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EVALUATION PROPERTIES OF GEOPOLYMER CONCRETE BY USING ARTIFICIAL FIBER

Ahire. R. N[01],Hembade A D[02], Hembade V M [03]
Bhavsar K .M [04], Labhade. M. [05]

[01] Lecturer in Department of Civil Engineering,
Santosh N. Darade Polytechnic, Maharashtra State Board of Technical Education, Babhulgaon (Yeola)-423401, Maharashtra, India.
[02,03,04,05] Students in Department of Civil Engineering,
Santosh N. Darade Polytechnic, Maharashtra State Board of Technical Education, Babhulgaon (Yeola)-423401, Maharashtra, India.
[06] Technical Assistant in Department of Civil Engineering, Santosh N. Darade Polytechnic, Maharashtra State Board of Technical Education, Babhulgaon (Yeola)-423401, Maharashtra, India.

Abstract
The present study is to investigate the basic fresh and hardened concrete properties of flyash based geopolymer concrete admixed with polypropylene fiber and compare to the conventional geopolymer concrete (without fiber). The fly ash based geopolymer is tested in two phase, one in fresh concrete phase where flow properties are determined after which hardened concrete is tested for its comprehensive strength. Also, the objective effectively extended to study the strength gain pattern in ambient curing condition. The strength is measured between 3 day to 28 days. The observed results are then converted into a data set, and an artificial neural network model is created out of the collected results using levenberg-marquaedt algorithm. The model istrained, validated and tested. Then the predicted value is compared with the actual value. This study proves that polypropylene fiber has enhancing.

Keywords-Fiber Reinforced, Geopolymer concrete, Fracture Toughness, Mechanical properties.

Introduction
In the past few years, many research and modification has been done to produce concrete which has the desired characteristics. Concrete is one of the most common materials used in the construction industry. Concrete is the one of the oldest and most utilized construction materials in the world. It might be due to Mouldability, availability of ingredients, utilization of local materials, ease in construction, and low cost of production. Every year the production of Portland cement is increasing with the increasing demand of construction. Therefore the rate of production of carbon dioxide released to the atmosphere during the production of cement is also increasing. Each ton of Portland cement release a ton of carbon dioxide into the atmosphere. The greenhouse gas emissions from the production of Portland cement is about 1.35 billion tons annually, which is about 7%of the total greenhouse gas emissions. On the other side, fly ash is the waste materials of coal based thermal power plant, available abundantly but pose disposal problem. Several hectors of valuable land is acquired by thermal power plants for the disposal of fly ask. As it is light in weight and easily flies, creates severe health problems like asthma, bronchitis, etc.
In the geopolymer concrete we are introducing artificial fiber.
A development of geopolymer concrete with fibre can provide a solution to produce greener concrete for sustainable development. Major parameters which influenced the strength of geopolymer are type and concentration of alkaline Activators, optimum percentage of fibre, silica and alumina content, fineness and quality of fly ash, water-to-geopolymer binders ratio by mass, solution to fly ash ratio by mass, type of curing, temperatures and its duration. Alkaline solution plays major role in the activation process which reacts with silica and aluminum present in fly ash. There for, in the present work, effect of solution to fly ash ratio at different quantity of fibre on flow and comprehensive strength of geopolymer concrete for all other parameters maintained constant were investigated.

- **Geopolymer**

Geopolymer is an inorganic alumino-silicate polymers synthesized from silicon and aluminum materials of geological origin or by products materials such as fly ash.Geopolymer based materials are environmental friendly, and need only moderate energy to produce. They can be made using industrial by products, such as fly ash, as the source material. In geopolymer concrete the geopolymer paste serves to bind the coarse and fine aggregate and any unreacted material. Geopolymer concrete can be utilized to manufacture pre cast concrete structural and non-structural elements, to make concrete pavement, to immobilize toxic wastes and to procedure concrete products that are resistance to heat and aggressive environment.

- **Fibre**

Fibres are man made fibre and natural fibre consequently of petrochemical, textile industrial activity and jute as a natural fibre. Fibre are used for reinforcing concrete derives from mix design of geopolymer concrete and ordinary concrete. There are various researches to improve on naturally occur in fibres. The raw materials derived from petroleum based chemicals. These materials are Polymerized into a long, linear chemicals that wants adjacent carbon atoms. Synthetic fibre and natural fiber that have been experimented in Portland cement concrete materials included the industrial activity material and naturally occurring jute. Research and field application of these fibres depended mainly of there availability while those that have found commercial applications have been object of extensive reporting. This research will be focused on the use of man made fibre and natural fibre to improve concrete strength.

Applications of fibre in reinforced concrete is continuously growing in various application fields. It is widely used in structure. Due to the property that fibre enhance toughness of concrete, it is used on large scale for structural purpose. The fibre is described by a convenient parameters called aspect ratio. The aspect ratio of the fibre is the ratio of it's length to its diameter. The principal motive behind in corporating fibres into a cement matrix is to increase the toughness And tensile strength and improve the cracking deformation characteristics of the resultant composite. For FRC to be a valuable construction materials, it must be able to compete economically with existing reinforcing system. FRC composite properties, such as crack resistances, reinforcement and increase in toughness are dependent on the mechanical properties of the fibre, bonding properties of the fibre and matrix, as well as the quantity and distribution within the matrix of the fibres.

LITERATURE REVIEW

B. V.Rangan- carried out study of the effects of mixture composition on the comprehensive strength of fly ash based geopolymer concrete. Test results show that water to sodium oxide (H2O-to-Na2O) molar ratio and the water to geopolymer solids ratio by mass influence the compressive strength of fly ash based geopolymer concrete . The compressive strength decrease when these ratios increase. However, the sodium oxide-to-silicon oxide (Na2O-to-SiO2) molar ratio of the geopolymer mixture does not have any significant effect on the compressive strength within the range of 0.095 and of 0.120 of this ratio.

S. S. Jamkar- studied the effects of fly ash fineness on the compressive strength of geopolymer concrete. Geopolymer concrete was produced by activating fly ash with a highly alkaline solution of sodium silicate containing 16.45% Na2O, 34.35% SiO2 and 49.20% H2O and 13 molar sodium hydroxide solutions. Concrete cubes of 150 mm were cast using five sample of fly ash with Blaine fineness of 542,430,367,327,265 m square per kg and solution to fly ash ratio of 0.35 . The specimens were cured in an oven for 4,8,12,16 and 24 hours at 90 degree C . The compressive strength results show that the fly ash fineness plays a vital role in the activation of geopolymer concrete. An increase in the fineness increased both Workabillity and compressive strength. It was also observe that finer particles resulted in increasing the rate of reaction needing less heating time to achieve a given strength.

S. V. Patankar- examined that geopolymer was a new invention in the world of concrete in which cement is totally replaced by Pozzolanic material that is rich in silica and alumina like fly ash ashand activated by alkaline liquids to act as a binder in the concrete. Experimental investigation has been carried out to study the effects of water to geopolymer binder ratio on Workabillity in terms of flow and comprehensive strength tested after heat curing in oven at 90 degree C for 8 hours duration. Activated liquid to fly ash ratio of 0.35 by mass was maintained constant on the basis of past research. Sodium silicate solution with Na2O -16. 37%, SiO2-34. 35%and H2O-49.28% and 13 mole concentrated sodium hydroxide solution were used as alkaline Activators. Test results show that the flow of geopolymer

concrete increase with increase in the water to geopolymer binder ratio. But the compressive strength decrease with increase in water to geopolymer binder ratio similar to water/cement ratio in cement concrete.

METHODOLOGY

Opening remark- The main purpose of the study is to evaluate the effects on the geopolymer concrete and ordinary concrete due to addition of natural and artificial fiber. Mainly the study is concerned on the strength property.

Objective of study

1. To study the effects of natural & artificial fibre in geopolymer concrete.
2. To find optimum percentage of artificial fibre.
3. Compressive study of artificial fibre in geopolymer concrete with conventional geopolymer concrete.
4. To achieve economy by use of fibre in geopolymer concrete.
5. To study the effect of addition of steel fibre on the compressive strength of geopolymer concrete composites.

Experimental work

1. In order to conduct test various materials such as artificial fibre, fly ash, are required.
2. For requirements of quality of material the various test on materials was taken.
3. The mix design of geopolymer concrete and ordinary concrete are prepared.
4. Various tests taken on the casted materials.

Advantages

1.High early strength.
2.less consumption of natural resources
3.cost effective ness
4.Capacity to form different structural configuration.

Disadvantages

1.high construction cost
2.high shrinkage and a fast curing process.

Material used

1. Cement

Test on ccement

- **Fineness of cement:**

1. Purpose: To know the quality of course material present in cement sample.

2. IS Recommendation: As per Is 269-1976 the fineness of cement should not exceed 10% by weight incase of opc. It should not exceed 5% for rapid hardening cement.

3.Result : Fineness of cement- 6%

- **Water absorption of fine and course aggregate:**

1. Purpose:To calculate percentage of absorbed water and able to decide water cement ratio .
2. IS Recommendation: As per IS 2386-1963 the ratio of the increase in weight to the weight of the dry sample expressed as percentage known as water absorption.
3. Result: water absorption of fine &course aggregate- 0.3009%

- **Fineness modulus of Fine aggregate:**
  1. Purpose:To determination of the fineness modulus consist of dividing a sample of aggregate into different sizes by sieving through a set of standard test sieves taken in order.
  2. IS Recommendation:As per IS 383-1970
  3. Result:The fineness modulus of fine aggregate is- 510.8%

EXPERIMENTAL PROGRAM

1) Physical and chemical properties of fly ash and alkaline solution.
2) .Batching , Mixing and casting of M25 grade concrete specimen.
3) Test to be conducted on harden concrete specimen: compressive strength by beam model at the ages of 7 to 28 days.

Test	**Specimen** (mm×mm)	**Number of Specimen**		
		0.25%	0.5%	1%
Compressive Strength	Cube (150×150×150)	3	3	3
Flexural Strength	Beam (150×150×700)	3	3	3

Testing of cubes

CONCLUSION

Geopolymer concrete is more environmental friendly and has the potential to replace ordinary cement concrete in many applications. The GPC has good Workabillity and cohesiveness and it'setting time is similar to that of OPC. Compressive strength of the FRGPC cured under ambient conditions, increase in value from 7 and 28 days. Crimped end steel fibre bond very well with GPC and also improve the tensile strength. The FRGPC possess good compressive strength and well suited to structural applications. Geopolymer also exhibit similar or superior engineering properties compared to cement.

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