use.

Both OPC and PPC concrete have exhibited higher carbonation resistance at lower W/C and with longer curing periods. Thus, to achieve enhanced carbonation resistance of concrete, longer curing periods and lower W/C is recommended.

6.3 Conclusions

From the above analysis, the following combinations of mix proportions of binders may be recommended for use in concrete:

- OPC + 10 % Fly ash replacement of cement.
- OPC + 7.5 % Micro silica replacement of cement.
- OPC + 30 % GGBS replacement of cement.
- OPC with 0-30% GGBS + 0-10% Fly ash replacement of cement.
- OPC with 0-25% GGBS + 0-5% Micro silica replacement of cement.
- PPC with 2.5 % Micro silica replacement of cement.
- PPC with 2.5 % GGBS replacement of cement.