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Analysis and improvement of geo -polymer concrete

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ABSTRACT

To reduce CO2 emissions, efforts are needed to develop environmentally friendly construction materials. This summary presents the experimental analysis and improvement of geo polymer concrete. In geopolymer concrete a by product materials rich in fly ash, chemical activated bynalkaline solution and conplast sp 430, geo polymer, ground granulated ballast furnance slag (GGBS) to form a paste that binds the loose coarse and fine aggregates are the materials is mixture the cube compressive strength was calculated for 12M solution for different mix ratio.ie) F90 G10,F70 G30 ,F50 G50(where F&G are represntively fly ash , GGBS and the numerical valve indicator the percentage of replacement of cement by FLYASH &GGBS. The maximum compressive strength of 80.50N/mm2 of mix ratio F60 G4. Also the split tensile strength and flexural strength for F60 G 40 Was done.

Keywords: Geoploymer, Fly ash, GGBS, Conplast sp 430, Control of CO2 emission.

INTRODUCTION

General

The cement industry is the India's second highest payer of Central Excise. With infrastructure development growing and the housing sector booming, the demand for cement is also bound to increase. However, the cement industry is extremely energy intensive. After aluminum and steel, the manufacturing of Portland cement is the most energy intensive process as it consumes 4GJ per tons of energy. After thermal power plants and the iron and steel sector, the Indian cement industry is the third largest user of coal in the country. In 2003-04, 11,400 million kWh of power was consumed by the Indian cement industry. The cement industry comprises 130 large cement plants and more than 300 mini cement plants. The industry's capacity at the beginning of the year 2008-09 was about 198 million tones. The cement demand in India is expected to grow at 10% annually in the medium term buoyed by housing, infrastructure and corporate capital expenditures [1].

Coal-based thermal power installations in India contribute about 65% of the total installed capacity for electricity generation. In order to meet the growing energy demand of the country, coal-based thermal power generation is expected to play a dominant role in the future as well, since coal reserves in India are expected to last for more than 100 years. The ash content of coal used by thermal power plants in India varies between 25 and 45%. However, coal with an ash content of around 40% is predominantly used in India for thermal power generation. As a consequence, a huge amount of fly ash (FA) is generated in thermal power plants, causing several disposal-related problems. In spite of initiatives taken by the government, several non-governmental organizations and research and development organizations, the total utilization of FA is only about 50%. India produces 130 million tons of FA. Disposal of FA is a growing problem as only 15% of FA is currently used for high value

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addition applications like concrete and building blocks, the remainder being used for land filling. Globally, less than 25% of the total annual FA produced in the world is utilized. In the USA and China, huge quantities of FA are produced (comparable to that in India) and its reported utilization levels were about 32% and 40%, respectively, during 1995. There is effective utilization of FA in making cement concretes as it extends technical advantages as well as controls the environmental pollution [2].

GEOPOLYMER CONCRETE

General

Geopolymer concrete is also known as Alkali-activated concrete or inorganic polymer concrete. Geopolymer is the most recently developed construction material for large scale utilization of fly ash without any cement. Compressive strength of fly ash based geopolymer mortar depends on the strength of geopolymer binder an excellent bonding between geopolymer binder and aggregate. Geopolymer concrete has excellent resistance to chemical attack and shows promise in the use of aggressive environments where the durability of Portland cement concrete may be of concern. This is particularly applicable in aggressive marine environments, environments with high carbon dioxide or sulphate rich soils. Similarly, in highly acidic conditions geopolymer concrete has shown to have superior acid resistance and may be suitable for applications such as mining, some manufacturing industries and sewer systems. Commercial geopolymer sewer pipes are in use today [3].

Advantages

It is a newer product that is making traditional concrete look not so spectacular. Here are some of the top advantages of geopolymer concrete.

High Strength

It has a high compressive strength that showed higher compressive strength than that of ordinary concrete. It also has rapid strength gain and cures very quickly, making it an excellent option for quick builds [4].

Geopolymer concrete has high tensile strength. It is less brittle than Portland concrete and can withstand more movement. It is not completely earthquake proof, but does withstand earth moving better than traditional concrete.

Very Low Creep and Shrinkage

Shrinkage can cause severe and even dangerous cracks in the concrete from the drying and heating of the concrete or even the evaporation of water from the concrete. Geopolymer concrete does nothydrate; it is not as permeable and will not experience significant shrinkage [5].

The creep of geopolymer concrete is very low. When speaking of creep in concrete terms it means the tendency of the concrete to become permanently deformed due to constant forces being applied against it.

Resistance to Heat and Cold

It has the ability to stay stable even at temperatures of more than 2200 degrees Fahrenheit. Excessive heat can reduce the stability of concrete causing it to spall or have layers break off. Geopolymer concrete does not experience spalling unless it reaches over 2200 degrees Fahrenheit [6].

As for cold temperatures, it is resistant to freezing. The pores are very small but water can still enter cured concrete.

Chemical Resistance

It has a very strong chemical resistance. Acids, toxic waste and salt water will not have an effect on geopolymer concrete. Corrosionis not likely to occur with this concrete as like traditional Portland cement.

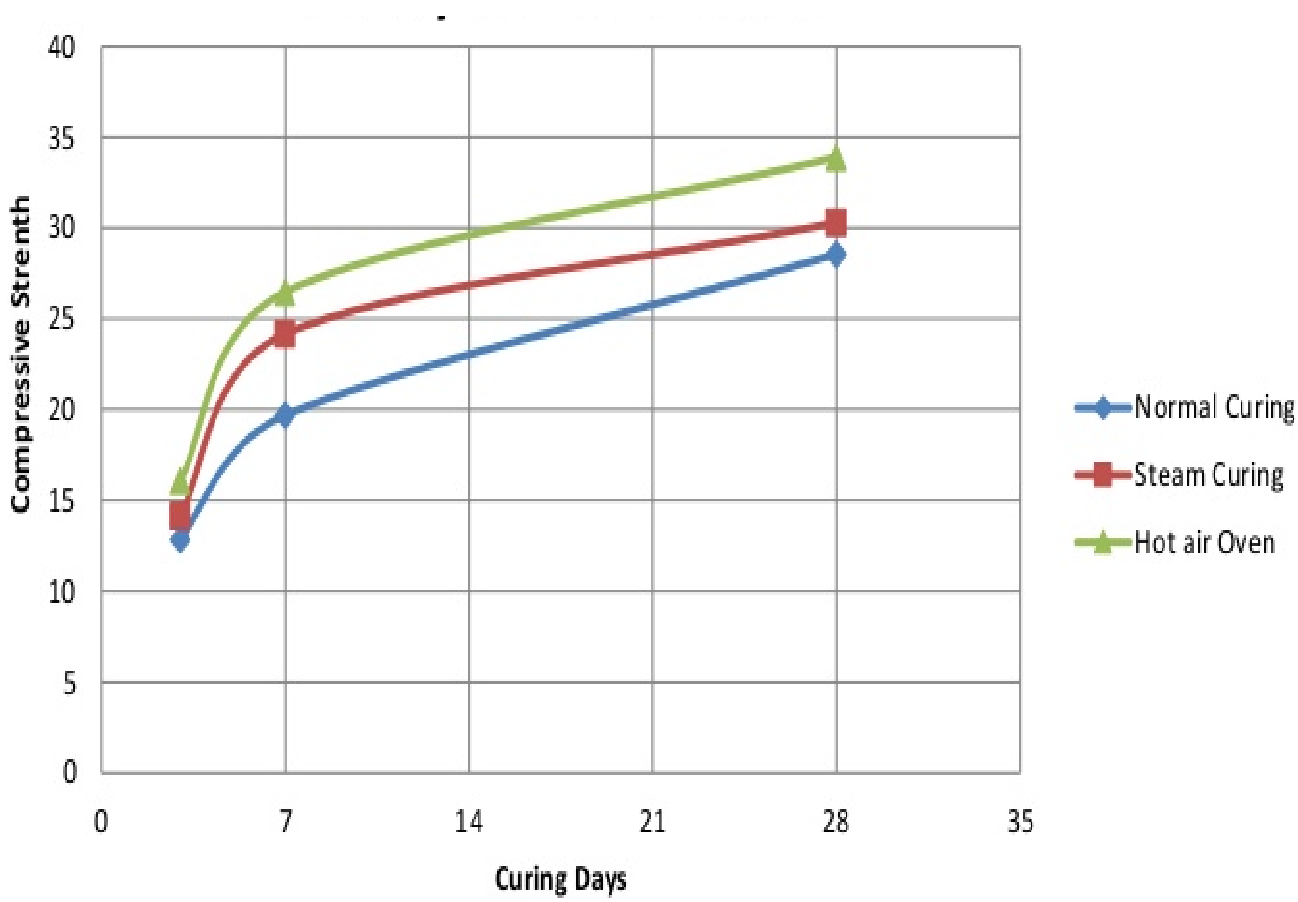
FIELD OF APPLICATIONS

According to Davidovits (1988b), geopolymeric materials have a wide range of applications in the field of industries such as in the automobile and aerospace, nonferrous foundries and metallurgy, civil engineering and plastic industries. The type of application of geopolymeric materials is determined by the chemical structure in terms of the atomic ratio Si:Al in the polysialate. Davidovits (1999) classified the type of application according to the Si:Al ratio as presented in Table 2.1. A low ratio of Si: Al of 1, 2, or 3 initiates a 3D-Network that is very rigid, while Si: Al ratiohigher than 15 provides a polymeric character to the geopolymeric material [7].

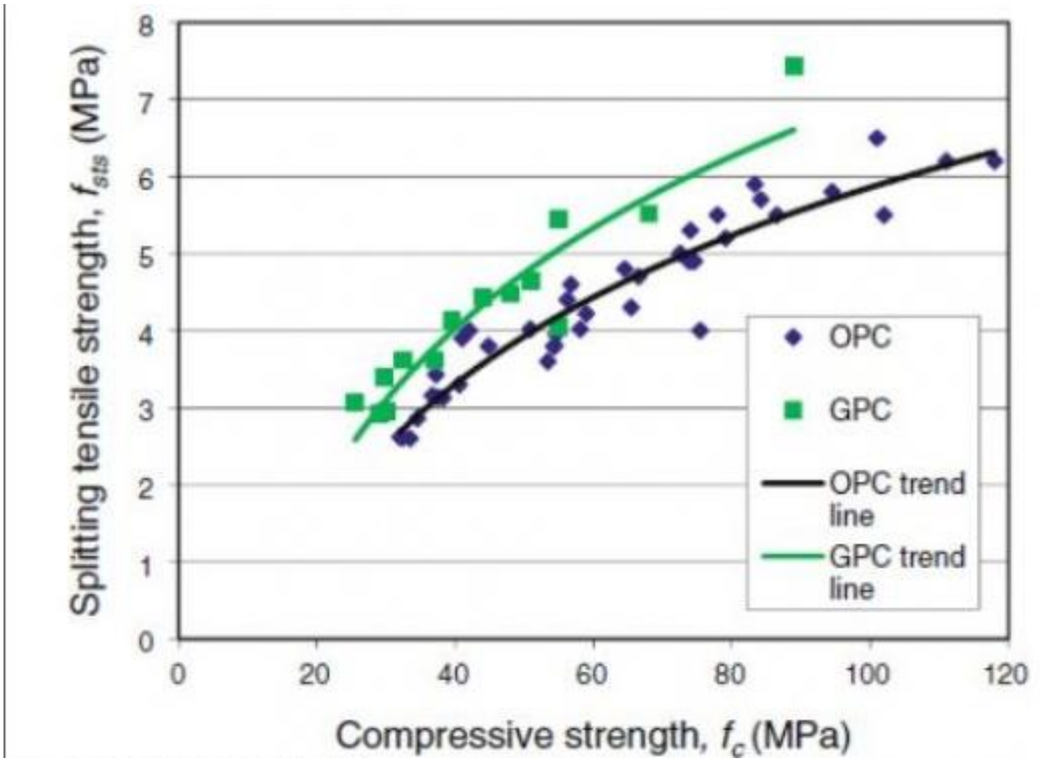
Mix proportion of Geopolymer Concrete

Materials	Mix ID		
	F_{90} G_{10}	F_{80} G_{20}	F_{70} G_{30}
Fly Ash (kg/m^3)	354.87	315.44	276.01
GGBS (kg/m^3)	39.43	78.86	118.20
Sodium Hydroxide (kg/m^3)	45.10	45.10	45.10
Sodium Silicate (kg/m^3)	112.60	112.60	112.60
Fine Aggregate (kg/m^3)	554.40	554.40	554.40
Coarse Aggregate (kg/m^3)	1293.4	1293.4	1293.4
Distilled Water (liters)	39.43	39.43	39.43
Super Plasticizer (liters)	11.83	11.83	11.83
Distilled Water: 10% Cementitious Material			
Super Plasticizer: 3% of Cementitious Material			
Mix ratio: 1:1.40:3.27			

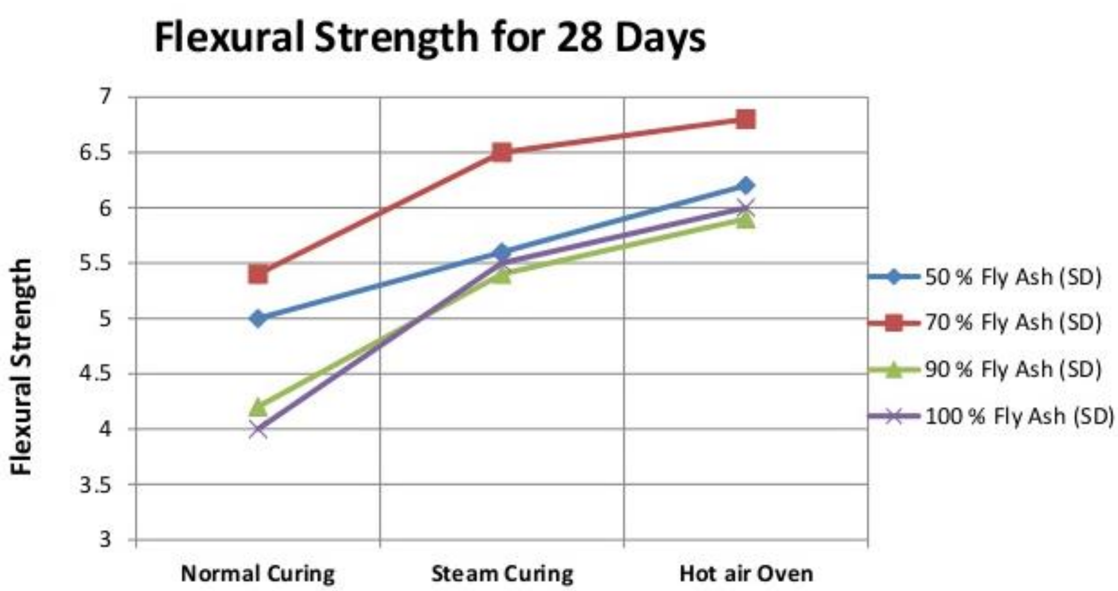
Mix design of geo polymer concrete G20 ratio on 50% fly ash + 50% of GGBS and conplast sp430 on geo polymer concrete.



Compressive strength on G20 grade



Tensile strength on G20 grade



CONCLUSION

- From the test data, it can be concluded that GPC are good materials of constructions from both strength and durability considerations
- Practical recommendations on use of geopolymer concrete technology in practical applications such as precast concrete products and waste encapsulation need to be developed in Indian context.

- Because of lower internal energy (almost 20% to 30 % less) and lower CO_2 emission contents of ingredients of geopolymer based composites compared to those of conventional Portland cement concretes, the new composites can be considered to be eco-friendlier and hence their utility in practical applications needs to be developed and encouraged.

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