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Comparision of Strength Behaviour of M-40 Grade with Ordinary Concrete by Replacing the Fine Aggregate with Geopolymers

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Abstract **- OPC is a major building material on this earth. Cement manufacturing is the major carbon dioxide emitting source and other hand besides deforestation and burning of fossil sources. The global warming and heating effect is caused by the emission of greenhouse gases, such as Carbon monoxide , CO2, into the atmosphere. Among the greenhouse gases, CO2 contribute about major amount is 65 % of global warming. The global cement industry contributes about 7-10% of greenhouse gas emission to the earth's open area. In order to impact on surrounding environmental effects associated with Portland cement, there is a need to develop alternative binders to make concrete.One of the efforts to produce more eco - friendly concrete is the development of organic inorganic polymers like aluminium silicate, called geopolymer, synthesized from materials of geological origin or by-product materials such as fly ash that are rich in silicon and aluminium.In this paper work, low-calcium fly ash-based geopolymer from Chennai Thermal power stations has been used for the production of geo-polymer concrete. The combination of silicates of sodium solution and hydroxide of sodium solution was used as alkaline solution for fly ash activation. Alkaline solution to fly ash ratio was varied as upto .45.The concentration of sodium hydroxide solution was maintained upto 8M (Molars).The curing condition of geopolymer concrete was varied as ambient curing and oven curing at and 100°C. The strength of the GPC was tested at various ages like normal conditions 7,14,28 days.**

Keywords- **Concrete, Polymers, Geopolymer, M40 Grade.**

I. INTRODUCTION

Cement contained major amount of argillaceous and calcareous materials, the usage of OPC is increasing day to day worldwide. Hence, an alternate innovative material used is fly ash.fly ash is having of high amount of Silica and alumina materials, It has high cementitious property, fly ash is by product of coal that is available in thermal power plant. Geopolymer concrete cement is replaced by fly ash in which the concrete gives more compressive strength comparing to normal concrete and also it has many more advantages. Fly ash is also less expansive when compare to cement. The main use of geopolymer concrete is that normal concrete produces more CO2 increasing the global warming in order to avoid this emission of CO2 gas, GPC concrete came into usage since CO2 emitted is very less. Comparatively GPC concrete has more Benefits than the other types of RCC.

II. OBJECTIVE OF THE PROJECT

The objective of the thesis to study the influence of parameters such as alkaline solution to binder, age condition on strength of fly ash based GPC at various ages.

III. SCOPE OF THE PROJECT

1. To Evaluate the affects of binder to alakline, concentration of hydroxideof sodium solution and curing conditions on fly ash GPC
2. Ratio of alkaline solution to binder by mass varies as 0.35-0.5.
3. Sufficient uring and oven curing (60oC & 100oC) was taken.
4. To determine the cube strength of FLY ASH GPC at various ages.

IV. MATERIALS AND PROPERTIES

The materials used for making fly ash-based geopolymer concrete specimens were low-calcium fly ash, aggregates, alkaline liquids, extra water and super plasticizer.

1. Fly ash

The fly ash used in this study was obtained from Chennai Thermal power plant. It falls in the category of class F grade and its chemical composition was given in T, The

physical properties of fly ash were determined .it was and given in Table.

XIDE	CEMENT	FLY ASH
IO_2	21.23	59.84
L_2O_3	4.31	22.86
E_2O_3	1.86	4.68
$I0_2$	0.13	0.96
ao	64.29	3.04
go	1.81	1.54
0_2	3.68	0.34
$_2O$	0.71	2.16
a2o	0.17	0.62
OI	1.50	3.32

2. Comparison of Strength Parameters

Compressive Strength is a major part of concrete and this journal . Focused on the topic "Review on strength and Durability studies on Geopolymer concrete". Material constituents Of GPC formation, various mix proportions, strength affecting parameters, and workability of geopolymer concrete in fresh state, casting process, and curing process were studied. The study concluded that geopolymer concrete has significant potential as a good engineering material for the future research, as the GPC is not only environmental friendly but also possesses excellent mechanical properties B.Vijya Rangan et. al. stated that the compressive strength of geopolymer concrete is very high when compared to normal concrete. It is about 1.5 times higher than normal concrete, for the same mix. Geopolymer concrete also showed very good workability compared to normal concrete .

3. Durability

"Rangan, B.V. et al stated that Geopolymer concrete is more resistant to heat, sulphate attack, water ingress & alkaliaggregate reaction. The role of calcium in Geopolymer concrete made up of fly ash is very prominent since it may cause flash setting. Such structures with high durability can be adapted to marine environment" "Wallah et al, explained that, fly-ash based geopolymer concrete which is heat cured, undergoes low creep and shows very little drying shrinkage as of about 100 micro strains at the end of one year. And it shows excellent resistance to sulphate attack Chanh et al., proved that better resistance is provided by fly ash-based geopolymer against aggressive environment. As such, this quality of resistivity can be used to construct structures which are exposed to marine environment [10]. Sathia et al., proved that when geopolymer is exposed to acid solution, only 0.5% of weight is lost when compared to normal concrete immersed in 3% sulphuric acid.

4. Workability of fresh geopolymer concrete

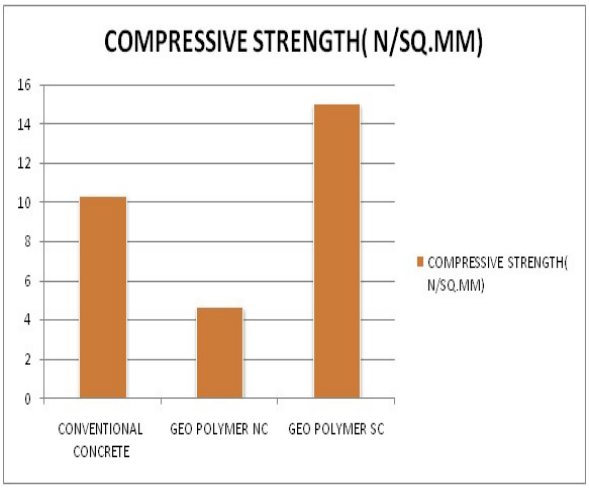
Sathia et al's study said that water also plays an important role in geopolymer concrete as much as normal concrete. Workability can be improved by use of water in geopolymer, but it will increase the porosity in concrete at elevated temperature due to the evaporation of water during curing process . Chindaprasirt et al. discovered that the flow of mortar decreases with an increase in sodium hydroxide and sodium silicate concentration. The workable flow of geopolymer mortar was in the range of 110 ± 5 to 135 ± 5% . Workability of mortar is upgraded with the addition of superplasticizer or extra water, but the use of super pl asticizer effects the strength of geopolymer. Though addition of extra water gives higher strength than addition of super plasticizer.

V. COMPARISON OF STRENGTH PARAMETERS

Y. Nagvekar et al made a comparative study between conventional concrete and green concrete and reported the following results. The study used M25 grade of concrete mix and two different techniques of curing was used viz. water submerged curing or conventional curing and steam curing. The cubes casted were tested for 3 days, 7 days and 28 days for their compressive strengths and results were reported as below:

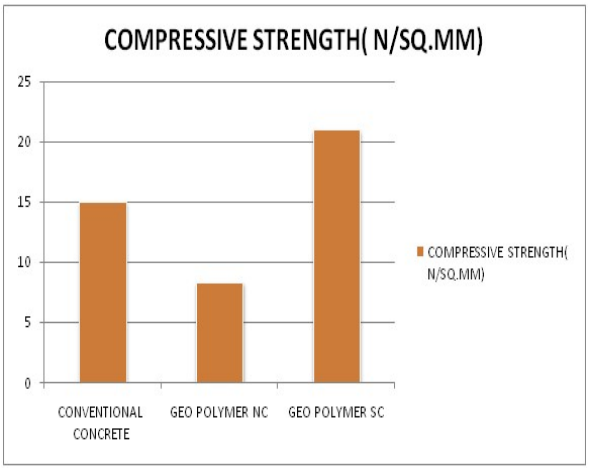
1. 3 days Compressive Strength

S.NO	CONVENTIONAL CONCRETE	GEOPOLYMER (WATER SUBMERGED N/MM^2	GEOPOLYMER (STEAM CURED) N/MM^2
1	10.3	4.64	15.00



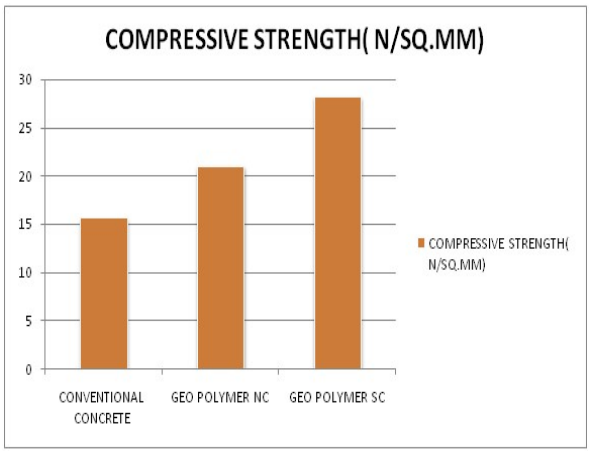
2. 7 Days Compressive Strength

S.NO	CONVENTIONAL CONCRETE	GEOPOLYMER (WATER SUBMERGED N/MM^2	GEOPOLYMER (STEAM CURED) N/MM^2
1	15.00	8.3	21.00



3. 28 Days Compressive Strength

S.NO	CONVENTIONAL CONCRETE	GEOPOLYMER (WATER SUBMERGED N/MM^2	GEOPOLYMER (STEAM CURED) N/MM^2
1	15.6	21.00	28.20



VI. CONCLUSIONS FROM GEOPOLYMERS AT NORMAL CURIN &, STEAM CURING

From various studies conducted it can be concluded that fly ash-based Geopolymer is preferred over normal concrete as it excels in many aspects such as compressive strength, exposure to aggressive environment, workability and exposure to high temperature. The Present matter that FGPC is more Tough to corrosion and fire hazards, and has high cube and cylinder strengths, it also gains its full strength quickly (cures fully faster).

The shrinkage is very less compared to ordinary concrete. Thus, taking account these structural advantages it may be concluded that, in near future Geopolymer concrete may find an effective alternate to standard cement concrete. For the common of merits and demerits of FGPC detailed study and research is required by the researches. Geopolymer concrete can be used easily under the same conditions which apply for ordinary Portland cement concrete.

These constituents of geopolymer concrete are capable of being mixed with low alkali activating solution and are curable in short time, under natural conditions. The production of this geopolymer concrete can be effectively mixed and hardened like Portland cement. Geopolymer concrete can be used for repair and renovation works.
Due to its property to attain high strength early, Geopolymer Concrete can be effectively used in the precast industries, so that in short duration huge production can be accomplished and the breakage during transportation shall also be minimized. The Geopolymer Concrete can be effectively used for junctions of beam and column of a RCC structure. Also, GEO POLYMER Concrete shall be used in the Consturction of works. In addition to that the Fly ash shall be effectively used and hence no landfills are required to dump the fly ash.

When steam cured than water submerged curing process geopolymer concrete gains better strength. The strength gained is increased by 10% when steam curedThe necessary steps can be taken by government to extract sodium hydroxide and sodium silicate solution from the waste materials of chemical industries, so that the cost of alkaline solutions required for the geopolymer concrete shall be reduced.

VII. CONCLUSION

1. The compressive strength of oven cured concrete was more than that of ambient cured concrete irrespective of age, alkaline solution to fly ash ratio.
2. 28 days compressive strength of oven cured specimens at 60 & 100 C is 25% and 35% more than that of ambient cured specimens, for alkaline fly ash ratio of 0.35
3. 28 days compressive strength of oven cured specimens at 60 & 100 C is 1.3 times and 1.4 times more than that of ambient cured specimens, for alkaline fly ash ratio of 0.4.
4. 28 days compressive strength of oven cured specimens at 60 & 100 C is 1.3 times and 1.1 times more than that of ambient cured specimens, for alkaline fly ash ratio of 0.45.
5. FGBC Is that means Flyash concrete cured in the laboratory ambient conditions gains compressive strength with age.
6. Period of curing for FGPC , compressive strength at 28 days is about 3 times and 1.4 times higher than 7 and 14 days respectively.
7. Increase in alkaline solution to fly ash ratio by mass, results in increase in the compressive strength of fly ash-based geopolymer concrete. When compressive strength was plotted against alkaline solution to fly ash ratio, 0.4 & 0.45 ratio was seen to be 1.8 & 2.9 times respectively greater than the 0.35 ratio and by percentage it was 44% &66% higher during the initial 7 days. Similarly, after 14 days for 0.4 & 0.45 ratio was seen to be 1.3 & 1.5 times respectively greater than the 0.35 ratio and by percentage it is 26% &34% higher comparatively. Likewise at the interval of 28 days for 0.4 & 0.45 ratio was seen to be 1.1 & 1.3 times respectively greater than the 0.35 ratio and by percentage it is 11%&22% higher comparatively.
8. The maximum compressive strength achieved in this project work for low calcium fly ash based geopolymer concrete is 27MPa.
9. There is no substantial gain in the compressive strength of oven-cured geopolymer concrete with age beyond 7days.
   - During ambient curing the compressive strength was increased by 77% from 7 days to 28 days.
   - Similarly, during oven curing the compressive strength was increased by 24% from 7 days to 28 days.
10. Increase in curing temperature in the range of 60°C to 100°C, causes marginal increase in compressive strength of fly ash-based geopolymer concrete.

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