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AN EXPERIMENTAL STUDY ON STRENGTH PROPERTIES INVESTIGATION OF GEOPOLYMERCONCERTE WITH GGBS & METAKAOLINE IN ADDITION WITH ALKALINE SOLUTION OF SODIUM HYDROXIDE AND SODIUM SILICATE

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ABSTRACT: The major problem the world is facing today is the environmental pollution. In the construction industry mainly the production of Portland cement will causes the emission of pollutants results in environmental pollution. We can reduce the pollution effect on environment, by increasing the usage of industrial by-products in our construction industry. Geo-polymer concrete is such a one and in the present study, to produce the geo-polymer concrete the Portland cement is fully replaced with GGBS (Ground granulated blast furnace slag) and Metakolin with alkaline liquids are used for the binding of materials. The alkaline liquids used in this study for the polymerization are the solutions of Sodium hydroxide (NaOH) and sodium silicate (Na_2Sio_3). Different molarities of sodium hydroxide solution 10M is taken to prepare different mixes. And the compressive strength is calculated for each of the mix.The geo-polymer concrete specimens are tested for their compressive strength at the age of 7 and 14 and 28 days. The objective of this project is to study the effect of Metakaolin (MK) and ground granulated blast furnace slag (GGBS) on the mechanical properties of geopolymeroncrete (GPC) at different replacement levels (GGBS80-MK20, GGBS70-MK30, GGBS60-MK40). Sodium silicate (Na_2SiO_3) and sodium hydroxide (NaOH) solution have been used as alkaline activators. In the present investigation, it is proposed to study the mechanical properties viz. compressive strength, split tensile strength of Metakaolin and GGBS based geopolymer concrete. These properties have been determined at different curing periods like 7, 14, 28, days and at ambient room temperature.
Key words: Geo-polymer, GGBS, Alkaline solutions, curing, compressive strength.

INTRODUCTION: The advancement of concrete technology can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment. Presently large amounts of Metakaoline, a dehydroxylated form of the clay mineral kaolinite came into existence. This project describes the feasibility of using in concrete production as partial replacement of cement.In India, the Metakaoline and GGBS are the most thriving indust rial effects. These contain physical and mechanical properties of fresh and hardened concrete that have been investigated. Slump and air content of fresh concrete and absorption and compressive strength of hardened concrete were also investigated. Test results show that this

Metakaoline and GGBS are capable of improving hardened concrete performance up to 10%, Enhancing fresh concrete behavior and can be used in architectural concrete mixtures. The compressive strength of concrete was measured for 7 and 28 days. In order to evaluate the effects of Metakaoline and GGBS on mechanical behavior, many different mortar mixes were tested.Growth of population, increasing urbanization, rising standards of living due to technological innovations have contributed to an increase both in the quantity and variety of solid wastes generated by industrial, mining, domestic and agricultural activities. Metakaoline and GGBS process industries are the most promising business areas of the mining sector, with a mean growth in the world production of approximately 6% per year in the last 10 years.In India, about 6 million tons of Metakaoline and GGBS industries are being released. In Tamilnadu state, Salem is an area that concentrates large quantity Metakaoline industries. This scene is even more aggravated by the increasing production in the last decade, getting attention from all society with the destination of disposal wastes.

Metakaoline and GGBS

Metakaoline is a calcined product of the clay mineral kaolinite. The Particle size of Metakaoline is smaller than cement particles, but not as fine as silica fume. When kaolinite, a layered silicate mineral with a distance of 7, 13 A between the layers of Sio_2 and Al_2O_3 is heated, the water contained between the layers is evaporated and the kaolinite is activated for reaction with cement. Calcined between 600^o and 850^o the kaolin transformed to an amorphous phase called metakaoline. This Mineral is activated and met stable. Metakaoline can then react with cement and lime. Heating above 900^oC produces mullet, a non pozzolanic material.

Therefore the scientific and industrial community must commit towards more sustainable practices. There are several reuse and recycling solutions for this industrial product, both at an experimental phase and in practical applications. These industrial wastes are dumped in the nearby land and the natural fertility of the soil is spoiled.

2. LITERATURE REVIEW

Sudharsan RaoT.V et al (2014): They are observed that The details of geopolymer material properties, mix design and the comparisons of the harden concrete properties such as compressive strength, split tensile strength, Flexural strength of concrete with conventional concrete are studied. The test results show that the use of GGBS based geopolymer concrete increases in compressive strength by 13.82% as compared with conventional concrete. As the silica fume content increases the compressive strength increases up to 15% and then decreases. Hence the optimum replacement is 15%.The percentage replacement of cement by silica fume increases, the workability decreases.

B. Rajini et al (2014): This paper presents a new method for Based on the results reported in this investigation the following conclusions are drawn. The compressive strength and split tensile strength of geopolymer concrete decrease with increasing FA content in the mix

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irrespective of curing periods. For a given proportion of a mix, the compressive strength and split tensile strength increase with age. The compressive strength and split tensile strength of geopolymer concrete is maximum for the FA0-GGBS100 irrespective of curing period. The rate of gain in compressive strength and split tensile strength of geopolymer concrete is very fast at 7 days curing period and the rate gets reduces with age. Geopolymer concrete can be recommended as an innovative construction material for the use of the use of construction.

3. MATERIALS

Metakaolin,
GGBS,
Fine and Coarse Aggregate
NaOH and Na2SiO3

TESTS ON MATERIALS

TABLE 1: The following tabular column shows the physical Tests results of Bharathi OPC cement

S.NO	PHYSICAL TESTS	OBTAINED RESULTS	REQUIREMENTS AS PER IS CODES
1	Fineness	2.6%	Not>10% as per IS 4031 part 1
2	Standard Consistency	28%	IS 4031 part 4
2	Initial Setting time	28 min	Not less than 30 minds as per IS 4031 part 5
3	Final setting time	560 min	Not more than 600 minutes as per IS 4031 part 5
4	Soundness	1.2mm	Not>10mm as per IS 4031 part 3
5	Specific gravity	3.01	IS 2720 part 3(3.15isgeneral value)

Metakaolin: Metakaoline is obtained from the Kaomine industries PVT LTD at Vadodara on Gujarat state. The specific gravity of Metakaoline is 2.7 and the size of particle is less than 90 microns.

Fine aggregate: The locally available river sand is used as fine aggregate. It should be free from clay, silt, organic impurities etc., and the sand is tested for various properties such as specific gravity, bulk density etc. in accordance with IS: 2386-1963. The grading or particle size distribution of fine aggregate shows that it is close to grading Zone – IV or IS: 383-1970

COARSEAGGREGATE: Machine crushed angular Basalt metal used as coarse aggregate. The coarse aggregate is free from clayey matter, silt and organic impurities etc. The coarse aggregate is also tested for specific gravity and it is 2.68. Fineness modulus of coarse aggregate is 4.20. Aggregate of nominal size 20mm downgraded 50% retained on 12.5mm sieve and remaining 50% is taken from the sieve 12.5mm (passing) and 4.75mm(retained) is used in the experimental work, which is acceptable according to IS: 383-1970

Alkaline Solutions: The most common alkaline liquid used in geopolymerisation is a combination of sodium hydroxide (NaOH) or Sodium Silicate (Na2sio3) or Potassium Hydroxide or potassium silicate. The alkaline liquids are from soluble alkali metals that are usually sodium or potassium based. The mass of geopolymer solids is the sum of the mass of Metakaolin and GGBS, the mass of sodium hydroxide solids used to make the sodium hydroxide solution, and the mass of solids in the sodium silicate solution (i.e. the mass of Na2O and SiO2).

PREPARATION OF SOLUTION FOR 10M NaOH and Na2SiO3 :

Molecular Weight of NaOH = 40

For 10M NaoH = 10 x40 = 400 gm/lit.

Total NaOH to be mixed = 400/(specific gravity of NaOH) = 400/2.541= 157.43 gm/lit

Take the ratio of sodium silicate solution-to-sodium hydroxide solution by mass as 2.5 sodium hydroxide

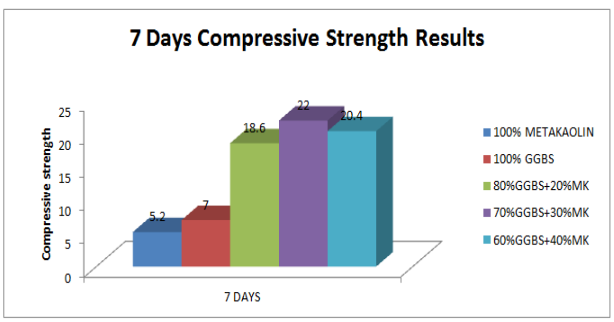
Na_2SiO_3 = 2.5 x NaOH = 2.5 x 400 = 1000gm/lit

Total Na_2SiO_3 = 1000/(specific gravity of Na_2SiO_3) = 1000/2.7 = 370.37 gm/lit

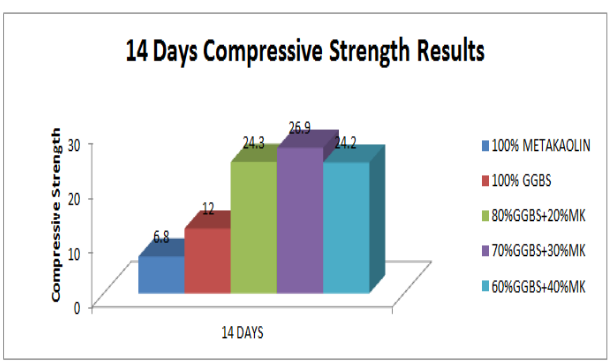
EXPERIMENTS AND RESULTS

Proportion of mix for M30 mix as per design is – 1:1.49:3.01

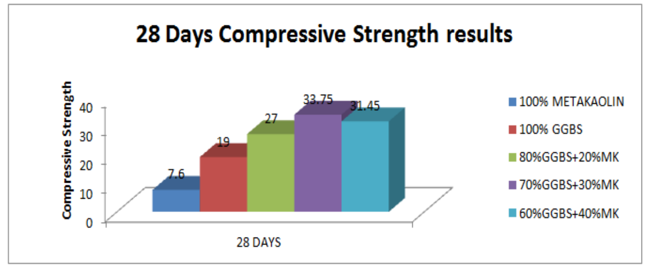
Compressive strength Results



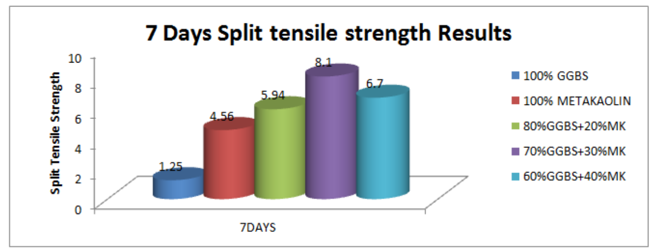
Graph :1 Graph showing the Strength parameters for 7days Specimens



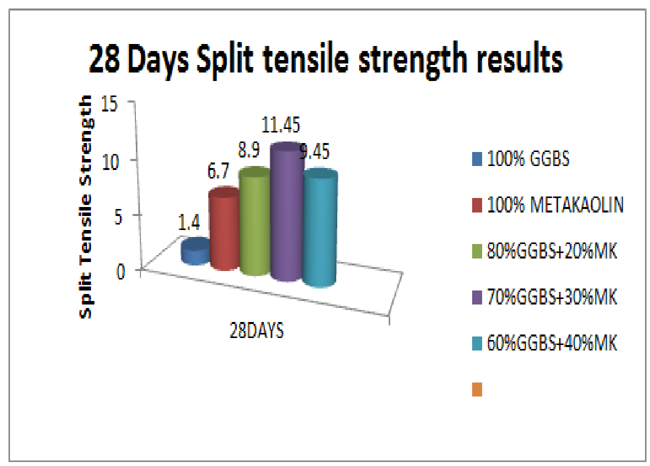
Graph :2 Graph showing the Strength parameters for 14days Specimens



Graph :3 Graph showing the Strength parameters for 28days Specimens



Graph 4: Split tensile strength with % compositions for 7days



Graph 5: Split tensile strength with % compositions for 28days

CONCLUSIONS: Based on limited experimental investigations conducted on concrete the following conclusions are drawn

1. The compressive strength of concrete is found to decreases with 100% Metakolin
2. The compressive strength of concrete is found to decreases with 100% GGBS
3. The compressive strength of concrete is found to increases with increase in 70 % GGBS and 30% Metakaolin content.

4.The strength of the Geopolymer concrete increases with 25%-30% from 7 to 28 days that means there is no much increase in the strength after 7days.

5. From the above results it is appearent that Geopolymer concrete based on GGBS and metakaolin has got more compressive than conventional concrete.

6. To increase the strength of concrete due to 10M alkaline solutions

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