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GEOPOLYMER CONCRETE TILE WITH PET BOTTLE FIBER

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Abstract -*In this experimental study the fly ash and GGBS is used to make the geopolymer concrete and PET bottle fibers were added in it with different percentage. The fly ash and ggbs based geopolymer concrete was used with equal quantity and PET bottle fibers were used in it.. The prepared samples were tested at 7 days and 28 days. The study has been done on the fresh property, compressive strength, tensile strength and flexure strength of PET bottle fiber encapsulated geopolymer concrete. The compressive strength improved a little with the incorporation of PET bottle fibers, tensile strength and flexural strength tests gave significant improvement over controlled specimen.*

Key Words: Geopolymer concrete, fly ash, PET bottle Fibre, Compressive strength.

1. INTRODUCTION

In the recent times, the greatest problem faced by industries is the disposal of its waste products such as fly ash, GGBFS, Rice Husk Ash etc. Land filling is not a desirable option because it not only causes huge financial burden on the foundries but also makes them liable for future environmental costs and problems associated with land filling regulations . Efforts should be made on a larger scale to effectively utilize these waste materials. The construction industry can play an important role regarding this issue. Concrete usage has been on rise all around the world consuming cement as a binder material. However, the amount of carbon dioxide released during the manufacturing of OPC is in the order of one ton for every ton of cement produced. It was reported that globally the production of cement contributed to about 5-7 % of the total carbon dioxide emissions into the atmosphere leading to global warming. Considering the rapid growth of infrastructures worldwide in near future, the production, usage and the need for cement will increase at a higher rate which will have a severe impact on the environment. Therefore there is an urgency of developing alternatives to OPC based concrete. Geopolymer concrete is one of those alternatives which contain OPC as binding material rather it utilizes industrial waste products rich in silica and alumina such as fly ash, GGBS, Rice Husk Ash etc. along with an alkaline solution for production of concrete having the strength and durability characteristics better than OPC based concrete with reduced carbon dioxide emissions. Thus the geopolymer concrete is used to reduce carbon footprint in constructions along with 3R implementation. At present generation we are in the need of the industries and residential buildings. The need of building materials also plays a role development of infra with minimum cost. In many industries flooring is done by geopolymer concrete tiles, in order to reduce cost, easy manufacturing & installation. The materials provided between machines and floor to avoid damages due to vibration from machines to floors becoming important one. This project is about to adding dampers such as waste plastic bottles directly with geoploymer concrete tiles to increase its flexural strength.

This experimental study explains about the properties of geopolymer concrete floor tiles using PET bottle fiber. Concrete tile is the world's most versatile, durable and reliable construction material. Geopolymer concrete tile is an innovative construction material which shall be produced by the chemical action of inorganic molecules. Fly Ash, a by-product of coal obtained from the thermal power plant which is abundantly available in worldwide. Flyash is rich in silica and alumina reacted with alkaline solution produced aluminosilicate gel that acted as the binding material for the concrete. It is an excellent alternative construction material to the existing plain cement concrete. Industries with the light weight machines mostly prefer using concrete tiles for flooring. Generally damping materilas such as rubber is provided between machines and floor to avoid damages due to vibrations from machines. Solid waste management is becoming an emerging area by the impact of plastic waste. The used PET bottles are reduced in ton plastic fibers which is one of the major solid waste is added to geoploymer for making tile. The PET bottle fibers may improve flexural strenght of the concrete. This project briefly reviews the constituents of geopolymer concrete tile, its strength and potential applications along with the applications of pet bottle fibers.

2. METHODOLOGY

Methodology is the overall approach that underpins the project. In this chapter the methods followed to complete the project is discussed. The following representation shows the methodology being used.

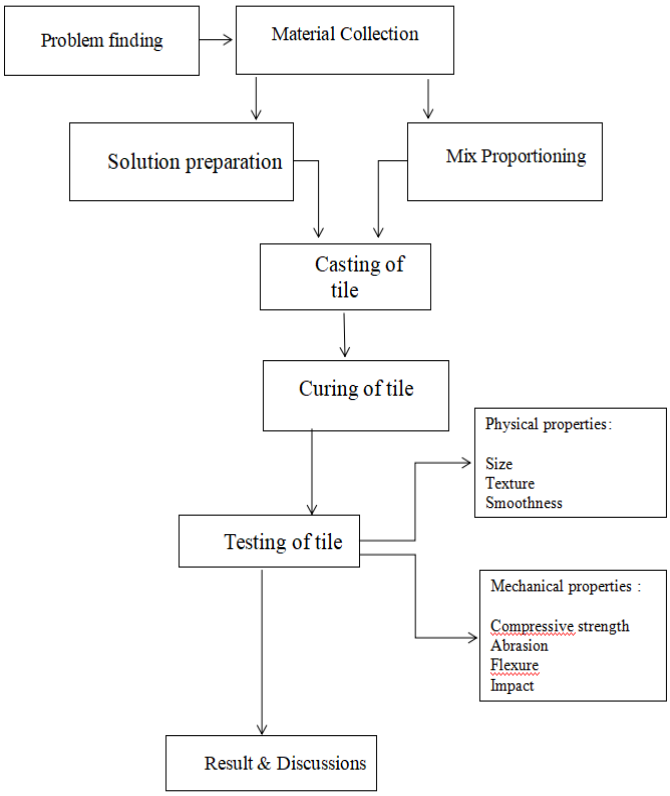

Fig-1 Methodology

3. EXPERIMENTAL INVESTIGATIONS

3.1Water absorption

In water absorption, the geopolymer concrete tile with PET bottle fibre produces maximum absorption compare to conventional concrete tiles (From Table 1) due to the presence of porosity in the geopolymer was by the length of time increased, the mixture was left in slurry form before being placed in curing tank to harden. As per IS10545 – 3 the water absorption of floor tile should be within 3%-6% which has been satisfy the both concrete and geopolymer tile. Water absorption of normal concrete tile is 1.520 % while water absorption for geopolymer concrete tile with PET bottle fibre is 2.88 % which may able to change with the % of replacement taken in place.

Table 1 – Water Absorption Test Result

Samples	Saturated Weight (g) (W1)	Dry Weight (g) (W2)	Water absorption (%)
Normal concrete tile	220.30	217	1.520
Geopolymer concrete with Pet bottle fiber	140	136.63	2.88

3.2 Compressive Strength Test

The compressive strength is the capacity of a material or structure to withstand loads tending to reduce size. It can be measured by plotting applied force against deformation in a testing machine. Some materials fracture at their compressive strength limit; others deform irreversibly, so a given amount of deformation may be considered as the limit for compressive load compressive strength is a key value for design of structures. Compressive strength is often measured on universal testing

machine, this range from very small table-top systems to ones with over 2000Kn capacity. Measurements of compressive strength are affected by the specific test method and conditions of measurement. Compressive strength are usually reported in relationship to a specific technical standard. Concrete mixtures can be designed to provide a wide range of mechanical and durability properties to meet the design requirements of a structure. The compressive strength of concrete is the most common performance measure used by the engineer in designing buildings and other structures. The compressive strength is calculated from the failure load divided by the cross-sectional area resisting the load and reported in units of N/mm2 Following results are observed in compressive strength when natural aggregates were replaced with demolition concrete waste aggregates. However a decrease in compressive strength was observed when natural aggregates were replaced with those replacing materials but characteristic strength was achieved successfully. Values of compressive strength for various percentages of recycled concrete wastes were reported in Table and variation of compressive strength with age of concrete is shown in chart

Table 3 – Compressive Strength test result

Vitrified tile	Normal concrete tile	Geopolymer concrete tile	Geopolymer con. with % of PET Fibre
15 N/mm2	41.05 N/mm2	105 N/mm2	**0% -**105 **0.05% -**109.4 **1% -**112.3 **1.5 % -**116 **2% -**120

3.3 Flexural Strength:

Generally, the tiles need maximum flexural behavior when it lay in flooring. In geopolymer concrete, it provides maximum flexure (1.69 times) to maintain its stability against the load application. As per ISO10545-4 the flexural strength should be >22MPa, has been attain in both concrete and geopolymer tile. Flexural strength of normal concrete tile is 132 N/mm2 at 3.1 kN load but the Flexural strength of geopolymer concrete tile with PET bottle fibre is 224 N/mm2 at 6.4 kN load, which shows the improved quality in stiffness and the strength can be auxiliary improved by changing the alkali activator molarity and replacement level of cement.

Table 4 – Flexural Strength test result

Vitrified tile	Normal concrete tile	Geopolymer concrete tile	Geopolymer concrete tile with % of PET Fibre
45 N/mm2	132 N/mm2	224 N/mm2	**0% -**224 **0.05% -**225.6 **1% -**227 **1.5 % -**228.1 **2% -**230.5

Table 5 – Abrasion resistance test result

Vitrified tile	Normal concrete tile	Geopolymer concrete tile	Geopolymer concrete tile with % of PET Fibre
2 mm	1.26 mm	0.89 mm	**0% -**0.89 **0.05% -**0.86 **1% -**0.81 **1.5 % -**0.79 **2% -**0.76

Table 6 – Impact test result

Vitrified tile	Normal concrete tile	Geopolymer concrete tile	Geopolymer concrete tile with % of PET Fibre
1	3	5	**0%** -5 **0.05%** -5 **1%** -5 **1.5 %** -6 **2%** -6

5. CONCLUSIONS

The type of curing is important one to improve the mechanical behavior of geopolymer concrete. The ponding method of curing provides better strength parameters. Here we followed ponding method of curing in a water tank. Water absorption of normal concrete tile is 1.520 % while water absorption for geopolymer concrete tile is 2.88 % which may able to change with the % of replacement taken in place. Free moisture content of normal concrete tile is 3.938 % while free moisture content of geopolymer concrete tile is 4.752 %, which improves the indoor environment by ensuring the maintenance. Flexural strength of normal concrete tile is 132 N/mm2 at 3.1 kN load but the Flexural strength of geopolymer concrete tile with PET fiber is 230.5 N/mm2 at 6.4 kN load, which shows the improved quality in stiffness and the strength can be further improved by changing the alkali activator molarity and replacement level of cement. Compressive strength of normal concrete tile is 41.05 N/mm2 while compressive strength of geopolymer concrete tile with PET fiber is 120 N/mm2. This may be due to the cement replacement and type of curing and curing period. The polymer bonding taken place in early age with minimum water content influence the strength parameter. Thus the tested property of geopolymer concrete tile with PET fiber added has more values than normal concrete tile when the depth is 15 mm. when compared with normal concrete tiles; geopolymer concrete tile with PET fiber has high strength. Moreover, geopolymer tiles were very easy to manufacture and easy to install & replace in industries for flooring.

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