

**EFFECTS OF CARBON BLACK AND GRAPHENE
OXIDE ADDITIONS ON PROPERTIES OF ORDINARY
PORTLAND CEMENT COMPOSITE**

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Degree of Master of Science

Department of Materials Science and Engineering

University of Moratuwa

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Dissertation submitted in partial fulfilment of the requirements for the degree Master
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Declaration

I declare that this is my own work and this dissertation does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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The above candidate has carried out research for the partial fulfilment of the requirements for the degree of Master of Science in Materials Science under my supervision.

Name of the supervisor: Mr. S. P. Guluwita

Signature of the supervisor:

Date:15.06.2020

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Abstract

The effect of the carbon black (CB) and graphene oxide (GO) on the mechanical properties and microstructure of cement mortar composite were studied by preparing CB-cement composite (CBCC) and GO-cement composite (GOCC) mortars. These properties were investigated by treating the cement mortar with 0.01% to 0.1% of GO and 0.1% to 1.0% of CB of the cement weight. The results revealed that the highest compressive strength obtained for 0.4% of CBCC and for 0.04% of GOCC. The incorporation of CB and GO to the cement mortar simultaneously increased the compressive strength of the samples drastically. The highest increase of the compressive strength was equal to 43.27% for specimens evaluated at the age of 2 days for the cement composite specimens of 0.4% CB and 0.03% of GO. The addition of 0.4% of CB increased the flexural strength of cement mortar up to 53.54% and 0.03% of GO increased the flexural strength of cement mortar up to 46.54% for 28 days. The addition of the combination of 0.3% CB and 0.04% GO to the cement composite enhanced the flexural strength by 60.61%. GO was found to be able to accelerate the hydration process by forming the flower-like cement hydration crystals which contribute to the enhancement of the early mechanical properties. The analysis of the microstructure relieved that the addition of CB provides the filling effect while GO could affect the growth form of cement hydration products.

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List of abbreviations

Abbreviation	Description
OPC	Ordinary Portland cement
IST	Initial Setting Time
CBCC	CB- Cement Composite
GOCC	GO- Cement Composite
SEM	Scanning Electron Microscope
C-S-H	Calcium silicate hydrate
CBCM	Cement based composite materials
GO	Graphene oxide
CB	Carbon Black
PCE	Polycarboxylic Ether
PC	Polycarboxylic
W/C	water/cement
CNTs	Carbon Nanotubes
CNFs	Carbon Nano Flakes
BHC	Blended Hydraulic Cement