EFFECT OF GGBFS AND RHA ON CHARACTERISTICS PROPERTIES OF CEMENT

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ABSTRACT : *One of the most broadly used man-made construction material in the world is obviously concrete. Cement, water, aggregate and some admixtures are added in required proportions to prepare it accordingly. It is very difficult to get a product which simultaneously fulfill all of the properties. So the different pozzolanic materials like Ground Granulated Blast furnace Slag (GGBS), silica fume, Rice husk ash, and Fly ash are some of the pozzolanic materials which can be used in concrete as partial replacement of cement, which are very essential ingredients to produce high performance concrete. In experimental analysis the test show that the consistency percentage is increasing with increase in percentage of GGBFS as a cement replacement, but the change is not so slow. But, it is found that on increasing the percentage of RHA the consistency percentage increases swiftly. The results show that 3 days and 7 days compressive strength reduces about 15.50% and 47.47%. So it has been concluded that the use of GGBFS in Portland slag cement leading to unfavorable result on strength of mortar. Also, RHA as a partial substitute of cement is not giving acceptable strength. Although RHA 2 is giving better strength when compared with RHA 1, but it also not satisfactory.*

KEYWORDS: GGBS, RHA, Cement.

1 INTRODUCTION

One of the most broadly used man-made construction material in the world is obviously concrete. Cement, water, aggregate and some admixtures are added in required proportions to prepare it accordingly. Freshly prepared concrete is such a material which can be moulded into any desired shape by us of patterns, similar of casting in production engineering. Chemical reaction between water and cement creates such a demanding hardness in concrete that it can sustain for years. As admixtures are almost always used these days and thus become a critical component of present concrete. Admixtures are materials other than aggregate (fine and coarse), water, fiber and cement, which are added into concrete batch immediately before or during mixing. The extensive utilize of admixture is primarily due to the benefits made by their application. Joseph Aspdin (1779-1835) patented the clay and limestone cement known as Portland cement in 1824. Portland cement is produced by mixing ground limestone, clay or shale, sand and iron ore. This mixture is heated in a rotary kiln to temperatures as high as 1,600°C. According to the type of binder used, there are many different kinds of concrete. For instance, Portland cement concrete, asphalt concrete, and epoxy concrete. The insertion of fly ash (FA) to concrete generally enhance its workability. Since then some investigations have shown that FA produces a complex interaction within the fresh concrete system affecting both the solid and paste phases. Glanville et al., 1947, resulted that very fine sands or angular sands needs more water for a given workability due to the increased surface area [2]. The inclusion of blast furnace slag to concrete subjected to lactic acid solutions, provides no appreciable improvement. It is noticed by Gray et al., 1968, that the admixtures and the sand present in HPC is all very fine [8]. Poblem regarding restricted supply of silica fume and variation from half to twice the cost per bag of Portland cement encourage the use of RHA as an alternative material to replace the silica fume function. Besides that, the production of cement destruct environment [11]. The use of GGBFS is repeatedly accompanied by reduced water contents for equivalent cohesion, flow and compaction characteristics, particularly when using a pump or mechanical vibrator. The reduction in water content for regular workability is influenced by the percentage of GGBFS, the total cementitious material content and the particle size allocation of the powders [1]. The addition of very small amounts of SF to normal structural concrete does not require the use of extra water or water-reducing admixtures to keep up the desired slump [16]. GGBFS concrete is better at both resisting chloride ingress and alkali-silica reactions than PC concrete [10]. Lowering the cement content of concrete, with given water content, will lower the workability. A high proportion of cement will surely result in excellent cohesiveness although may be too sticky to be finished conveniently [12]. Pozzolans are effective at lowering the mortar's heat of hydration, as it improves its workability and durability. Simultaneously, it also resists both sulfate and alkali-silica reactions, which makes it beneficial to use in large concrete projects such as bridges and dams [3]. 28 day compressive strengths are equal or slightly more with 20% fly ash replaced concrete at elevated temperatures up to 250°C than in no fly ash concrete [13]. 7 day compressive strength of concrete mixture having fly ash as cement replacement material up to 25% is slightly less than that of the control concrete mixture at the age of 28days [5]. Performance of GGBFS and the consequence of it on fresh concrete and hardened concrete. GGBFS concrete have high strength, lower heat of hydration and resistance to chemical corrosion[17]. Volcanic ash, which is similar to fly ash but is more abundant in volcanic disaster areas, can also be used as partial cement replacement material to manufacture HPC [7]. Effect of curing method on the compressive strength development of cement mortar and concrete incorporating ground granulated blast furnace slag has been studied by [14]. The compressive strength development of cement mortar incorporating 20, 40 and 60% substitute of GGBFS for dissimilar types of sand and strength development of concrete with 20, 40 and 60% substitute of GGBFS on two grades of concrete are investigated. Results illustrate that inclusion of 20% and 40% GGBFS is highly significant to enhance the compressive strength of mortar after 28 days and 150 days, respectively. The replacement of OPC with RHA helps in improving the durability index of normal grade concrete besides improving the compressive strength He highlighted the work carried out on the replacement of OPC with RHA in higher strength [9]. The effectiveness of GGBFS, silica fume and fly ash as cement replacement to achieve high performance and sustainable concrete, can lead not only to improving the performance of the concrete but also to the reduction of CO_2 [15].

2 EXPERIMENTAL ANALYSIS

Table 1: Effect of GGBFS on Consistency of Cement

Amount of Cement replaced by GGBFS (%)	0	10	20	30	40	50
Consistency (%)	30.5	31.5	32.5	34	35.5	36

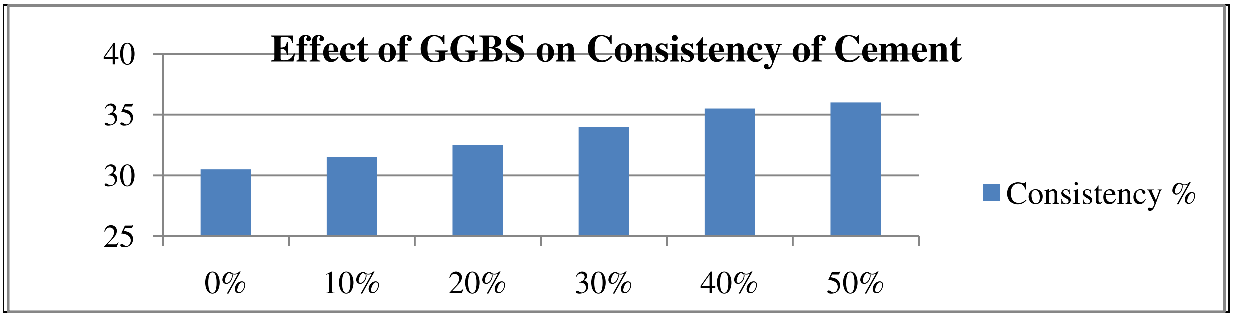

Fig. 1: Variation of Consistency of Cement containing different % of GGBFS

Table 2: Effect of GGBFS on Compressive Strength of Cement

Amount of Cement replaced by GGBFS (%)	0	10	20	30	40	50
3 Days Strength (MPa)	11.21	9.70	7.22	6.14	4.74	3.09
7 Days Strength (MPa)	24.70	16.72	11.19	9.78	7.95	6.17

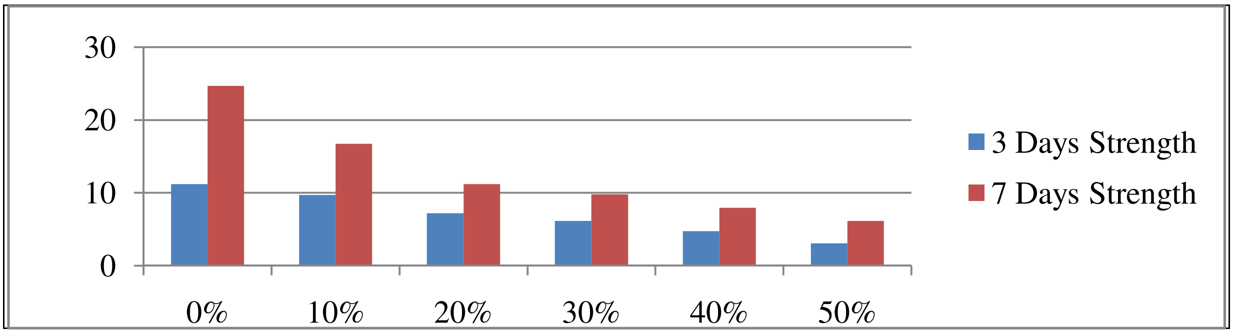

Fig. 2: Variation of Compressive Strength of mortar with different % of GGBFS

Table 3: Effect of RHA on Normal Consistency of Cement

Amount of Cement replaced by RHA (%)	0	10	20	30	40
Consistency (%)	32	43	48	51	55

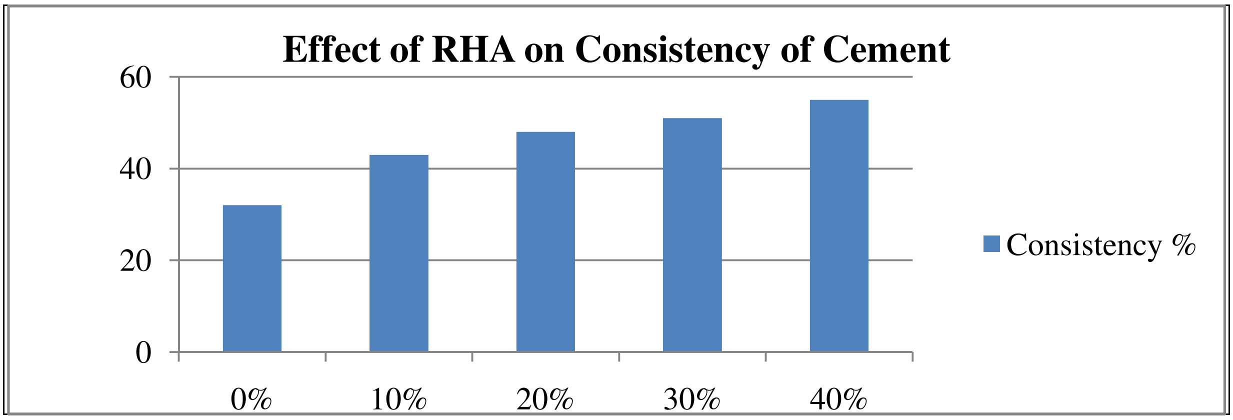

Fig. 3: Variation in Consistency of Cement with different % of RHA

Table 4: Effect of RHA on Compressive Strength of Cement

% of Cement replaced by RHA	**0% (RHA)**	**20% (RHA I)**	**20% (RHA II)**
3 Days Strength (MPa)	11.21	2.78	3.84
7 Days Strength (MPa)	24.70	4.72	7.70

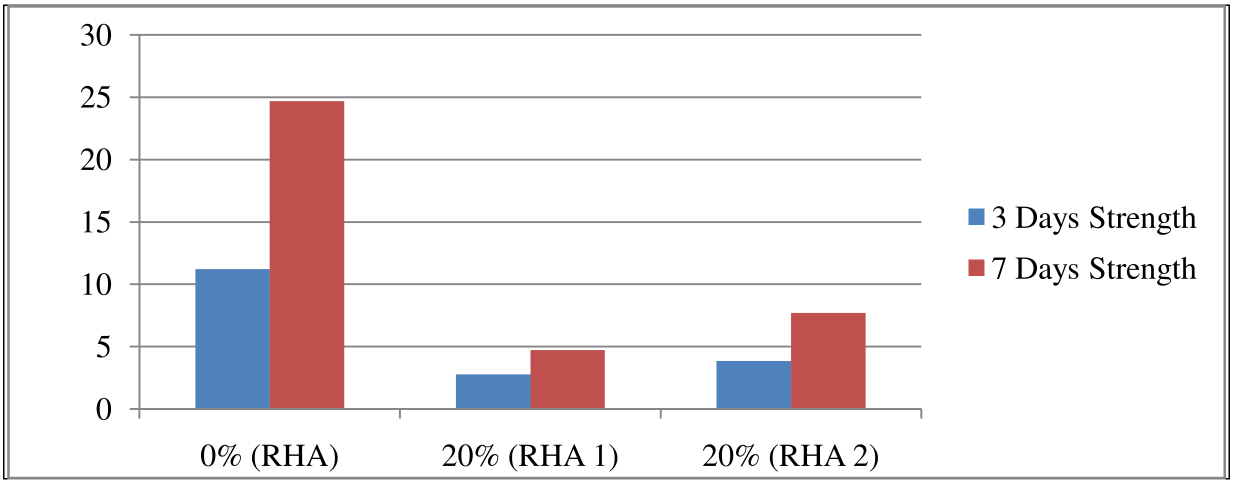

Fig. 4: Variation in Compressive Strength of mortar using RHA 1 and RHA 2

3 RESULT DISCUSSION

The test show that the consistency percentage is increasing with increase in percentage of GGBFS as a cement replacement, but the change is not so slow. But, it is found that on increasing the percentage of RHA the consistency percentage increases swiftly.

The results show that 3 days and 7 days compressive strength reduces about 15.50% and 47.47% that is from 11.20MPa to 9.70MPa and 24.70MPa to 16.72MPa respectively, when we increase GGBFS percentage increases from 0 to 10%. If percentage of GGBFS was further increased than there is sharp reduction in the compressive strength. Finally when the GGBFS percentage increased to 50% the strength reduces by about 53.4% and 28.8% in 3 days and 7 days respectively of its initial values. So it has been concluded that the use of GGBFS in Portland slag cement leading to unfavorable result on strength of mortar. Also, RHA as a partial substitute of cement is not giving acceptable strength. Although RHA 2 is giving better strength when compared with RHA 1, but it also not satisfactory. Due to high carbon percentage in RHA 1, it is not suitable for using as a pozzolanic material leads to give very poor strength and RHA II which was burnt more than as compared to RHA I, so it has less carbon percentage and whitish in colour.

4 CONCLUSION

It has been concluded from the research that:

1. If we replace cement with GGBS there is increase in consistency. GGBS passing 75 micron sieve not giving good strength of mortar.
2. By replacing cement with RHA the consistency increases. Use of RHA which is properly burned in controlled temperature improves the strength of mortar. Strength doesn't increase satisfactorily by the use of RHA

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