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Experiment Study On Geo Polymer concrete With Replacement Of Fine Aggregate By Granite Waste

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Abstract: Geo polymer concrete is an alternative to cement concrete. Geo polymer concrete is produced by pozzalonic material such as fly ash ,GGBS etc, alkaline solution (sodium hydroxide (NaOH)+sodium silicate(NaSiO3))with various molar concentration. Based on literature fine aggregate(river sand), coarse aggregate of size 20mm with elevated temperature curing is to be used. In this study, it is proposed to use granite waste instead of fine aggregate as a partial replacement. Then the strength characteristics and durability test are to be performed and the values will be compared with control concrete.

Index terms: Replacement Material, Waste Management, Natural Admixture, New Material, Cost Efficient.

I. INDRODUCTION

Concrete is one of the most widely used construction materials and the Portland cement is a main component for making concrete. Concrete usage around the world is second only to water. Ordinary Portland cement (OPC) is conventionally used as the primary binder to produce concrete. The production of cement generates large amount of carbon dioxide. Carbon dioxide could be reduced if the production of cement could be reduced. The production of one ton of cement emits approximately one ton carbon dioxide to the atmosphere, which leads to global warming conditions. So, one of the ways to produce environmentally friendly concrete is to reduce the use of Ordinary Portland Cement by replacing cement with by-product materials such as fly ash. One of the efforts to produce more environmentally friendly concrete is to replace the Portland cement in concrete with by-product materials such as fly ash. An effort to make environmentally friendly concrete is the development of inorganic alumina-silicate polymer, such as fly ash that are rich in silicon and aluminum called Geopolymer, synthesized from materials of geological origin or by-product materials such as Fly ash that are rich in Silicon and Aluminum. GGBS (Ground Granulated Blast Slag) is a waste material Generated in iron or Slag Industries have significant impact on Strength of Geopolymer Concrete. The global warming is caused by the emission of greenhouse gases, such as CO2, CO to the atmosphere by human activities. Among the green house gases, CO2 contributes about 65%of global warming (McCaffrey). In this respect, the Geopolymer technology proposed by Davidovits shows considerable promise for the concrete industry as an alternative binder to OPC. 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%. One of the efforts to produce more environmentally friendly concrete is to reduce the use of OPC by replacing the cement in concrete with Geo polymers (i.e. 100% fly ash in place of OPC).

II. DEFINITION OF GEOPOLYMER

Davidovits of France first coined the term Geo polymer concrete and proposed that an alkaline liquid could be used to react with the silica (Si) and the Alumina (Al) in the source material of geological origin or in by-product materials such as fly ash, and rice husk ash to produce binders. The chemical composition of Geo polymer materials is similar to natural Zeolitic materials, but the microstructure is amorphous. The polymerization process involves a substantially fast chemical reaction under alkaline condition on Si-Al materials that results in a three dimensional polymeric chain reaction consisting a ring of Si-O-Al-O bonds. Thus the concrete is named as Geo polymer concrete.

III. PROPERTIES OF GGBS

Ground-granulated blast-furnace slag (GGBS) is obtained by quenching molten iron slag (a byproduct 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. The chemical composition of a slag varies considerably depending on the composition of the raw materials in the iron production process. The main components of blast furnace slag are CaO (30-50%), SiO_2 (28-38%), Al_2O_3 (8-24%), and MgO (1-18%). In general increasing the CaO content of the slag results in raised slag basicity and an increase in compressive strength. GGBS is used to make durable concrete structures in combination with ordinary Portland cement and/or other pozzolanic materials. Concrete made with GGBS cement sets more slowly than concrete made with ordinary Portland cement, depending on the amount of GGBS in the cement material, but also continues to gain strength over a longer period in production conditions.

IV. PROPERTIES OF GRANITE POWDER

Concrete is the single most widely used construction material in the world today. It is used in buildings, bridges, sidewalks, highway pavements, house construction, dams, and many other applications. The key to a strong and durable concrete are the mix proportions between the various components. Less cement paste can lead to more voids, thus less strength and durability while more cement paste can lead to more shrinkage and less durability. The gradation and the ratio of fine aggregates to coarse aggregates can affect strength and porosity. The mix design should also achieve the desired workability of concrete so as to prevent segregation and allow for ease of placement. Typically, a concrete mix is about 10% to 15% cement, 25% to 30% sand, 40% to 45% percent aggregate and 15% to 20% water. Entrained air (5% to 7%) is also added to concrete to improve durability. Concrete should have enough compressive strength and flexural strength to support applied loads. At the same time it should have good durability to increase its design life and reduce maintenance costs. In general, durable concrete will have good resistance to freeze and thaw, abrasion, sulfate reactions, ultraviolet radiation, seawater, alkali-silica reaction, and chlorides. The gradation and maximum size of aggregates are important parameters in any concrete mix.

Figure 3.1 Granite Powder

V. MATERIAL TESTING

The materials are tested and their properties are listed below like properties of corse aggregate, fine aggregate, coconut shell and cement.

Table 5.1 Properties of GGBS

SI.No	Properties	Value
1	Specific gravity	2.6
2	Color	White
3	Surface moisture	Nil
4	Average particle size, shape	5m down, round

Table 5.2 Properties of Corse Aggregate

SI. No	Properties	Values
1	Fineness Modulus	9.88 %
2	Specific Gravity	2.6
3	Percentage of water absorption	5.8 %

Table 5.3 Properties of Fine Aggregate

SI.No	Properties	Value
1	Specific Gravity	2.6
2	Fineness Modulus	5.785 %

Table 5.4 Properties of Granite Powder

SI.NO	Properties	Values
1.	Porosity	Very Low
2.	Absorbtion	0.5 to1.5%
3.	Specific Gravity	2.6 to 2.8
4.	Density	2500-2650Kg/m3
5.	Crushing Strength	1000-2500Kg/m3
6.	Frost Resistence	Good
7.	Fire Resistence	Low
8.	Color	Mostly Light Coloured

VI. MIX DESIGN

The mix design is designed by analysis the properties of the material. it is designed for M30 grade of concrete using IS 10262:1982

Table 6.1 Mix design detail

Component	M_{30}
Mix ratio	1:1.06:2.32
Water cement ratio	0.38
GGBS	490 kg/m^3
Fine aggregate	523 kg/m^3
Coarse aggregate	1140 kg/m^3
Water	186 lit/m^3

The size of the cube is 150 x 150 x 150 mm and size of the cylinder is 150 x 300 mm. The each layer is compacted using tamping rod up to 25 blows. The concrete mixing is done with granite powder. The concrete mix consist of fine aggregate, coarse aggregate, GGBS and Granite powder diluted Alkaline Solution. Submerge the specimen in clean, fresh water until the time of testing.Test2specimensfor 7 day &2 specimens for 14 days and 2 specimen for 28 days curing. After curing process the cubes are tested using CTM.

VII. RESULTS AND DISCUSSION

The molded cubes are removed from heat, ambient, water curing after the specified curing. Excess water is wiped out on the specimen is dried. Dimensions of the specimens are measured to the nearest 0.2 meter. The specimens are taken for the testing at compressive testing machine is cleaned and the specimens are placed in such a manner that the load is applied to the opposite sides of the cube cast uniformly. The specimen is aligned centrally on the base plate of the machine and the movable portion is rotated by hand so that it touches the top surface of the specimen. The load is applied gradually without shock and continuously at the rate of 140 kg/cm^3/min till it fails. The maximum load is recorded and any usual features in type of failure are noted. A min of 3 specimens are tested at selected age. If any strength is varied by more than 15% of average strength results of such specimen should be rejected. Average of three specimens gives the crushing strength of concrete. During the compressive strength and spilit tensile strength, the load P is collected and the strength was calculated

Compressive Strength

Table 7.1 Compression Strength Test

Curing Condition	7 days	14 days	28 days
Oven	4.77	10.55	23
Water	5.66	13.06	26.89
Ambient	5.22	11.33	25.44

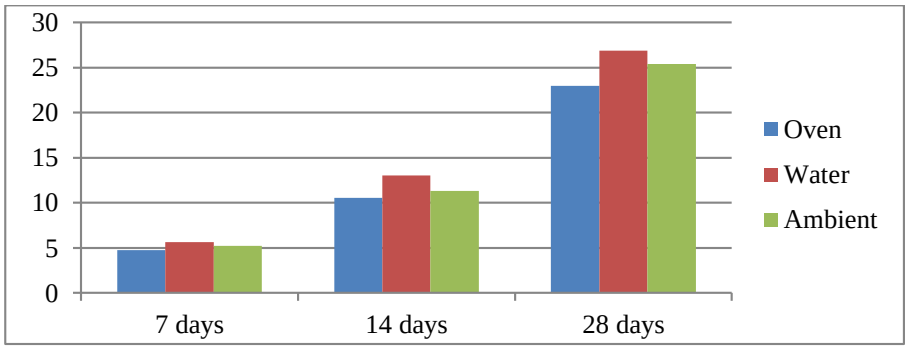

Figure 7.1 Compression Strength Test Result

Spilit Tensile Strength

Table 7.2 spilit Tensile Strength Test

Curing Condition	7 days	14 days	28 days
Oven	0.665	0.99	1.305
Water	1.025	1.38	2.47
Ambient	0.915	1.24	1.585

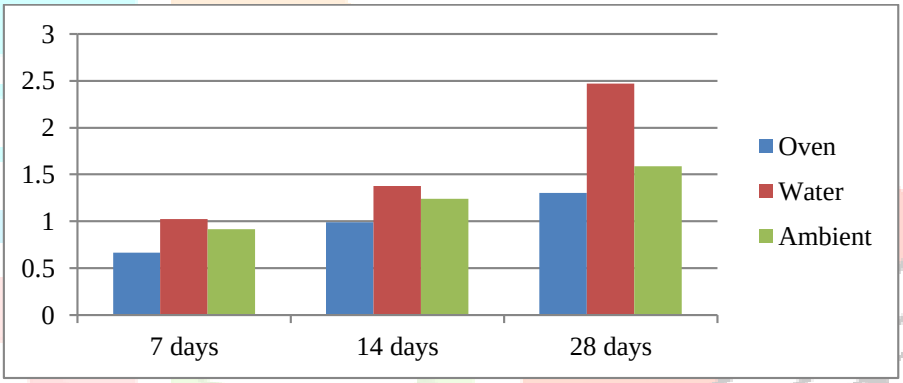

Figure 7.2 Spilit Tensile Strength Test

VIII. CONCLUSION

The experimental study on geo polymer concrete with replacement of fine aggregate by granite powder is done successfully. In this project we have used granite powder as an admixture. In this we have replaced granite powder in various percentages like 0%, 10 % and 15 %. For each ratio 6 samples has been casted and curing is done. The compression test and spilit tensile test was done in 3 stages, 7 days, 14 days, and 28 days. The experimental investigation on the influence of size of gravel on the compressive and spilit tensile strength of Geo polymer concrete. compressive test was carried on a 150 mm x 150 mm x 150 mm cube specimen using a compression testing machine and split tension test was carried on a 150mm x 300mm cylinder specimen using a split tension testing machine.

- It was founded that the size of the coarse aggregate and GGBS are used in the concrete.
- it was observed that the size of coarse aggregate does not affect the trend that oven-cured specimen has higher compressive strength and spilit tensile strength value than ambient and water cured specimen.
- The higher concentration of NAOH solution then the required setting time becomes longer Geo polymer concrete achieved an optimum compressive strength on NAOH solution molarity 12M.

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