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Original Research Paper

Reduction of Green House Gases Emission in Self Compacting Geopolymer Concrete Using Sustainable Construction Materials

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ABSTRACT

The global warming is caused by emission of green house gases such as carbon dioxide and carbon monoxide into the atmosphere. The cement industry is held responsible for some of the carbon dioxide emissions, because the production of one tonne of Portland cement emits one tonne of carbon dioxide into the atmosphere. In terms of global warming the geopolymer technology could significantly reduce the carbon dioxide emission into the atmosphere caused by cement industries. This research is aimed to give awareness about the green house gas emissions from the cement manufacturing industries and the methods of reducing this by the use of fly ash and GGBFS. Two kinds of systems have been considered in this study, 100% replacement of cement by fly ash and 100% replacement of river sand by manufactured sand. The workability of Self Compacting Geopolymer Concrete (SCGC) for various molarities was investigated and fixed to 12M. The work focused on the concrete mixes with a fixed water-to-geopolymer solid (W/Gs) ratio of 0.33 by mass and a constant total binder content of 450 kg/m^3. The workability related fresh properties for molarity of 12M of SCGC were assessed through slump flow, T_{50cm} slump flow, V-funnel, L-box and U-Box test methods. The mix proportions are arrived according to EFNARC (European Federation of National Associations Representing for Concrete) guidelines. Based on the results from workability and strength study, the results have been discussed for SCGC.

INTRODUCTION

Geopolymeric materials have become the focus of interest and received a considerable attention because of the environmental benefits, such as the reduction in consumption of natural resources and the decrease in production of CO_2. Unlike ordinary Portland cement, the production of raw material for geopolymers does not require a high level of energy consumption because the high temperature calcining is not required. It is demonstrated that the geopolymeric cement generates 5-6 times less CO_2 than Portland cement. Therefore, the use of geopolymer concrete technology not only significantly reduces CO_2 emissions but also utilizes the industrial waste and/or by-product, converting a potentially hazardous material to a valuable construction material. To save our rivers from sand mining and to sustain our environment, M-sand is used. The manufactured sand was used as a fine aggregate since the demand and cost of river sand is high. Self-compacting concrete, also referred to as self-consolidating concrete, can flow and consolidate under its own self weight and de-aerate almost completely while flowing in the formwork. It is cohesive enough to fill the spaces of almost any size and shape without segregation or bleeding. This makes self-compacting concrete particularly useful wherever placed such as in heavily reinforced concrete members or in complicated formworks. Self-compacting concrete can save labour, eliminate consolidation noise and lead to innovative construction methods.

SCGC (Self Compacting Geopolymer Concrete) is relatively a new concept and can be regarded as a revolutionary development in the field of concrete technology.

It is an innovative type of concrete that can achieve the combined advantages of both geopolymer concrete and SCC. Literature review indicated that, up to date, no research has been conducted on SCGC. This research study was therefore intended to explore the feasibility and potential of SCGC made with locally available constituent materials by examining their basic physical and mechanical properties. The present work investigated the workability related fresh properties of SCGC through slump flow, T_{50cm} slump flow, V-funnel, L-box and U-Box test methods. Jhumarwala et al. (2013) studied that, maximum compressive strength of self compacting geopolymer concrete is achieved at elevated temperature cured concrete, and as molarity increases the strength goes on decreasing but after 14M the