MECHANICAL PROPERTIES OF BINARY AND TERNARY BLENDED CONCRETE CONTAINING RICE HUSK ASH

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Abstract

This paper reports an investigation on the mechanical properties of Grade 40 concrete made with binary and ternary blends of normal Portland cement (NPC), rice husk ash (RHA) and fly ash (FA). Conventional superplasticizer was used to impart required workability. Five mixes (control superplasticized NPC, RHA and FA binary blend as well as two ternary (NPC/RHA/FA)) combinations were chosen for tests on mechanical properties. Data up to 180 days showed that inclusion of RHA in binary and ternary combination can provide the desired workability and enhancements in many mechanical properties compared to the control.

Keywords: rice husk ash (RHA), fly ash (FA), workability, mechanical properties.

1.0 INTRODUCTION

Currently, development and use of concrete containing mineral admixtures in binary blended cementitious system especially with condensed silica fume (CSF) is growing rapidly in the construction industry worldwide. These materials have been successfully used in construction of important projects, meeting demanding design criteria and also hostile environments. However, CSF is very expensive and becoming scarce. Locally it is valued approximately 8 – 10 times the cost of NPC.

The development of ternary blended cementitious system (having three cementing constituent systems) is relatively new in the industrial world. Even though binary blended system is quite common, it is not used on a large scale. Individual mineral admixture normally has limitations and contrasting influences on concrete properties. With the combination of two cementitious materials in concrete mixture, they can complement each other and produce better concrete than conventional concrete. In order to derive the maximum benefits from the use of mineral admixtures in concrete, the potential synergy between these materials may be exploited by using ternary blends. Substantial improvements in concrete performance have been reported with ternary systems **[1-4]**. Rice husk ash (RHA), produced by burning rice husk in a controlled manner, has many similar properties to that of condensed silica fume (CSF) **[5,6]**. Current technology shows that RHA is suitable for cement replacement in concrete. Being a pozzolan, its incorporation contributes to the higher long term strengths and improves the durability of concrete **[7]**. This paper concentrate on investigating the properties of concrete containing RHA and fly ash (FA).

2.0 EXPERIMENTAL PROGRAMME

2.1 MATERIALS

A local normal Portland cement (NPC) Type 1 conforming to ASTM C150 was used for all the tests reported here. Typical specific gravity and specific surface area (Blaine) on this material was 3.07 and 3515 m^2/kg respectively. RHA was obtained by incinerating the husk at temperatures below 700^{o}C for 24 hours in a ferrocement furnace. The ash was then ground using a Los Angeles grinding machine for 5000 cycles until it met the BS 3892 fineness requirement. The fineness as that retained on a 45 micrometer sieve was 14.26%. Its specific gravity, average pore size and specific surface area (nitrogen absorption BET technique) was 2.03, 4.08 nm and 20195 m^2/kg respectively. X-ray fluorescence (XRF) analyses confirmed that it consists mainly of silica (SiO_2) of 87.80 % and its loss on ignition (LOI) value was 6.19 %. X-ray diffraction (XRD) analysis of the RHA samples shows mainly amorphous silica formation with small quantities of crystallined