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A Geo - Polymer Concrete by Partial Replacement of Fine Aggregates with Plastic Waste

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***Abstract*:- The use of Portland cement in concrete construction is under critical review due to high amount of carbon dioxide gas released to the atmosphere during the production of cement. In recent years, attempts to increase the utilization of fly ash to partially replace the use of Portland cement in concrete are gathering momentum. Most of this by-product material is currently dumped in landfills, creating a threat to the environment. We can reduce the pollution effect on environment, by increasing the usage of industrial by-products in our construction industry. Geo-polymer concrete is a concrete in which Portland cement is fully replaced by fly ash and GGBS (Ground granulated blast furnace slag).**

Geo-polymer concrete is a 'new' material that does not need the presence of Portland cement as a binder. Instead, the source of materials such as fly ash, that are rich in Silicon (Si) and Aluminum (AI), are activated by alkaline liquids to produce the binder. Hence it is the concrete with no Portland cement.

The present study covers the use of plastic Waste in geo-polymer concrete as partial replacement of fine aggregate. Sand is replaced with plastic waste at 5, 10, and 15 percentages respectively. Alkaline liquids used in this study are the solutions of sodium hydroxide (NaOH) and sodium silicate (Na2SiO3). Molarity of sodium hydroxide (10M) is considered. Fly ash and GGBS were used in different combinations and percentages respectively. This study is conducted to know the compressive strength of Geo- polymer concrete with plastic waste and to compare the same with Geo- polymer concrete without any replacement of fine aggregate.

key words: Geo-polymer concrete, CO_2 emission, GGBS, plastic waste, fly ash.

INTRODUCTION

For the construction of any structure, Concrete is the main material. Concrete usage around the world is second only to water. The main ingredient to produce concrete is Portland cement. On the other side global warming and environmental pollution are the biggest menace to the human race on this planet today.. Combustion of fossil fuels to operate the rotary kiln is the largest source and other one is the chemical process of calcination limestone into lime in the cement kiln also produces CO2.In India about 2,069,738 thousands of metric tons of CO2 is emitted in the year of 2018. The cement industry contributes about 5% of total global carbon dioxide emissions. But the demand of concrete is increasing day by day for its ease of preparing and fabricating in all sorts of convenient shapes. So to overcome this problem, the concrete to be used should be environmental friendly. To produce environmental friendly concrete, we have to replace the cement with some other binders which should not create any bad effect on environment. The use of industrial by products as binders can reduce the problem. In this respect, the new technology geo-polymer concrete is a promising technique. In terms of reducing the global warming, the geo-polymer technology could reduce the CO2 emission to the atmosphere caused by cement and aggregates industries by about 80%. And also the proper usage of industrial wastes can reduce the problem of disposing the waste products into the atmosphere. Geo-polymer concrete is a concrete in which Portland cement is fully replaced by fly ash and GGBS (Ground granulated blast furnace slag). Geo-polymer concrete is a 'new' material that does not need the presence of Portland cement as a binder. Instead, the source of materials. such as fly ash, that are rich in Silicon (Si) and Aluminum (AI), are activated by alkaline liquids to produce the binder. Hence it is the concrete with no Portland cement.

Objectives :

- To understand properties of geo polymer concrete in order to use it as alternative for Ordinary Portland Cement.
- To draw conclusion on whether geo polymer technology can provide an appropriate alternative for Portland cement.
- Compare the strength of geo polymer concrete having partial replacement of fine aggregates with normal geo polymer concrete.
- Use of plastic waste as construction material and reduce the problems of disposing plastic waste and industrial by products.

METHODOLOGY

Kamlesh. C. Shah sovereign conducted research on strength restrictions and stability and durable of fly ash based Geo polymer concrete. In this study, two concrete mixes are to be controlled out; GPC Mix-1 fly ash concrete and OPC Mix-2 Concrete mix consuming OPC conforming to amount of cementitious material used in GPC Mix-1. Dissimilar attentions were used such as alkaline liquid to fly ash ratio of 0.40 ,0.45 and 0.50, ratio of NaOH to Na2SiO3 2.0 and 2.5, molarities of NaOH; 10M ,12M, 14M and 16M and check the compressive strength. Compressive strength and durability test were achieved under ambient temperature curing he regulate that fly ash based geo polymer concrete have an admirable conflict to sulfate attack, salt attack and acid attack as connected to ambient curing. Minor increase in the mass of

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concrete cube due to preoccupation of sulphuric acid and salt for concrete.

Benny Joseph and George Mathew allotted the steering of mixture contains of aggregate content on the engineering assets of Geo polymer concrete. Impact of other limitations such as curing temperature, dated of curing, ratio of sodium silicate to sodium hydroxide, ratio of alkali to fly ash and molarities of sodium hydroxide were also conversed. Created on the study accepted out, it can be determined that a Geo polymer concrete with appropriate proportioning of whole aggregate content and ratio of fine aggregate to entire aggregate, laterally with the ideal values of other parameters, have better engineering properties than the corresponding properties of ordinary cement concrete. As a consequence can obtain the expansion properties achieved by Geo polymer concrete then ordinary concrete.

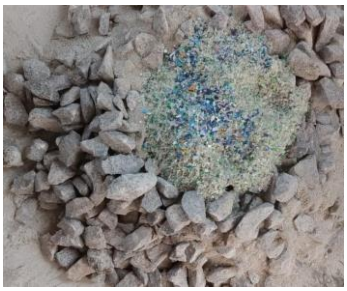
Rashidah Mohamed Hamidi , carried out the impact that Combination of Alkali matrixes intricate consumption of alumino silicate materials and alkali activators as the central starting materials where the preceding could be fly ash, sodium hydroxide (NaOH) and sodium silicates (Na2SiO3) correspondingly. It will be further label the consequence of NaOH attentiveness towards the possessions of fly ash based alkali formation. The stimulus of NaOH attentiveness in the range of 4 M to 18 M was analytically studied using Fourier Convert Infrared Spectroscopy (FTIR) for structural elucidation, Scanning Electron Microscope (SEM) to detect the morphology and purpose of the mechanical assets flexural strength was approved out by Universal Testing Machine. Based on the consequences achieved, the optimal NaOH attentiveness (12 M) at which alkali revelations the best mechanical possessions was attained.

Urvashi Khandelwal, during this study, cement has remained and replaced by fly ash and the assets such as compressive strength, sulphur resistance, acid conflict, water absorption, sorptivity and chloride attack have been considered. Class F fly ash has sustained and Geo polymer concrete was heat cured for 24 hours under 75◦C. It was distinguished that use of Geo polymer concrete not only regulate its greenhouse gas but conjointly increases its strength and resistivity to detrimental acids sulfuric acid attack also causes deficiency in the compressive strength of Alkali concrete; the extent of degradation be contingent on the absorption of the acid fortitude and the amount of exposure.

Abdul Aleem and Arumairaj, projected an optimal mix for the alkali concrete. They conveyed that the alkali concrete accessible high demonstration with reverence to the strength and that high early strength was attained in the alkali concrete mix. The increase in proportion of fine aggregates and coarse aggregates increased the compressive strength up to the optimal level.

Alexandre Rodrigue , Josée Duchesne, For an suitable air void system, good mechanical belongings and low permeability micro exceedingly in alkali activated binder systems, appropriate slag fly ash proportioning, water and admixture substances are needed. Air entraining admixture quantities of up to 10 times the optional dosage were necessary to obtain minimal air void properties similar to what is needed for normal Portland cement concretes subjected to freezing conditions. Collective added water caused in emergent absorption and decreasing crack counts in concrete. Increasing fly ash insulation resulted in increasing preoccupation and decreasing early age crack counts. Increasing both added water and fly ash content caused in less autogenously shrinkage.

GEOPOLYMER CONCRETE WITH PLASTIC REPLACEMENT 2019 DEPARTMENT



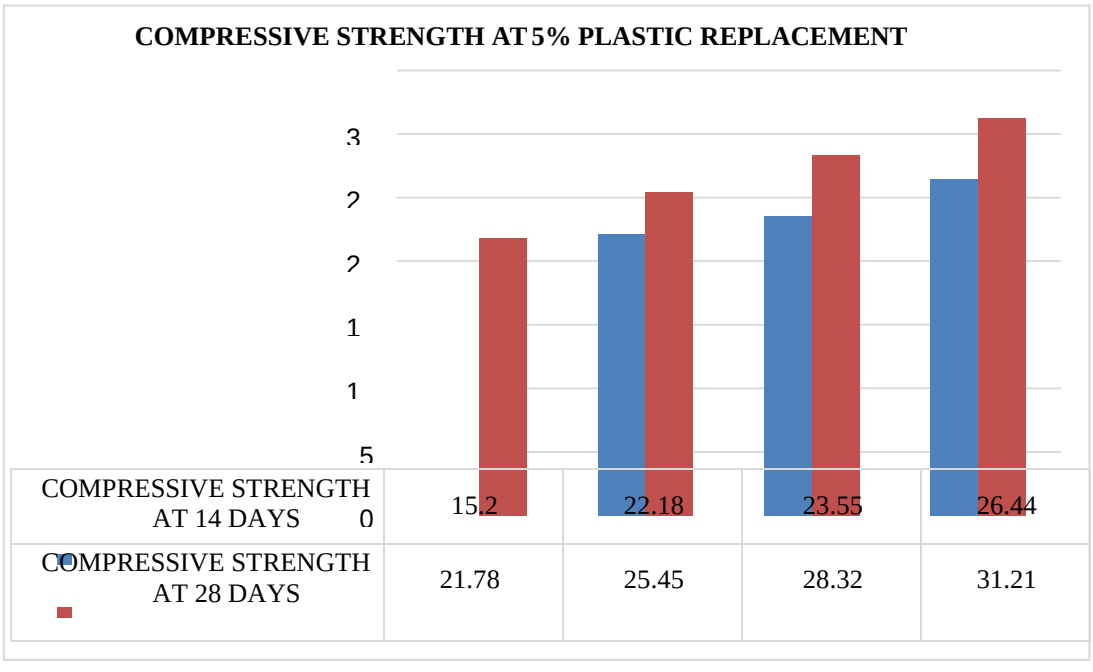


Figure 6.2 : mixing of hand

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RESULTS AND DISCUSSION :

Compressive strength

The compressive strength of fly ash based Geo polymer concrete specimen with GGBS 10,20,30,40% replacement and different percentages replacement of plastic for 14 days and 28 days.

Test results for Compressive strength of Geo polymer concrete Mix	Partial replacement of fine aggregates with plastic (in percentages)	Average compressive strength for 14 days (in Mpa)	Average compressive strength for 28 days (in Mpa)
F90G10	100% sand	14.95	19.43
95% sand + 5% plastic	15.2	21.78	
90% sand + 10% plastic	14.13	18.31	
85% sand + 15% plastic	12.93	17.12	

Graph 7.3 Comparison between Compressive strength at 14 days and 28 days with 5% replacement

CONCLUSIONS

1. The strength of geo polymer concrete at 5% replacement of fine aggregates with plastic increased as compared to that of geo polymer concrete with zero percentage replacement of fine aggregates.
2. As the percentage of replacement of fine aggregates increases after 5% the strength of geo polymer concrete decreases. So it is advisable to replace plastic up to 5%.
3. Geo polymer concrete with 100% replacement of fine aggregates couldn't attain proper strength (i.e. we got 4.5 Mpa) hence complete replacement will not be possible.

FUTURE SCOPE :

Ground Granulated Blast Furnace slag based Geo polymer concrete can be investigated with other source materials which include rice husk ash, kaolinite clays etc. Development of high strength geo polymer concrete manufactured with silicates and hydroxides of potassium can be tested and effect of high strength in flexural behavior can be study. More usage in real constructions can be implemented. Plastic which is one of the reasons for global changes can be reduced by using again in geo polymer concrete. Geo polymer concrete which is already green by addition of plastic it will be best solution for global and climatic changes by producing less carbon as cement is not used, by reducing the disposal problems of industrial by products and by reusing plastic as a construction material.

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