ISSN (e): 2250 – 3005 || Volume, 09 || Issue, 8 || August – 2019 ||
International Journal of Computational Engineering Research (IJCER)

Compressive Strength of Flyash, GGBS and M-Sand Based Concrete Pavement

Sachin Patil1, Sagar2, Rashmi Y3, Meghana V4
1,2Assistant Professor,Civil Engineering Department, Rao Bahadur Y Mahabaleshwarappa Engineering College, Ballari-583104.
3,4 UG Student,Civil Engineering Department, Rao Bahadur Y Mahabaleshwarappa Engineering College, Ballari-583104.
Corresponding Author:Sachin Patil

ABSTRACT: *Nowadays the disposal of industrial and Agro wastes has become serious concern to environment and special attention is required towards handling them. Agricultural wastes such as Rice husk ash, sugarcane bagasse ash etc. and the Industrial wastessuch as GGBS, Fly ash etc. can be partially replaced with cement. In the present paper, theattempt is made towards the utilization of GGBS and Fly ash in cement concrete pavement. The use of these wastes would not only be economical but it also helps in reduction of greenhouse gases and makes the environment pollution free. The mineral admixture such as fly ash, silica fume etc. has been utilized in many of the developed countries.In the present investigation GGBS and Fly ash has been utilized as a partial replacement of cement up to 25 %. varying from0%, 5%, 10%, 15%, 20% and 25% . M-Sand is used as a complete replacement of fine aggregate. Compressive strength are checked at 7 and 28 days for cubes of 150mm. The result shows that GGBS and Fly ash can be partially replaced with cement up to 10%.*
Keywords*: GGBS, M-sand, Flyash, River sand, Ordinary portlandcement, Compressive strength, Concrete Pavement.*

Date of Submission: 05-08-2019 Date of Acceptance: 20-08-2019

I. INTRODUCTION

The two basic components, which concrete is mainly composed of are binder (paste) and aggregates. The paste, which mainly consists of cement, water and supplementary cementitious materials, has main functions of binding up the aggregates, filling up the voids and thus making concrete strong and dense. The aggregates, both coarse and fine, provide volume to concrete. The voids in coarse aggregates are filled up by the fine aggregates and voids in the fine aggregates are filled up by cement, thus helping in making concrete a densely packed system. The strength of concrete increases with the decrease in voids.As compared to other road making materials concrete pavements have higher modulus of elasticity and rigidity. Due to this property the pressure on the subgrade gets limited. The thickness of the concrete pavement is mainly determined by the magnitude of the wheel or axle loads and by the flexural strength of the concrete and there is no significant contribution provided by sub-bases. In flexible pavements, a much deeper depth is needed to diminish the intensity of the stresses due to traffic loads. In this both the base and the sub-base contribute significantly to the structural properties of the pavements. Hence less pressure is applied to the material below the concrete.GGBS is a by-product obtained during the manufacture of iron in the blast furnace. It is economically available in large quantities, requiring storage facilities and, therefore, it is suitable for use in ready-mix concrete, in the production of large quantities of site-batched concrete and in precast product manufacturing. Blast furnaces are fed carefully with controlled mixtures of iron ore, coke and limestone at a temperature of 2000^{o}C. The iron ore is reduced to iron and sinks to the bottom of the furnace. The remaining material that floats on top is the slag. The annual production of GGBS in China alone is *15 million tones, which is used as raw material in cement production, concrete and pavements. The authors reported that replacement of cement by slag up to 40% has greater compressive and flexural strength than normal concrete. In the authors studied the behavior of GGBS-added concrete at elevated temperatures. The cementitious properties of GGBS depends on the chemical composition of the GGBS slag, alkali concentration of the reacting system, glass content of the GGBS, fineness of the GGBS and Portland cement and temperature

II. LITERATURE REVIEW

Brown (1982) conducted several studies with fly ash replacing cement and fine aggregate at levels of 10-40% by volume. He concluded that for each 10% of ash substituted for cement, the compacting factor or workability changed to the same order as it would by increasing the water content of the mix by 3-4%. When fly ash was substituted for sand or total aggregate, workability increased to reach a maximum value at about 8% ash by volume of aggregate. Further substitution caused rapid decrease in workability.

Owens, (1989) reported that with the use of fly ash containing large fraction of particles coarser than 45µm or a fly ash with high amount of unburned carbon, exhibiting loss on ignition more than 1%, higher water demand was observed.

Sivasundram, et al. (1990) investigated the setting time of high-volume fly ash concrete mixes, and concluded that the initial setting time of 1.50 hours was comparable to that of the control concrete, whereas the final setting time was extended by about 3 hours as compared to that of the control concrete.

Carette and Malhotra(1983) studied the effect of Canadian fly ashes on the compressive strength of concrete mixes. Cement was replaced with 20% fly ash in all the mixes. Compressive strength was measured up to the age of 365 days. It was seen that compressive strength continued to increase with age, indicating pozzolanic action of fly ashes.

Ravikumar et al. (2013) studied the effects of using different pozzolonic materials as a partial cement replacement material in mortar mixes. An experimental study of mortar made with Ordinary Portland cement (OPC) and 12% of OPC, replaced by different pozzolanic materials such as Fly Ash, Rice Husk ash, Silica Fume, Calcined Clay (Grog) and Slag (GGBS) were tested for the strength and durability properties, to determine the effect of these materials on mortar properties and was compared to control mortar mix. Mortar specimens were tested for compressive strength at age of 3, 7 and 28 days and flexural strength at age of 28 days. To investigate the mortar for its durability, the specimens after initial curing of 28 days were immersed in fresh water with solutions of 10% sodium sulfate (Na2SO4) and 10% magnesium sulfate (MgSO4) for another period of 3 months. Through this period, the specimens were tested for compressive strength at 60, 90 and 120 days to evaluate its durability.

Awasare et al. carried out investigation that the Industrial wastes like Ground Granulated Blast Furnace Slag (GGBS) show chemical properties similar to cement. Use of GGBS as cement replacement will simultaneously reduce cost of concrete and help to reduce rate of cement consumption. This study report of strength analysis of GGBS concrete will give assurance to encourage people working in the construction industry for the beneficial use of it. This research work focuses on strength characteristics analysis of M20 grade concrete with replacement of cement by GGBS with 20%, 30%, 40% and 50% and compare with plain cement concrete. Now days crush sand is used to replace natural sand, so study area extends to find best percentage of replacement by using both crush and natural sand.

III. MATERIALS

The details of the various materials used in this investigation are given in the following sections.

3.1Cement

Ordinary Portland cement of 43 grade of sagar cement conforming to IS: 8112 standards were used in this investigation. The specific gravity of the cement was 3.0. The initial and final setting times were found as 50 minutes and 270 minutes respectively.

3.2 M-Sand

M-Sand which was collected in an around Ballari conforming IS: 383-1970 passing 4.75 mm and with the specific gravity of 2.73.

3.3 Coarse-aggregate

Coarse aggregates collected around RYMEC college Ballari has been used. The specific gravity of coarse aggregate is 2.67.

3.4Water

Potable fresh water available from local sources was used for mixing and curing of mixes.

3.5 GGBS

GGBS is brought from JINDAL and the specific gravity of GGBS is 2.82

3.6Fly ash

Fly ash collected from PPR industry in Ballari conforming to specific gravity 2.4 is used.

IV. METHODOLOGY

The main aim of this investigation is to study the Compressive strength of concrete at 7 and 28 days. Cement is partially replaced with Flyash and GGBS in varying the proportion of 0%(Reference mix), 5% and 10% 15%, 20% and 25%. M-Sand is used instead of natural river sand. The materials are weighed and dry mixed thoroughly and water for Water binder ratio of 0.45 is added and the material is mixed thoroughly until it becomes uniform. Concrete produced are filled in 150mmcube moulds. After 24 hours of casting, the specimens are de-molded and kept for curing.The specimens were tested after 7 and 28 days of curingfor the Compressive strengthin accordance with Bureau of Indian Standards. For each trail, 3 cubes were cast and tested and the average values of compressive strength were adopted in each case.

V. RESULTS AND DISCUSSIONS

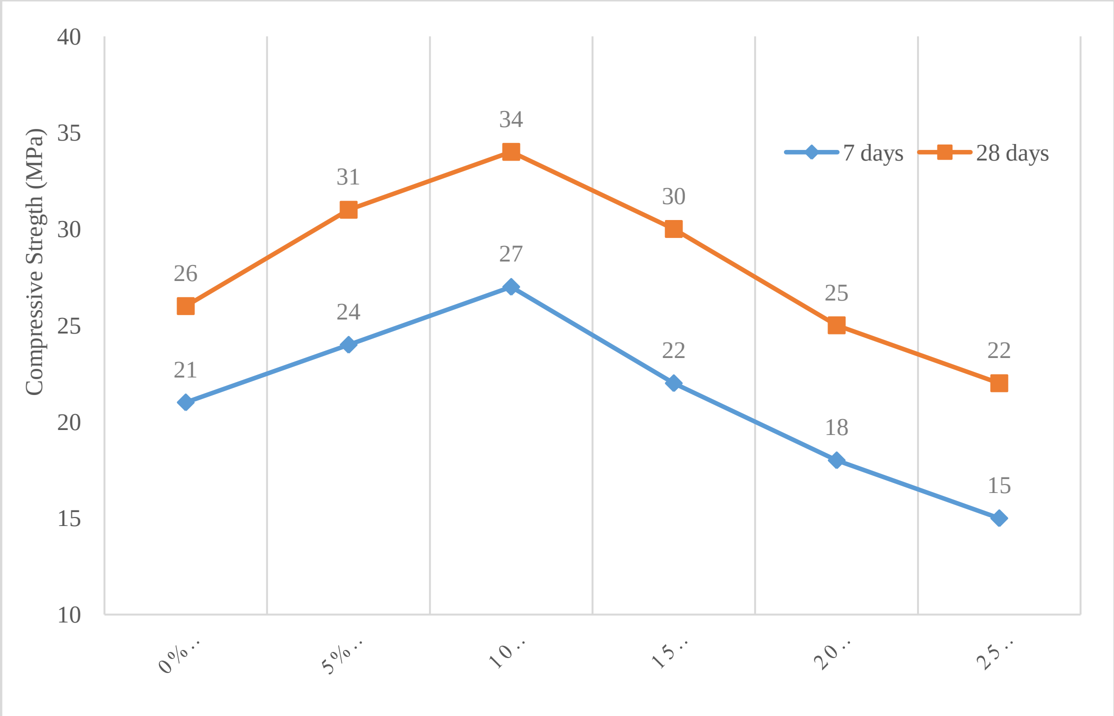

Figure 1. Compressive strength for different mixes at 7 and 28 days.

Figure 1 shows 7 and 28 days compressive strength for variation of GGBS and Flyashpercentages, for water binder ratio of 0.45.

For 7 days, Compressive Strength increases by 14.29%, 28.57% and 4.76% with respect to referance mix for 5%, 10% and 15% replacement respectively. Compresive strength decreases by 14.29% and 28.57% with respect to referance mix for 20% and 25% replacement respectively.

For 28 days, Compressive Strength increases by 19.23%, 30.77% and 15.38% with respect to referance mix for 5%, 10% and 15% replacement respectively. Compresive strength decreases by 3.85% and 15.38% with respect to referance mix for 20% and 25% replacement respectively.

28 days Compressive strength increases by 23.81%, 29.17%, 25.93%, 36.36%, 38.89% and 46.67% with respect to 7 days compressive strength for 0%, 5%, 10%, 15%, 20% and 25% replacement respectively.

Maximum compressive strength obtained is 34 Mpa and is for mix with 10% GGBS and Flyash replacement and is increased by 30.77% compared to referance mix.

VI. CONCLUSIONS

On the basis of the present experimental investigation, the following conclusions are drawn.

1. Maximum compressive strength obtained is 34 Mpa and is for mix with 10% GGBS and Flyash replacement and is increased by 30.77% compared to referance mix with water binder ratio of 0.45.
2. From the results it is evident that compressive strength increases with every 5% increase in cement replacement with GGBS and Flyash upto 10% replacement. With further increase in cement replacement the compressive strength decreases. Thus we can conclude that 10% replacement is optimum for concrete pavement.
3. Partial replacement of OPC with GGBS and Flyash and complete replacement of fine aggregete with M-sand can enhance the compressive strength of concrete.

4. The utilization of GGBS and Flyash will not only reduce the cost of construction but also reduce the environmental pollution.

REFERENCES

[1]. Sivasundaram, V., Carette, G. G., &Malhotra, V. M. (1990) "Selected properties of high volume fly ash concretes", Concrete International, 12(10), 47-50

[2]. Vallabuni Vinay Kalyan1, P.Sandeep Chandra Mohammed Ibrahim, B.Tech Student, Department of Civil Engineering, MRITS College, Maisammaguda, Dulapally, Secunderabad, DIST. Medchal, India1 Assistant Professor, Department of Civil Engineering, MRITS College, Maisammaguda, Dulapally, Secunderabad, DIST. Medchal, India2,3.

[3]. Shanmuganathan.N1, Akbar Basha.S, Sheikibrahim.K, Mohammed fahad.A.S 1Assistant Professor, civil department, Dhaanish Ahmed College of Engineering, India Associate Professor, civil department, Dhaanish Ahmed College of Engineering, India & BE-Final Year, civil department, Dhaanish Ahmed College of Engineering, India

[4]. BTech Student, Department of Civil Engineering, Balaji Institute of Technology & Science, Narsampet, Warangal Asst.Professor, Dept. of Civil Engineering, Balaji Institute of Technology & Science, Narsampet, Warangal, Telangana, India

[5]. G. Aditya M. T. S. Lakshmayya M. Tech Scholar Assistant Professor Department of Civil Engineering Department of Civil Engineering GMR Institute of Technology, Rajam, India – 532127. GMR Institute of Technology, Rajam, India – 532127.

[6]. Harsh Bansal1, Munish Kumar

[7]. Student of Shree Ram Mulkh College of Education, RaipurRani Assistant Professor in Department of Civil

Sachin Patil" Compressive Strength of Flyash, GGBS and M-Sand Based Concrete Pavement" International Journal of Computational Engineering Research (IJCER), vol. 09, no.8, 2019, pp 31-34