An Experimental Study on Geopolymer Concrete With Convention Concrete -A Review

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Abstract- *The aim of this investigation is to compare convention concrete and micropozz Geopolymer concrete containing silica fume and polypropylene fiber. The main objective of Geopolymer concrete is to reduce a carbon dioxide emission by reducing use of cement. The main purpose of this type of concrete is to achieve higher Compressive strength and Flexural strength of the high durable concrete. Due to silica fume & micropozz, concrete can achieve high compressive strength and polypropylene fiber can improve the flexure strength of concrete. In the experimental work changes the percentage of silica fume 0%,3%,6%,9% and 12% with replacement of classified class Fly ash in geopolymer concrete.*

Keywords- Geopolymer, Micropozz, silica fume

I. INTRODUCTION

Geopolymer concrete is an innovative construction material which shall be produced by the chemical action of inorganic molecules. Otherwise geopolymer is an inorganic alumino- hydroxide polymer synthesized from predominantly silicon (Si) and aluminium (Al) materials of geological origin or byproduct materials such as fly ash Waste Fly Ash from Thermal Industry + Waste water from Chemical Refineries = Geopolymer concrete.

Generally, materials containing mostly amorphous silica (SiO2) and alumina (Al2O3) are the source for geopolymer production. Naturally available materials like kaolin , natural puzzolana and Malaysian marine clay , treated minerals like metakaoline and waste materials like fly ash ,Construction waste , red clay brick waste , fly ash and rice husk-bark ash, fly ash and blast furnace slag etc can be used. Many different materials have already been investigated and used as the binder in geopolymer concrete mixes, including:

- Low calcium fly ash (Class F fly-ash)
- High calcium fly ash (Class C fly-ash)
- Calcined kaolin or metakaolin
- Natural minerals containing Al and Si
- Silica fume
- Slag
- Red mud
- Albite
- Polypropylene fiber
- Silica fume

II. LITERATURE REVIEW

1. M. Rostami and K. Behfarnia (2016) presented the effect of substitution the slag silica fume on compressive strength and permeability of alkali activated slag concrete. Alkali activated slag concrete with a proper mixture shows superior mechanical properties and durability compared to traditional normal Portland cement concrete. This research was carried out to examine the effect of using silica fume on permeability of alkali activated slag concrete by substitution of three levels of silica fume including 5% weight, 10% weight and 15% weight of slag. The effects of two types of curing conditions including water curing and curing under plastic cover were also examined. Short term and final water absorption, penetration of chloride ion and depth of penetration of water were measured to examine the permeability. The results showed that the application of silica fume could increase compressive strength and reduce the permeability of alkali activated slag concrete and water curing was the most appropriate type of curing.

2..MukundLahotiet. Al(2017) presented an innovative way to utilize alkali-silica reactive (ASR) rocks as a natural resource to produce high strength geopolymer binder. Excavation of rocks has produced large quantities of sedimentary rocks. These rocks, however, cannot be used for ordinary cement concrete production duo to their ASR reactivity. They have classified the rocks based on petrography into four types based on their grain size and color and then converted to power form in a sequence of steps. The rock powers were used to synthesize geopolymers by replacing metakaolin in different replacement ratios. Results shows that geopolymer binder with 67% wt rock power and only 33% metakaolin can achieve a high compressive strength of 80 MPa. Moreover, a significant observation was that the incorporation of sedimentary rock power enhanced the compressive strengths by 15-30% as compared to those reported for pure metakaolingeopolymers.

3.Abdul Awal et Al. (2017) presented the potential use of waste polypropylene carpet fibers and highlights the impact resistance and mechanical properties of concrete with the fibers. Six volume fraction varying from 0 to 1.25% of 20 mm long carpet fibers were used with ordinary Portland cement (OPC) concrete mixes. Another six mixes were made where OPC was replaced by 20% palm oil fuel ash (POFA) as supplementary cementing material. It has been found that the addition of polypropylene carpet fibre decreased the slump values and increased the VeBe time of fresh concrete. The inclusion of carpet fibre to either OPC or POFA concrete mixes did not improve the compressive strength at early ages. At later ages, however, the compressive strength of the mixtures containing POFA significantly increased and the obtained values were higher than that mixes with OPC alone. At the end it was concluded that waste carpet fibres and palm oil fuel ash can be used as building materials in the construction of sustainable concrete.

4.Ankur Mehta and RafatSiddique (2017) presented the sulfuric acid resistance of fly ash based geopolymer concrete blended with an additional calcium source. Ordinary Portland Cement (OPC) was added as additional calcium in the geopolymer system as fly ash replacement (0, 10, 20 & 30%). The specimens were exposed to 2% sulfuric acid solution up to the age of 365 days.The results indicate that the inclusion of OPC (as fly ash replacement) improves the compressive strength of fly ash based geopolymer concrete specimens significantly whereas it did not have a similar effect on its resistance to sulfuric acid.For the specimens exposed to sulfuric acid for 365 days, the inclusion of OPC at 10% showed the maximum retained compressive strength of around 52% of the strength value achieved for unexposed specimens at the same age. However, OPC inclusion beyond 10% decrease the ability of geopolymer concrete specimens to retains compressive strength.

5.ManasSarkar et Al. (2017) presented the structural performance of nano-silica modified fly-ash based geopolymer concrete. The fly ash based geopolymer concrete generally requires heat activation of different temperatures, which has been considered as an important limitation for its practical application. Such limitation can be overcome by the addition of appropriate amount of nano-silica in the mixture. Therefore, a fly ash based geopolymer concrete can be developed 6% nano-silica replacing fly ash.The structural performance of such geopolymer concrete in terms of bond strength, flexural strength and micro structural behavior has been explored. Such nano-silica modified fly ash based geopolymer concrete shows improvement in structural behavior at different ages without any hear activation.Results shows excellent mechanical strength compared to conventional heat cured geopolymer concrete and OPC concrete. The flexural strength of reinforced beam and bond strength of reinforcing bars were higher than the heat activated geopolymer concrete. .

III. CONCLUSION

On the basis of the above study following conclusion are obtained,

- Geopolymer concrete has the potential to Ssubstantially curb CO2 emissions.
- Silica fume increase the strength of geopolymer concrete in early age.
- Geopolymer concrete gives batter strength as compare to convention concrete.
- In geopolymer concrete different type of material are used, in which silica fume is gives batter compressive strength in early age.
- Polypropylene fiber increase the tensile strength of concrete.

IV. OBJECTIVE OF STUDY

- To understand properties of geopolymer concrete in order to use it as alternative for Ordinary Portland Cement.
- To establish the economical, technological and environmental benefits of geopolymer binders over Ordinary Portland Cement.
- To verify the improvement of properties like compressive strength, tensile strength, flexural strength by using geopolymer binders instead of OPC.
- To draw conclusion on whether geopolymer technology can provide an appropriate alternative for Portland cement.

V. SCOPE OF WORK

- Geopolymer concrete is an innovative material and a real alternative to conventional Portland cement for use in transportation infrastructure, construction and offshore applications.
- Geopolymer cements cure more rapidly than Portland based cements. They gain most of their strength within 24 hours. However, they set slowly enough that they can be mixed at a batch plant and delivered in a concrete mixer.
- Geopolymer concrete can be proved economical and also eco-friendly. In today’s time, this technology is being used widely used in USA, Europe and Australia. It is being used for railway sleepers,

electric power poles, road pavements, cement mortar, marine structure and waste containments.

The current trends of research is under way to develop geopolymer systems that create a low embodied energy, low carbon dioxide binder that has similar properties to Portland cement.

REFERENCES

[1] M. Rostami and K. Behfarnia (2016) " The effect of Silica Fume on the Durability of alkali activated slag oncrete".Dept.ofCivil.Engineering ,Isfahan University of Technology, Isfahan 84156-8311, Iran.

[2] MukundLahotiet. Al(2017) "use of Alkali-silica reactive sedimentary rock powder as a resource to produce high strength geopolymer binder".School of Civil and Environmental Engineering, Nanyang Technology University, Singapore 639798, Singapore.

[3] Abdul Awal at Al. (2017) "Use of alkali-silica reactive sedimentary rock powder as a resource to produce high strength geopolymer binder" School of Civil and Environmental Engineering, Nanyang Technological University, Singapore 639798, Singapore

[4] Ankur Mehta and RafatSiddique (2017) "Sulfuric acid resistance of fly ash based geopolymer concrete" Civil Engineering Department, Thapar University, Patiala 147004, India

[5] Ping Duan, Chunjie Yan, Wei Zhou "Compressive strength and microstructure of fly ash based geopolymer blended with silica fume under thermal cycle". Faculty of Materials Science and Chemistry, China University of Geosciences, Wuhan 430074, China Engineering Research Center of Nano-Geomaterials of Ministry of Education, China University of Geosciences, Wuhan 430074, China