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DEVELOPMENT OF ALKALI ACTIVATED SLAG CONCRETE BY PARTIAL REPLACEMENT OF SAND WITH GRANULATED BLAST SAND

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***Abstract*—The current study aims to investigate the engineering properties of Alkali Activated Mixtures (AAM) with composite alumina-silicate solid precursor as blast furnace slag activated with Sodium Hydroxide (SH) and Sodium Silicate (SS) as activator solution. Besides, using the industrial by-product as binder, Granulated Blast Sand (GBS) used as fine aggregate. The utilization of this material substantially lowers the carbon foot print and embodied the energy of concrete material by addressing disposal problem. The air cured Alkali Activated Slag Concrete (AASC) developed using GBS, a by-product from Iron and steel industry is analyzed for physical and mechanical properties. The river sand was partially replaced by GBS in the range of 0% to 50% at an interval of 10%. The strength of this AAM were evaluated in terms of Compressive, Flexural and Split tensile strength, Modulus of Elasticity and fatigue analysis. Addition of GBS enhanced the workability and the effect was abrupt beyond 50% GBS replacement level. The workability and strength properties of AASC mixtures improved upto 50% GBS replacement. Besides, more than 60% of the strength of a control mixture (0% GBS) was achievable at 50% GBS replacement level.**

***Keywords*—AASC; GBS; SH; SS; Fatigue analysis**

I. Introduction

The cement production is associated with environmental issues such as high carbon foot print, consumption of large quantities of raw materials (limestone and shale) with high energy intensive in manufacturing process [1]. Nearly 2 tonnes of raw materials are required to produce 1 ton of cement, which emits nearly 850kgs of carbon-di-oxide (CO_2) to the atmosphere [2]. The utilization of source material (binder) having the similar chemical composition as that of cement can be used as a Supplementary Cementitious Material (SCM). This SCM includes Ground Granulated Blast Furnace Slag (GGBFS), flyash, red mud and metakaolin with Dolomite, Limestone and Quartz powder as admixture. Alkali activated materials are preferred over the conventional concrete. Since, industrial byproducts are used as binders, less energy consumption with reduced carbon foot print prompts for the development of sustainable concrete. The calcium, aluminium and silica mineral from source material act as solid precursor in producing the alkali activated concrete. Slag and flyash particles are activated with the aid of alkaline activator solution, Sodium Hydroxide (SH) and Sodium Silicate (SS) are commonly used alkali solution [3]. Alkali Activated Materials (AAM) are basically inorganic materials of non-metallic type produced from the alumina-silica rich source materials [4]. High alkalinity of activator solution enhances the polymerization of source material by leaching of solid precursors, thus increase in strength is achieved. The compressive strength of alkali activated mixtures increases with the NaOH concentration [5]. Increase in SS/SH ratio enhances the strength of activated mixtures, which adds extra silica to the polymerization process by increase in SiO_2/Na_2O ratio [6]. Workability and mechanical properties of alkali activated flyash-slag concrete were affected by SH and SS/SH ratio [7]. Hardjito and Rangan 2005 reported SS/SH=2.5 is sufficient to produce the flyash based geopolymer. SS/SH ratio optimized to 0.67 and 1, when the NaOH concentration range between 10M and 20M [8]. The amount of NaOH required to prepare the activator solution is primarily dependent on the source material [9]. The total Na_2O content in activator solution does not have significant contribution in strength development beyond the threshold value [4]. The fresh and hardened concrete properties of flyash slag alkali activated concrete were influenced by slag replacement level along with type and concentration of activator solution [10,11]. The current study aim to develop the air cured alkali activated slag concrete with Granulated Blast Slag (GBS) as partial

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