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Grzegorz Ludwik Golewski

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An assessment of microcracks in the Interfacial Transition Zone of durable concrete composites with fly ash additives

Grzegorz Ludwik Golewski

Faculty of Civil Engineering and Architecture, Department of Structural Engineering, Lublin University of Technology, Nadbystrzycka 40 str., 20-618 Lublin, Poland

Abstract

This paper presents results of tests on the effect of the addition of fly ashes (FA) in the amount of: 0, 20 and 30% by weight of cement on the size of microcracks in concrete composites. The analyses were carried out based on the results of the microstructural tests, by using Scanning Electron Microscope (SEM). During investigations the size of microcracks occurring in the Interfacial Transition Zone (ITZ) of coarse aggregate with cement matrix was evaluated. In the own testing, it was demonstrated that addition of FA modifies the microstructure of the ITZ. Composites with FA at early age are characterized by greater microcrack width in the ITZ in comparison to the unmodified concrete. In matured concretes the smallest microcracks occur in composite with the 20% FA additive. It can be concluded that the mature composites with 20% addition of FA are characterized by low permeability and therefore high durability.

Keywords: concrete composite, siliceous fly ash, Interfacial Transition Zone (ITZ), microstructure, microcrack, Scanning Electron Microscopy (SEM).

*Corresponding author. Tel.: +48 81 5384394; fax: +48 81 5384390
E-mail address: g.golewski@pollub.pl

1. Introduction

Increasing demands for durability and strength of cement-based composites have made it essential to introduce Supplementary Cementitious Materials (SCMs) into the Ordinary Portland Cement (OPC) [1]. These materials can be divided generally into 6 classes (Table 1), i.e.: industrial wastes, nano industrial wastes, agriculture-farming wastes, aquaculture-farming wastes, natural minerals, dust and powders. Moreover, each class contains several types of SCMs (Table 1), e.g. [2-13]. One of SCMs is siliceous Fly Ash (FA). In OPC, the FA produces a considerable

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