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Investigation on the Properties of Luminecent Concrete-(Lightcrete)

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Abstract: *The traditional concrete currently used in the construction industry has a greyish color and high density. The high density of the concrete prevents the passage of light through it. Therefore, the concrete couldn't illuminate itself. On the context, it has been identified that the concrete can be provided with the property of luminance by varying the property of cement. The cement will be induced with luminance property by adding certain photo luminescent chemical substances to it. This project presents an investigation of the luminescent property of the concrete by modifying the property of the cement. These elements are also proven to be inert and causes minimal harm to the environment. From the results it is also found that the luminescent concrete also possesses considerable compressive strength as like traditional concrete. The emergence of photoluminescent concrete has the ability to create a spectacular change in the field of construction and architecture. In many nations, the illumination of highways and rural households are still a biggest challenge. Lack of light in the night leads to many social issues and accidents. In these circumstances the photoluminescent concrete can play a drastic role. It is not only meant for these instances it can also be used to improve the ambience thereby reducing the cost of electricity used for decorations. This project builds on two existing areas of research in order to investigate new concrete materials.*

Keywords: Luminescent Pigment, Light emitting concrete

I. INTRODUCTION

A luminative paver is one that has the capacity to store solar or artificial light energy during the day and transform it into visible light at night. Other names for luminescent concrete include light-emitting concrete and glow-in-the-dark concrete (GID). Without using any electricity, the concrete generates a gentle glow throughout the night, helping to maintain a low-carbon atmosphere and conserve energy. Concrete that glows in the dark is a relatively new and understudied topic. Applications may be made with it. The general definition of luminescence is the emission of light, which results from the photons of light being absorbed and causing the electrons to leap from their energy levels. Both natural and artificial methods can be used to charge the photoluminescent material. The photoluminescent substance can be made to glow brighter by using the sun's free energy. Without the use of batteries or solar cells, the power of the sun could light up highways at night, all night, and for many years. Even though the upfront cost is expensive, the operational and maintenance costs will show it to be cost-effective. The variety known as luminescent concrete is comparatively new and understudied. Applications in a range of civil, structural, and design fields are possible. This concrete has applications in coating buildings, roads, highways, interiors, and exterior designs to increase vehicle and pedestrian safety, as well as in lowering the demand for energy-intensive street and building lighting. These uses go beyond its potential for aesthetic and creative use. A xenon lighting system that mimicked sunlight, a photometer (a light-measuring device that evaluates the luminance of the excited concrete surface), and a housing unit that prevented outside light from influencing the test findings were used to consistently excite the luminous sealant. The studies' findings showed that after being activated, the luminescent surface released light (glowed) for roughly 24 hours in a dark environment. Strontium aluminate particles were discovered to luminesce for a longer period of time when they were larger. The luminance of the stimulated sealant did not depend on the duration of exposure to the xenon lighting

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system's light. Charged with sunlight by day, pavers with embedded lights deliver safe pathway illumination atnight without added electricity. This is a practical and increasingly popular application for outdoorcirculationspaces

II. MATERIALS

2.1 Cement

Ordinary Portland Cement(OPC) confirming Indian standard code IS:12269-2013.

2.2 White Cement

It is used because its white colour allows luminescent powder to glow more brilliantly than grey cement. It is used 50% replacement of cement.

2.3 Fine Coarse

Locally available manufacturing sand, confirming to IS:383-1970 is used as coarse aggregate.

2.4 Polypropylene

Polypropylene is a nonmetallic micro-fiber (thermoplastic fiber) which is a byproduct of petroleum. It is used because of its improved dimensional stability, resistance to warpage, rigidity and strength

2.5 Epoxy Resin

The class of fundamental elements or dried end products known as epoxy includes epoxy resins. It is used because of its adhesive properties and low cost and low toxicity.

2.6 Photoluminescent Pigment

It is the main ingredient of our project. It observes light either sunlight or artificial light and emits during night.

2.7 Water

The water used in the study was clean and clear. It was free from bacteria and other impurities. There was no acid content in it. The water cement ratio for the concrete mix is 0.45.

III. MIX PROPORTIONING

The calculations of mix design were done according to IS 10262 – 1982.

Materials	Ratio of White Cement and Fine Aggregates (1:1)	Ratio of Cement and Fine Aggregates (1:1)
White Cement	7kg	
Cement	-	7kg
Fine Aggregates	7kg	7kg
Polypropylene	70gm	70 gm
Number of tiles	7	7

Final Mix Ratio = 1: 1.5: 0.5

Mix Design done for the Preparation of Luminescent Chips (20).

Materials	Ratio of Epoxy resin and Photoluminescent Powder (3:1)
Epoxy Resin (Resin and Hardener)	1000 ml
Photoluminescent Powder	400

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IV. EXPERIMENTAL PROGRAMME

4.1 Preparation of Light Emitting Concrete (Using Luminescent Chips)

The mould of 300mmx300mmx20mm is prepared for casting of concrete tiles. The luminescent chips are prepared using a small semicircular mould. Luminescent powder is mixed with Epoxy resin (Resin and hardener in a ratio of 2:1) to manufacture the Luminescent chips. The luminescent chips are kept 48hrs to dry. Then, We used white cement and m sand for the top layerand mixed it using shovel in the ratio of 1:1. The light emitting chips are placed in the required pattern / design in the mould. Fill up the half of the mould with the white cement paste which is prepared earlier. Make sure that the light emitting chips are not disturbed. The bottom half of the mould is filled with normal cement mortar mixed with polypropylene fiber to strengthen the concrete. Drying of concrete is defined as providing the proper condition to allow the concrete to achieve a moisture condition appropriate for its intended use. Curing is necessary to increase strength and improve the quality. The light emitting concrete tiles is remoulded after 24hrs. We cured tiles for 14 days.

Figure: Light Emitting Concrete

4.2 Preparation of Light Emitting Concrete (Using Luminescent Paste)

The mould of 300mmx300mmx20mm is prepared for casting of concrete tiles. Here, Theluminescent powder is mixed with white cement to make a paste. Then, We poured this white cement-luminescent powder paste into the mould only on designs. We used white cement and ms and for the top layer and mixed it using shovel in the ratio of 1:1. Fill up the half of the mould with the white cement paste which is prepared earlier. Make sure that the paste poured in the mould is undisturbed. The bottom half of the mould is filled with normal cement mortar mixed with polypropylene fiber to strengthen the concrete. Drying of concrete is defined as providing the proper condition to allow the concrete to achieve a moisture condition appropriate for its intendeduse. The light emitting concrete tiles is remoulded after 24hrs. Curing is necessary to increase strength and improve the quality. We cured tiles for 14 days.

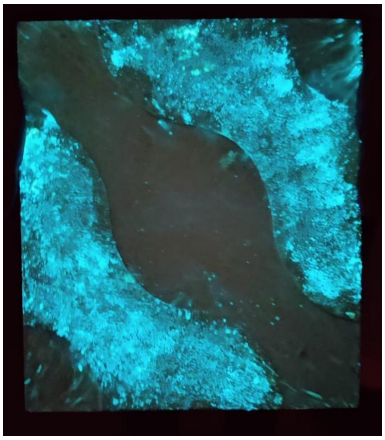

Figure: Light Emitting Concrete Tile (Luminescent Paste)

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V. RESULTS

5.1 Material Test Results

The test done on the materials for the mix design:

A. Compressive Strength Test

Table 5.1: Compressive Strength Results

Days	Loads KN	Compressive strength n/mm^2
7	779.2 KN	8.658 N/mm^2
14	950.4 KN	10.56 N/mm^2
28	1210 KN	13.449N/mm^2.

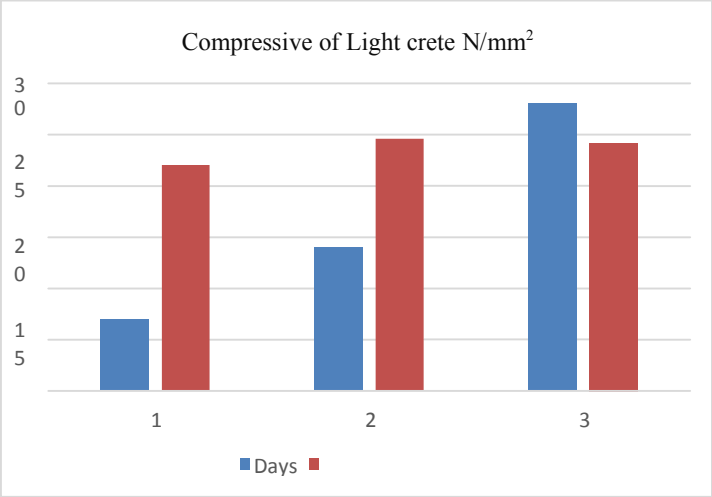

Figure: Compressive Strength Graph

B. Perpendicularity Test

One arm of a square, whose arms are longer than the sides of the square, is placed along one of the tile's edges, so that the square's corner touches the tile's corner. At the tile's end, the distance between the other arm of the square and the other edge is measured. The test is performed till the two opposite edges are tested. The space between the arm and the tile's edges cannot be larger than 1% of the edge length.

Fig 5.2 Perpendicularity test

C. Straightness Test

The maximum distance between the thread and the plane, which connects two tile surface corners, is recorded. The test is repeated along each of the remaining edges. The space between the thread and the tile's plane cannot be larger than 1% of the edge length.

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Fig. Straightness test

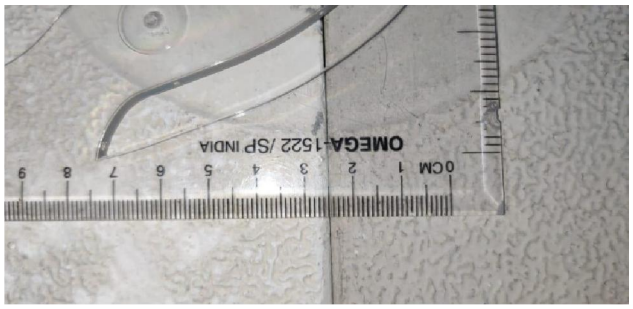

Fig. Measuring Straightness of the tile

D. Water Absorption Test

Water absorption, percent by mass–***M1 – M2/M2X 100***

Where, *M*1=mass of the saturated specimen, in g; and

*M*2 = mass of the oven-dried specimen, in g.

The average value shall be reported.

Percentage=M1—M2/M2X 100

= (4950 - 4900/4900)*100 = 1.02%

When tested according to the procedure laid down, the average percent of water absorption shall not exceed 10%. The percentage of water absorption of our tile is 1.02%.

Fig. Tiles in water

Fig. Tiles in oven for drying

Light Emitting Test

After keeping the concrete cube for 24 hours in daylight, the concrete cube was observed to emit the light for about nearly nine hours. According to the test, the percentage addition of the light-emitting pigments needs to be raised in order to achieve the maximum luminosity. More specifically, the results of luminous concrete will improve with the increased use of strontium aluminate

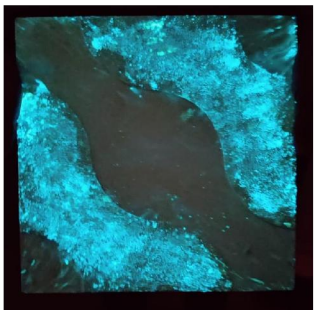

Fig: Visual Observation Of Light Emitting Concrete

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VI. CONCLUSION

- Self-sustaining concrete is created by incorporating photoluminescent properties into concrete.
- This experiment will serve as a precursor to a future initiative to closely examine a newly emerging advanced construction method.
- According to this research, the percentage of luminescent material can be increased by70% to improve the glow.
- It also adds a new utility to the concept of life cycle sustainability.
- The effect of photoluminescent properties on concrete strength is studied descriptively.
- On the other hand, it has its own drawbacks.
- According to our findings, the sunrays or UV light are a more important source of luminescent conventional concrete than the sun.
- The use of photoluminescence induced concrete on a large scale would be an excellent alternative for lighting up the country's rural households.

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