TENSILE STRENGTH OF GEOPOLYMERIC CONCRETE

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Abstract:- Geopolymer, a novel binder, a type of inorganic polymer synthesized from room temperature and is also used as binder for complete replacement of Ordinary Portland cement (OPC). The main objective of this research work is to study the comparative tensile behavior of precast cylinders packed / cast in both types of conventional OPC mortar/geopolymer mortar. The sizes of the cylinder were fixed at 300mm long, 150mm diameter. Comparative tensile performance shows geo-ferrocrete cylinders have good tensile behavior compared with Ferrocement cylinders.

Keywords: - **:**Geopolymer, sodium hydrauxide, sodium silicate.

Introduction: - Increased awareness regarding the bad effects of the over exploitation of natural resources, Eco-friendly technologies are for effective management of these resources. Construction industry uses of the natural resources like cement, sand, rocks, clay and other soils. The increasing cost of the usual ingredients of concrete imposes the limit of construction hence it forces the engineer to rethink about the construction material that he is using. And, because of industries of energy production, steel manufacturer and transportation has been responsible for the production of large amounts like fly ash, blast furnace slag, silica fume and quarry dust with consequent disposal problem.

OBJECTIVE

1. To make cylinder of dimensions 300mm and 150mm dia and find its tensile strength compressive strength and tensile strength so that it can be effectively used in partition wall
2. Reduce the use of cement as well as water in construction of deferent building units.
3. Use of waste that is extracted from boiler that is fly ash.

SCOPE OF STUDY-

1. The work involves building unit that is less in dimension and long term use of walling unit.
2. Most of the work would be done by changing the size and molarity of the cylinder and geo polymer concrete respectively

MATERIAL USED AND METHODOLOGY OF TESTS

FLY ASH- The process under heat of harder, older anthracite and bituminous coal produces Class F fly ash. Class F fly ash is pozzolanic material, and contains less than 10 to 12% lime (CaO). The silica and alumina of Class F type fly ash requires a cementing agent, those are Portland cement, quicklime, hydrated lime, with the presence of water for reaction and production cementations compounds. Specific gravity 2.15, particle size 5-10 micrometer. In the present experimental work, low calcium, fly ash (ASTM CLASS F) were collected from the Electrostatic precipitators of the SARNI THERMAL POWER PLANT IN M.P. (India), was used, list of constituents in fly ash-

Table-1: Properties of fly ash

S/no.	constituents in fly ash	%
1	SiO_2	67.35
2	Al_2O_3	22.8
3	Fe_2O_3	5.55
4	LOI	3.33
5	CaO	1.21
6	MgO,K_2O,Na_2O,TiO_2 are present in traces	

Fly ash

FINE AGGREGATE

The coarse aggregate is crushed granite stone and free from clay

Properties of fine aggregate

S. no.	Properties	Results
1	Type	Crushed

2	Specific gravity	2.70
3	Particle size	6mm

Fine Aggregate

ALKALINE ACTIVATORS- Sodium silicate solution and sodium hydroxide solution mixed with same proportion and used as a alkaline activators. Sodium-based solutions were used instead of potassium based solution because they were cost effective than potassium-based solutions.

Sodium hydroxide–most often the sodium hydroxides are available in the form of solid chips . The cost of the sodium hydroxide is mainly varied according to the quality. The sodium hydroxide (NAOH) solution was prepared by mixing the flakes in water. The mass of NAOH solids in a solution varied depending on the concentration of the solution in terms of molar(M).

Properties of NaOH

s.no.	Parameters	Values
1	Chemical formula	NaOH
2	Molecular weight	40gms/mol
3	Specific gravity	2.12

Sodium hydroxide

A. Sodium silicate

Sodium silicate are also called as liquid glass or water glass and present in both liquid and solid state in our study we are using it in solid state

Properties of Sodium Silicate

S.N.	Parameters	Values
1	Chemical formula	Na_2SiO_3
2	Molecular weight	122.06gms/mol
3	Specific gravity	1.6
4	Na_2O	15.9%
5	SiO_2	31.4%
6	H_2O	52.7%

Sodium silicate

CEMENT: The cement used is Ultratech brand cement of OPC 53 grade and the properties are studied according to specified IS code provision.

Physical properties OPC Cement

S/no.	Properties	values
1	Standard consistency of cement	30%
2	Specific gravity of cement	3.14
3	Initial setting time(minutes)	21
4	Final setting time(minutes)	55

Water: - Water is used in these test is potable water ph ranges 6 to 8

CASTING OF cylinders-

- For casting of ferrocement cylinders we are taking cement, fine aggregate, and welded mesh chicken mesh and water
- For casting of geopolymer cylinders we are taking fly ash, fine aggregate, alkaline activator and water
- And the alkaline solution that we have used in geopolymer mortar is on 12 molar

Composition of Ferro cement cylinders

Cement	**Aggregate**	**Water**
2.5 kg	7.5kg	1.2kg
1	3	0.45(w/c)

Composition of ferrogeopolymer cylinders

Flyash	**Aggregate**	**Solution**
2.5kg	7.5kg	1.56kg
1	3	0.62(fly ash/solution)

fresh geopolymer mortar

CURING-

a) Geopolymer cylinders were cured at ambient temperature for 28 days

b) Cement cylinders were cured at water for 28 days

TESTING

SPLIT TENSILE STRENGTH (IS 5816:1999)

a) About the machine

Compressive strength of cube of same material if found out by compression testing machine according to IS 516-1959 that comprises of hydraulic compression limiting 2000KN and one division of the machine is 10KN and gradually increases the load from 0 to 10

Fig.3.15 Lever to reduce the pressure and release the sample

Fig.3.16 Lever to increase Load from 0 to 10

b) About the test

For split tensile strength test,specimens of cylinders dimension 150 mm diameter and 300 mm length were cast. The specimens were de-molded after 24 hours of casting and were kept for ambient curing and they were allowed to cure for 28 days. These specimens were tested under compression testing machine. In each category three cylinders were made and tested and their average value is reported.

Split tensile strength = $2P/\pi DL$ where, P = Applied load, D = Dia. Of cylinder specimen, L = Length of cylinder specimen.

Fig.3.18 split tensile test

RESULTS

SPLIT TENSILE TEST–

Tensile test is conducted on cylinder scaled 150 mm diameter and 300 mm length were casted and put geopolymer cylinder in ambient temperature and cement cylinder in water for 28 day after demolding 24 hours of casting

In each category three cylinders were made and tested and their average value is reported.

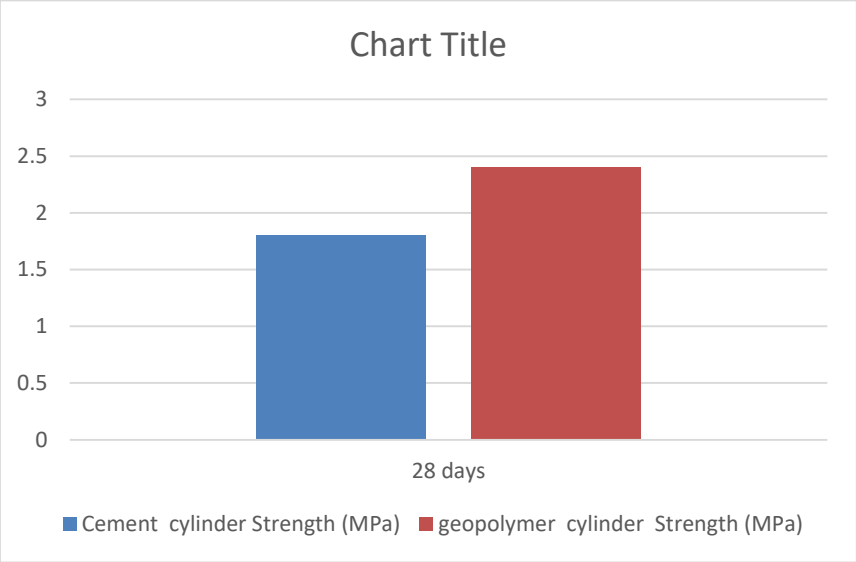
According to **(IS 5816:1999)**

Split tensile strength = $2P/\pi DL$ where, P = Applied load, D = Dia. Of cylinder specimen, L = Length of cylinder specimen.

Tensile Strength

Samples	Strength (28days) MPa
Cement cylinder (150mm*300mm)	1.8
geopolymer cylinder (150mm*300mm)	3.3

a) Chart 1 -for split tensile test



CONCLUSION

1. The handling time of geopolymer mortar is up to 2 hours
2. There is no need of water to cure of water
3. In ferrogeopolymer cylinders there is no effect of corrosion in geopolymer mortar
4. The geopolymer mortars gain more than 95% of its 28-day strength within 14- days. Comparatively the cement mortar gains about 80% of its 28-day strength within 14-days. This point concludes that the geopolymer mortars gain strength rapidly, unlike the case of cement mortars.
5. Tensile strength of ferro geopolymer cylinders is greater than ferrocement cylinder.