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EXPERIMENTAL INVESTIGATION ON GEOPOLYMER CONCRETE WITH E-WASTE

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ABSTRACT

The major problem the world is facing today is the environmental pollution. Mainly in the construction industry the production of Portland cement causes the emission of pollutants that causes serious threat to the environment .The pollution effects on environment can be reduced by increasing the usage of industrial by-products in our construction industry. Geo-polymer concrete in the present study, to produce the geo-polymer concrete the Portland cement is fully replaced by fly ash and GGBS (Ground granulated blast furnace slag). The alkaline liquids are used for the activation of these materials. The alkaline liquids used in this study are the solutions of sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3). Molarity of sodium hydroxide (8M) is considered. Fly ash and GGBS were used in this study such as 90% fly ash and 10% GGBS. Rapid growth of technology and a high rate of obsolescence in the electronics industry have led to one of the fastest growing waste streams in the world, simply called as E-waste. Improper disposal of E-waste can cause serious threats to human health and environment. The present study covers the use of E-Waste as partial replacement in fine aggregate in geopolymer concrete. The main aim of this study is to investigate the change in mechanical properties of geopolymer concrete with E-Waste in concrete. And also to reduce as far as possible the accumulation of used and discarded electronic and electrical equipments. In this investigation were made with replacement of sand by using e-waste are 0%,10%,20%,30%,40% and 50%. Further the strength characteristics of cubes, beams and cylinder of geopolymer concrete with E-waste of varying mix ratios can be carried out.

Keywords— Fly ash, GGBS, E-Waste, Sodium hydroxide, Sodium silicate, Molarity, Super Plasticizer and Geopolymer concrete.

I. INTRODUCTION

Concrete is the most widely used construction material in the world. Ordinary Portland Cement (OPC) has been traditionally used as the binding material for concrete. The manufacturing of OPC requires the burning of large quantities of fossil fuels and decomposition of limestone which results in significant emissions of carbon-di-oxide (CO2) to the atmosphere. This CO2 emission is the main cause for global warming, which have become a major concern. In order to reduce this, Geopolymer technology was introduced.

1.2 Geopolymer Concrete

The term 'Geopolymer' was used by Professor Davidovits in 1978 to describe the inorganic alumino-silicate polymeric gel resulting from reaction of amorphous alumino-silicates with alkali hydroxide and silicate solutions. Unlike ordinary Portland cement, Geopolymer do not form calcium silicate hydrates for matrix formation and strength but utilize the polycondensation of silica and alumina to attain strength. Two main constituents of Geopolymers are source materials and alkaline liquid. The source material should be alumino-silicate based and rich in both silica and alumina. In Geopolymer concrete, supplementary cementing materials such as Fly ash, Silica fume, Rice husk ash , Ground Granulated Blast furnace Slag (GGBS) and metakaolin are used as alternative binders to Portland cement. In this project, Fly ash and Ground Granulated Blast furnace Slag (GGBS) are used as alternative binders.

Geopolymer is an excellent alternative which transform industrial waste products like GGBS and fly ash into binder for concrete. Geopolymer binders are used together with aggregates to produce geopolymer concrete. They are ideal for building and repairing infrastructures and for pre-casting units, because they have very high early strength. Their setting times can be controlled and they remain intact for very long time without any need for repair. Geopolymer, with properties such as abundant raw resource, little CO2 emission, less energy consumption, low production cost, high early strength and fast setting.

II. LITERATURE REVIEW

2.1 General

Significant amount of work on Geopolymer concrete is reported by many researchers. A few of them is reviewed in this chapter. **B.V.Rangan(2008)** and his team of Curtain University of Technology, Perth, Australia have carried out many research on geopolymer concrete using fly ash as a precursor.

2.2 Review On Geopolymer Materials

Shankar H. Sanni (2012) examined the performance of geopolymer concrete under several environmental condition. Durability of specimens were assessed by immersing GPC specimens in 10% sulphuric acid and 10% magnesium sulphate solutions separately, periodically monitoring surface deterioration and depth of dealkalization, changes in weight and strength over a period of 15, 30 and 45 days. The test results indicate that the heat-cured fly ash-based geopolymer concrete has an excellent resistance to acid and sulphate attack when compared to conventional concrete. Thus the production of geopolymers have a relative higher strength, excellent volume stability and better durability.

Voraa et al. (2013) reported on parametric studies on compressive strength of geopolymer concrete. The experimental work conducted by casting 20 geopolymer concrete mixes to evaluate the effect of various parameters affecting its the compressive strength in order to enhance its overall performance. The test results shown that compressive strength increases with increase in the curing time, curing temperature, concentration of sodium hydroxide solution and decreases with increase in the ratio of water to geopolymer solids by mass and admixture dosage respectively.

Gupta (2015) studied the effect of concentration of sodium hydroxide, temperature, and duration of oven heating on compressive strength of fly ash based geopolymer mortar. Geopolymer mortar mixes were prepared by considering alkaline liquid-to-fly ash ratio of 0.35, 0.40, and 0.45. The temperature of oven curing was maintained at 40, 60, and 120°C each for a heating period of 24 hours and tested for compressive strength at the age of 3 or 7 days as test period after specified degree of heating. Test results shown that the workability and compressive strength both increase with increase in concentration of sodium hydroxide solution for all solution-to-fly ash ratios.

Gupta et al. (2015) carried out on the application of recycled coarse aggregates and e-waste for pavements with low traffic. Huge quantities of construction wastes, demolition, and electronic wastes are being generated these days in many of the countries and the disposal of them has become a serious problem. This study is an integrated experiment in which different combinations of e-wastes and recycled coarse aggregate together are used as a substitute of conventional aggregate. Recycled aggregates from site-tested concrete specimens were collected and are integrated with the e-waste by altering the proportions of these wastes.

III. METHODOLOGY

The methodology clearly shows the process which have been carried out in this work. The step by step process of this project is explained in the flow chart. The process includes the determination of material properties and obtaining the mix proportions.

Collection of Literatures

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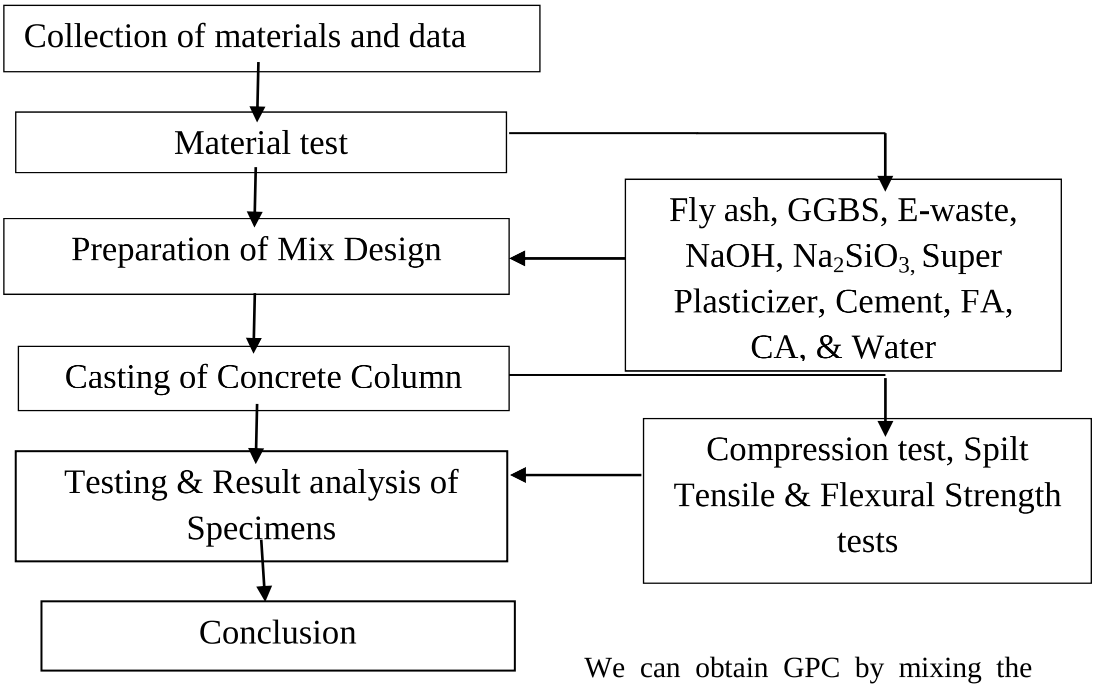


IV. MATERIAL PROPERTIES

4.1 General

The materials used in making the Geopolymer concrete and the methodology are described in this chapter. The chemical properties of fly ash and alkaline activators are presented.

4.2 Materials Used

The materials used in making the Geopolymer concrete and concrete are listed below.

- Fly ash
- Granulated Blast furnace Slag (GGBS)
- Alkaline activators
- Super plasticizer
- Fine aggregates
- Coarse aggregates
- E-waste

We can obtain GPC by mixing the above mentioned substances with various mix design. These are all based on trial mix and there is no specified codal provision. Through the strength obtained from the trail mix, we can easily find out the exact "mix", from the given specified strength.

4.2.1 Fly Ash

Fly ash is the waste obtained as a residue from burning of coal in furnaces and locomotives. It is obtained in the form of powder. It is a good pozzalona the colour of fly ash is either grey or blackish grey. The size of the fly ash generally varies between silty sand and silty clay. The chemical composition is mainly composed of the oxides of silicon (SiO2), aluminium (Al2O3), iron (Fe2O3), and calcium (CaO), whereas magnesium, potassium, sodium, titanium, and sulphur are also present in a lesser amount.Fly ash plays the role of an artificial pozzolana, where its silicon dioxide content reacts with the calcium hydroxide from the cement hydration process to form the calcium silicate hydrate (C-S-H) gel. The spherical shape of fly ash often helps to improve the workability of the fresh concrete, while its small particle size also plays as filler of voids in the concrete, hence to produce dense and durable concrete. The pH of fly ash contacted with water range from 8 to 12.

TABLE 4.1 CHEMICAL

COMPOSITION OF FLY ASH

CHEMICAL COMPOSITION	PERCENTAGE
CaO	30-50
SiO2	28-38
Al2O3	8-24
MgO	1-18

CHEMICAL COMPOSITION	PERCENTAGE
Silica	55-65
Aluminum oxide	22-25
Iron oxide	5-7
Calcium oxide	5-7
Magnesium oxide	<1
Titanium oxide	<1
Phosphorous	<1
Sulphates	0.1
Alkali oxide	<1
Loss of ignition	1-1.5

4.2.2 GROUND GRANULATED BLAST FURNACE SLAG (GGBS)

Granulated Blast furnace Slag (GGBS) is obtained by quenching molten iron slag (a by-product of iron and steel making) from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and ground into a fine powder.

It is a granular product with very limited crystal formation, is highly cementitious in nature and ground to cement fineness, hydrates like portland cement (Admixtures and ground slag 1990; Lewis 1981; ACI Comm. 226 1987a). ASTM C 989-82 and AASHTO M 302 were developed to cover ground granulated blast furnace slag for use in concrete and mortar. The three grades are 80, 100, and 120.

Most GGBS is a by-product from the blast-furnaces used for manufacturing iron. The way of its production is that the blast-furnaces are fed with carefully controlled mixtures of iron-ore, coke and limestone, with temperatures of about 1500^o C. The slag is rapidly put out in volumes of water. The process of putting out improves the cementitious properties and produces granules similar to coarse sand particles. The ‘granulated slag’ is become dry and ground to a fine powder that is called GGBS . It has off-white colour and a bulk density of 1200 kg/m^3.

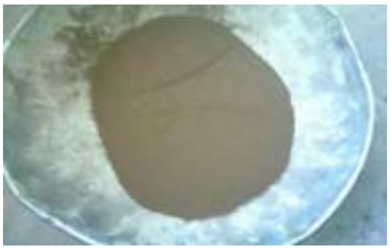


FIG 4.2 GGBS

TABLE 4.3 CHEMICAL PROPERTIES OF GGBS

4.2.3 Alkaline Activators

The combination of Sodium hydroxide and Sodium silicate is used as the alkaline activator in this study. Alkaline liquids are prepared by mixing of the Sodium hydroxide and Sodium silicate solutions at the room temperature.

FIG 4.3 ALKALINE SOLUTION

4.2.3.1 Sodium Hydroxide And Sodium Silicate

Sodium hydroxide is available in solid state by means of pellets and flakes. The cost of Sodium hydroxide is mainly varied according to the purity of the substance. Since the Geopolymer concrete is homogeneous material, the commercial grade of the Sodium hydroxide of purity 98perent is used.

Sodium hydroxide pellets is used in this study. The Sodium hydroxide pellets are dissolved in distilled water based on the corresponding molarity. The heat is generated when the pellets are dissolved with water. In order to prepare the Sodium hydroxide solution, the molarity should be multiplied with molecular ratio.

FIG 4.4 SODIUM HYDROXIDE PELLETS

COMPOSITION	PERCENTAGE
Carbonate(Na2co3)	2%
Chloride(Cl)	0.01%
Sulphate(so2)	0.05%
Lead(pb)	0.001%
Iron(Fe)	0.001%
Potassium(K)	0.01%
Zinc(Zn)	0.02%

TABLE 4.4 CHEMICAL PROPERTIES OF SODIUM HYDROXIDE

Sodium silicate is also known as water glass or liquid glass. It is available in liquid (gel) form. Silicates were supplied to the detergent company and textile industry as bonding agent.

FIG 4.5 SODIUM SILICATE SOLUTION

TABLE 4.5 CHEMICAL COMPOSITION OF SODIUM SILICATE

COMPOSITION	PERCENTAGE
SiO2	34.52
Na2O	25.88
WATER	39.6

4.2.4 Superplasticizer

Conplast SP430 is a chloride free, super plasticizing admixture based on selected sulphonated naphthalene polymers. It is used where a high degree of workability is required and to facilitate production of high quality concrete of improved durability and water tightness. Normal curing methods such as water spray, wet hessian or a concure curing membrane should be used. Conplast is nontoxic. Any splashes should be washed off with water.

4.2.5 E-WASTE

Rapid technology change, low initial costs have resulted in a fast growing surplus of electronic waste around the globe. Several tones of E-waste need to be disposed per year. Ten states generate 70% of the total e-waste generated in India. E- waste available in the form of loosely discarded, surplus, obsolete, broken, electrical or electronic devices from commercial informal recyclers have been collected which were crushed to the particle size. E- Waste particles can be used as coarse aggregate, fine aggregate, fine filler in concrete depending on its chemical composition and particle size. Reuse of E-waste in concrete has economical and technical advantages for solving the disposal of large amount of e- waste.

FIG 4.6 E-WASTE

TESTS	PERCENTAGE
Specific gravity	2.38
Fineness modulus	2.9

TABLE 4.6 PHYSICAL PROPERTIES OF E-WASTE

4.2.6 FINE AGGREGATE

Fine aggregate is a naturally occurring granular material composed of finely divided rock and mineral particles. In places where sand is not available or large quantity of sand is used, crushed stone dust can be used. The composition of sand is highly variable, depending on the local sources and conditions but the most constituents of sand is silica. The locally available River sand of zone II conforming to the requirements of IS 383 is used.

FIG 4.7 FINE AGGREGATE

SL. NO.	TESTS	RESULTS
1	Fineness	3.8
2	Specific Gravity	2.624
3	Moisture Content	2.4%

TABLE 4.8 PROPERTIES OF FINE AGGREGATE

4.2.7 COARSE AGGREGATE

Coarse aggregates are produced by disintegration of rocks and by crushing rocks. There are available in many different sizes. Coarse aggregates are usually those particles which are retained on an IS 4.75mm sieve. In this project, Coarse aggregate of size 20mm and specific gravity 2.75 is used. Locally available crushed granite stone aggregate is used.

FIG 4.8 COARSE AGGREGATE

TABLE 4.9 PROPERTIES OF COARSE AGGREGATE

V. MIX DESIGN

5.1 Mix Proportion

This chapter defines the mix design

for Geopolymer concrete beams. As the Geopolymer concrete are new construction materials they don't have any standard mix design. To identify the mix ratios for different grades of Geopolymer Concrete the trial and error method is followed. To identify the best mix or optimum mix for the Geopolymer paver block the various parameters and ingredients are varied. The parameters changed in the mix proportions are Density, Molarity and percentage ratio between the Fly ash and GGBS. The density is 2400 kg/m^3. The Molarity or the concentration of sodium hydroxide pellets solution is 8M. And the major parameter is the ratio between the Fly ash and GGBS which is fully replaced for ordinary cement and the percentage is varied in range of 90 percent and 10 percent.

SL. NO.	TESTS	RESULTS
1	Fineness	6.87
2	Specific Gravity	2.7
3	Moisture Content	0.233%
4	Water Absorption	0.4%

5.2 Design Procedure

Concrete mixture design process is vast and generally based on performance criteria. Based on the guidelines for the design of fly ash-based geopolymer concrete have been proposed Hardjito et al (2004) and Rangan (2008). The fly ash based geopolymer concrete consists 75 percent to 80percent by mass of aggregate, which is bound by a geopolymer paste formed by the reaction of the silicon and aluminum within the fly ash and the alkaline liquid made up of sodium hydroxide and sodium silicate solution with addition of superplasticiser. The strength development using two binders was determined. The fly ash and GGBS was varied as 90 percent and 10 percent.

A combination of sodium silicate solution and sodium hydroxide (NaOH) solution can be used as the alkaline liquid. It is recommended that the alkaline liquids prepared by mixing both the solutions together at least 24 hours prior to use. The E-waste particles can be considered as partial replacement of fine aggregate (10 to 50 Percent) substitute retaining the mix ratio as the same.

5.3 Mix Ratio

According to B V Rangan (2010) procedure,
MIX RATIO 1: 90%FLY ASH + 10%GGBS and 100% FA
MIX RATIO 2: 90%FLY ASH + 10%GGBS and 90% FA + 10% E-WASTE
MIX RATIO 3: 90%FLY ASH + 10%GGBS and 80% FA + 20% E-WASTE
MIX RATIO 4: 90%FLY ASH + 10%GGBS and 70% FA + 30% E-WASTE
MIX RATIO 5: 90%FLY ASH + 10%GGBS and 60% FA + 40% E-WASTE
MIX RATIO 6: 90%FLY ASH + 10%GGBS and 50% FA + 50% E-WASTE

5.4 MIX DESIGN FOR M1

MIX RATIO 1: 90% FLY ASH + 10% GGBS and 100% FA
Step 1: STANDARD PARAMETER
Density of aggregate = 2400 kg/m^3
Alkaline liquid to binder ratio = 0.4
Ratio of sodium hydroxide pellets to sodium silicate solution = 2.5

Step 2: CALCULATION OF AGGREGATES
Total volume of aggregate = 77 % of density = (77/100)*2400 = 1848 kg/m^3
Fine aggregate = 30% of total volume of aggregate = 554.4 kg/m^3
Coarse aggregate = 70% of total volume of aggregate = 1293.6 kg/m^3
Step 3: CALCULATION OF BINDER QUANTITY
Alkaline liquid / binder = 0.4
Alkaline liquid = 0.4* binder
Binder quantity + alkaline liquid =2400 – 1848= 522 kg/m^3
Binder quantity + 0.4 binder quantity = 522
1.4 Binder quantity = 52
Binder quantity = 522/1.4
= 394.85 kg/m^3
Mass of fly ash = 394.85 kg/m^3
Fly ash = 90 % of binder quantity
= (90/100)*394.28 =354.85 kg/m^3
GGBS = 10 % of binder quantity
= 39.43 kg/m^3

Step 4: CALCULATION OF ALKALINE QUANTITY

Alkaline quantity = 0.4 * 394.28
= 157.712 kg/m^3
$NaOH + Na_2SiO_3$= 157.712 kg/m^3
We know that, Ratio of sodium hydroxide to sodium silicate solution = 2.5
Na_2SiO_3 = 2.5 NaOH
NaOH +2.5 NaOH = 157.712
NaOH = 45.06 kg/m^3
Na_2SiO_3 = 112.65 kg/m^3.

In Sodium hydroxide solution

Considering 8M concentration where in the solution consists of 26% of NaOH solids and 74% water, by mass
Since the molecular weight of NaOH pellets = 40
For 10M solution = 8*40 = 320
For 1 litre of water, 320gm of NaOH pellets is added
Mass of solids = (0.26*45.06)= 11.71 kg
Mass of water = 45.06 – 11.71 = 33.34 kg

In sodium silicate solution

Mass of water = (0.559*112.64) = 62.96 kg Mass of solids = 112.64 – 62.96 = 49.67 kg

Total mass of water

Mass of water in NaOH solution + Mass of water in Na2SiO3 = 33.34 + 62.96 = 96.3 kg

Total mass of solids

Mass of solids in NaOH solution + Mass of solids in Na2SiO3 +394.28 =45.66 kg

Ratio of water to Geopolymer Solids = (96.3) / (455.66) = 0.21 The alkaline solution to fly ash ratio was 0.4.

Super plasticizer = 1.5% of mass of fly ash = (1.5/100)*394.28
= 5.91 kg/m3

Extra Water	39.4
Liquid/binder ratio	0.40
Water /geopolymer solid ratio	0.21
Super Plasticizer	5.91
RATIO OF MIXTURE PROPORTION	**1:1.405:3.2**

TABLE 5.1 MIX DETAILS FOR GEOPOLYMER CONCRETE

MIX RATIO	BINDER (kg/m^3)		FINE AGGREGATE (kg/m^3)		COARSE AGGREGATE (kg/m^3)	NaOH (8M) (kg/m^3)	Na_2SiO_3 (kg/m^3)
	Fly ash	GGBS	FA	E-Waste			
MIX 1	354.85	39.43	554.4	0	1293.6	45.06	112.64
MIX 2	354.85	39.43	498.96	55.44	1293.6	45.06	112.64
MIX 3	354.85	39.43	443.52	110.88	1293.6	45.06	112.64
MIX 4	354.85	39.43	388.08	166.32	1293.6	45.06	112.64
MIX 5	354.85	39.43	332.64	221.76	1293.6	45.06	112.64
MIX 6	354.85	39.43	277.2	277.2	1293.6	45.06	112.64

TABLE 5.2 MIX PROPORTION

VI. EXPERIMENTAL PROCEDURE

6.1 Preparation Of Geopolymer Concrete

6.1.1 Sodium Hydroxide

Sodium hydroxide pellets are taken and dissolved in water at 8 molar concentration. Sodium hydroxide should be prepared 24 hours prior to use and also if it exceeds 36 hours it terminate to semi solid liquid state. So the prepared solution should be used

with in this time. To find the best molarity various calculations where done. The mass of NaOH solids in solution varied depending on the concentration of the solution expressed in terms of molarity (M).

6.1.1.1 Molarity Calculation

The solids must be dissolved in water to make a solution with the required concentration. The concentration of sodium hydroxide solution can vary in different molar. The mass of NaOH solids in a solution varies depending on the concentration of the solution.

NaOH solution with a concentration of 8 molar consist of 8x40 = 320 grams of NaOH solids per litre of water, where 40 is the molecular weight of NaOH.

6.1.2 Alkaline Liquid

Generally alkaline liquids are prepared by mixing of sodium hydroxide solution and sodium silicate at the room temperature. When the solutions mixed together the both solution start to react with each other there polymerization process take place. It liberate large amount of heat so it is recommended to leave it for about 20 minutes thus the alkaline liquid is ready as binding agent.

6.1.3 Mixing

The fly ash and GGBS is collected and weighed; the fine aggregates with E-waste and the coarse aggregates are batched separately. The sodium hydroxide flakes are prepared for 8 molar in one litre of water. Sodium silicate solution is added in sodium hydroxide and it is kept for 24 hours prior mixing the concrete. Dry mixing is to be done for 3 minutes and wet mixing is to be done for 4 minutes. The mixture is to be mixed thoroughly and properly.

6.1.4 Casting Of Testing Of Specimens

After the fly ash, GGBS and the aggregate were mixed together in concrete pan mixture with the same mix proportions of cubes were casted. When tested for 3 days strength is achieved is good. Hence, the same proportions used for casting cubes, cylinders, beams of standard size and cured for 28 days.

6.1.5 Curing Of Test Sprcimens

After casting the moulded specimens are stored in laboratory at a room temperature for 24 hours. After this period the specimens are removed from the moulds and immediately submerged in clean, fresh water of curing water tank. The specimens are cured for 28 days in present investigation.

6.2 Test On Specimen

6.2.1 Compression Test

The compressive strength of concrete is determined at the age of 7 days and 28 days using cubes. The test was carried out on 150mm x 150mm x 150mm size cube as per IS: 516-1959. A 3000kN capacity standard compression testing machine was used to conduct the test. This is done by putting cement paste and spreading smoothly on whole area of specimen. For the studies on compressive strength, cubes are tested with a replacement of 100% of mass of cement with fly ash.

Compressive strength (N/mm^2) = Crushing load/ Area of cross section

$$\mathbf{Fcy = 4P/\pi d^2\ (N/mm^2)}$$

Where,

P= load at failure (N)

d = diameter of the specimen (mm)

FIG 6.1 COMPRESSIVE STRENGTH TEST

6.2.2 Split Tensile Test

The splitting tests are well known indirect tests used for determining the tensile strength of concrete cylinders also referred as split tensile strength of concrete. The test consists of applying a compressive line load along the opposite generators of a concrete cylinder placed with its axis horizontally. Due to the compression loading a fairly uniform tensile stress is developed over nearly 2/3 of the loaded diameter as obtained from an elastic analysis. The magnitude of this tensile stress fsp is given by the formula (IS: 5816-1970)

$$\mathbf{Fsp = 2P/\pi dl\ N/mm^2.}$$

Where, Fsp = Split tensile strength (N/mm^2)

P = Load at Failure (N)

d = Diameter of the specimen (mm)

l = Length of the specimen(mm)

FIG 6.2 SPLIT TENSILE STRENGTH TEST

6.2.3 Flexural Strength

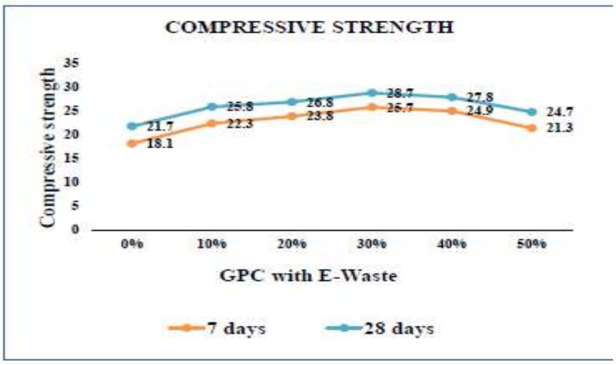
The flexural strength of concrete is usually carried out on a flexural testing prism of size 700 x 100 x 100mm were used to determine the flexural strength. After curing, the specimens were tested for flexural test using a universal testing machine of 2000KN capacity.

FIG 6.3 FLEXURAL STRENGTH TEST

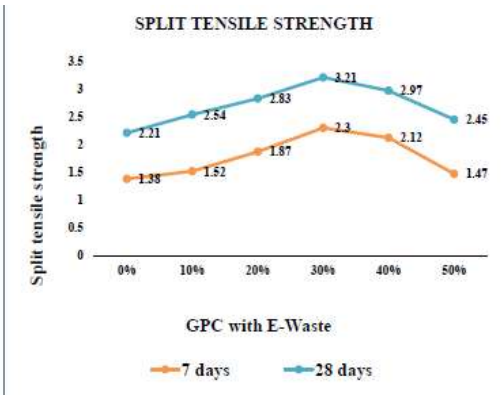
6.3 RESULTS AND DISCUSSIONS

MIX DESIGNATION	COMPRESSIVE STRENGTH		SPLIT TENSILE STRENGTH		FLEXURAL STRENGTH	
	7 days	28 days	7 days	28 days	7 days	28 days
MIX 1	18.1	21.7	1.38	2.21	3.38	4.59
MIX 2	22.3	25.8	1.52	2.54	3.65	4.75
MIX 3	23.8	26.8	1.87	2.83	3.86	4.98
MIX 4	25.7	28.7	2.30	3.21	4.08	5.34
MIX 5	24.9	27.8	2.12	2.97	3.92	5.16
MIX 6	21.3	24.7	1.47	2.45	3.47	4.72

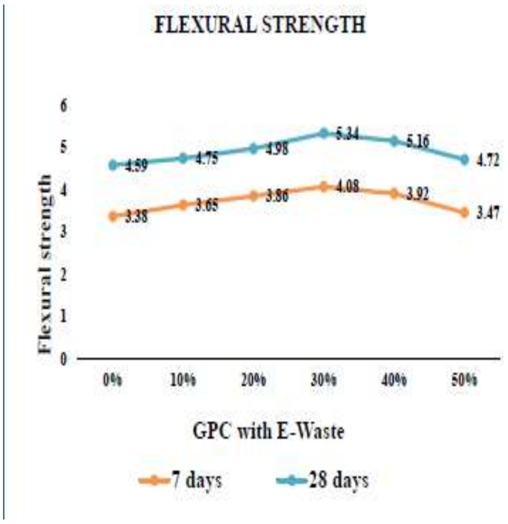
TABLE 6.1 GEOPOLYMER CONCRETE WITH E-WASTE



GRAPH 6.1 COMPRESSIVE STRENGTH



GRAPH 6.2 SPLIT TENSILE STRENGTH



GRAPH 6.3 FLEXURAL STRENGTH

VII. CONCLUSION

The Geopolymer mix planned for this study with replacement of E-Waste found possible and economical based on previous studies. In this study the cement is fully replaced by industrial by-products fly ash and GGBS. The following points are arrived from the present study.From the past studies it has been proved that using E-waste doesn't affect the properties of geopolymer concrete majorly. The initial setting time with 90 percent fly ash + 10 percent GGBS obtained as 19.9 hours The normal consistency obtained at 28 percentage.

- Use of E-waste as partial replacement of fine aggregate is economical. Reuse of E-waste reduces environmental hazards. Partial replacement of E-waste as fine aggregate proved as well graded aggregate. Geopolymer concrete represent as a "Green concrete" and also as a "Eco-friendly concrete" as it reduces the CO2 emission in the world. Partial replacement of E-Waste may use as a recent technique of disposal of non-metallic E-Waste.

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