GLOWCRETE: A MODERN PHOSPHORESCENT CONCRETE

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Abstract

In developing countries energy demand is insatiable and growing day by day. Road lighting is one of the biggest challenge faced by the government. One fifth of the houses in rural areas still remain in darkness. A concrete dormant in daylight and producing luminescence at night-time proves to be efficient in managing daily energy consumption in an efficient manner especially during night-time when the demand is at its peak. This concrete applies the basic principle of phosphorescence in which the phosphorescent material absorbs energy in the daytime from sun's radiation and re-emits the light energy in the dark. It is eco-friendly, cost efficient and appealing to the eye due to its luminescent glow. It provides easy road solutions to night lighting and road signs in highways. Glowcrete assures steady glow supply upto 12 hours, has aesthetic appeal and can be extensively used in construction**.**

Keywords: eco-friendly, glow, night-time, aesthetic, energy efficient

Introduction

Concrete is a key component in the construction industry. Innovation in concrete to enhance strength and specific properties have increased over the years.Birth of many new construction materials after the industrial revolution, dominated the world with its advancements and efficiency. Energy resources are gradually decreasing as the demand keeps increasing. The government faces a major problem in illuminating streets and highways. Frequent blackouts cause difficulty among travelers to recognize the path and pose a great threat to their sense of safety and security. Sunlight, a naturally available light energy source, can be used to obtain brighter glow in the photo luminescent material. Glowcrete is an innovation which involves the use of phosphorescent materials to impart a Luminant glow to the concrete surface thereby providing ambient lighting in the night by absorbing the solar radiation inthe day. The main working principle involved in this process is phosphorescence. Phosphorescence is the process of emitting light from a substance exposed toradiation, long after the radiation is removed. Normally, during radiation electron gets excited from ground level to excited level, but in phosphorescence it stays in a rather temporary state called the meta stable level. The longer the electron stays in the metastable level indicates the duration of luminescence.

Objective

i. To reduce energy demand.
ii. To promote eco-friendly and energy efficient construction.
iii. To promote smarter construction as in smart roads, smart cities etc.
iv. To withstand forces experienced by ordinary structural concrete.
v. To improve aesthetic performance.
vi. To improve visibility during night-time

Materials

Phosphorescent material (Strontium aluminate**)**

Strontium aluminate is the strongest and powerful phosphorescent agent that can produce glow upto 14 hours after absorption of radiation.

It has two varieties, strontium aluminate doped with europium which produces a green glow and the higher aluminates produce an aqua glow.

The green hues give the maximum brightness and the aqua hues have longer glow period.

Solvent

A medium is required for dissolving the phosphorescent strontium aluminate powder to form paste or solution of ratio for ease of mix and even distribution of phosphorescent material.

Mostly resins especially epoxy resins are used as solvents for the purpose

Glass

To improve the phosphorescent glow, glass powder or glass beads are added to the mix to improve the luminescence by imparting reflective properties to the phosphorescent mix.

We use borosilicate glass powder for this purpose.

The use of this material is optional and not compulsory.

Methodology

The strontium aluminate is mixed with the solvent as in epoxy resins in the ratio of 2:1.

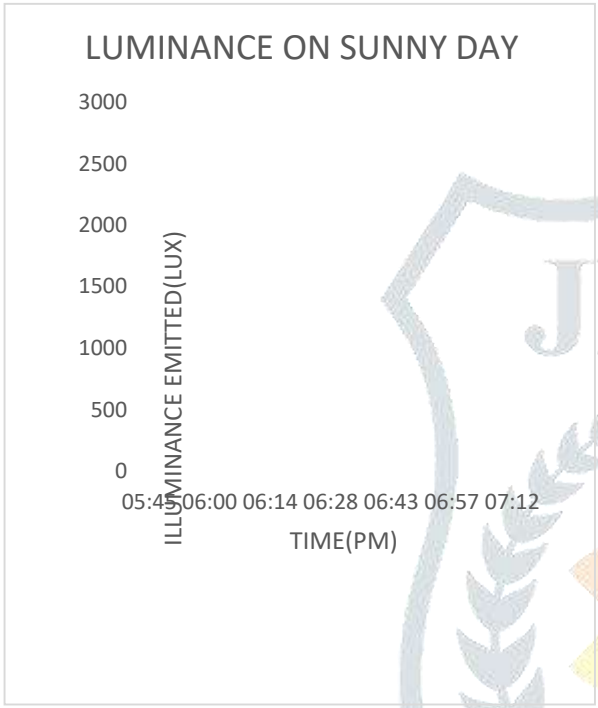
An addition of suitable amount reflective glass beads or glass powder is preferred to the to improve luminescence.

The prepared mix is coated on the surface of cured concrete providing a layer of 5mm – 15mm thickness. The prepared mix is coated over a test surface and the various tests are conducted and the results are obtained.

Results and discussion

1. Luminance an illuminance test

The luminescence of sunlight during daytime in the test area is computed using lux meter. The data was collected on early August to early September between 6.00 PM to 7:00 PM at road in Panimalar Engineering College. The amount of radiation absorbed by the phosphorescent material (strontium aluminate) depends on the illuminance during the day.



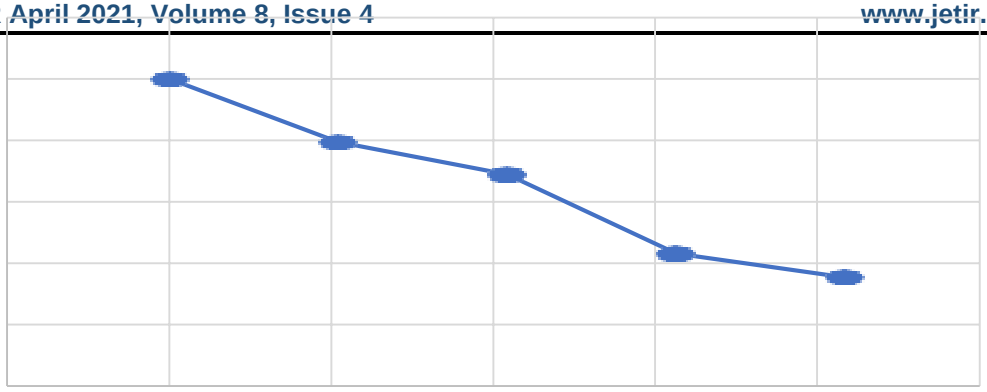


Fig 1.1

The glow is maximum during daylight and keeps decreasing as night time approaches.

The study of luminance is very important in determining the characteristics of glow. Fig

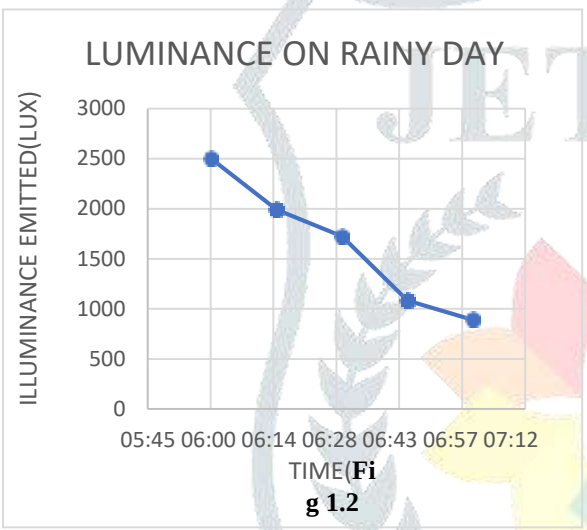


Fig 1.2

1.1 shows the variations in illuminance on sunny days during the month of august where the radiation decreases as night time approaches. Fig

1.2 depicts the decrease in illuminance on rainy days during the month of September when compared to sunny days. This shows that the radiation absorbed is intermittent and not constant at any given moment. However, longer exposure to radiation throughout day ensures steady reradiation throughout night time.

2. Light emission characteristics of phosphorescent concrete

The duration of afterglow is measured based on the time taken for absorption of light. From this the time for which the phosphorescence prevails. Based on the data obtained the duration of phosphorescent glow can be estimated for any duration.

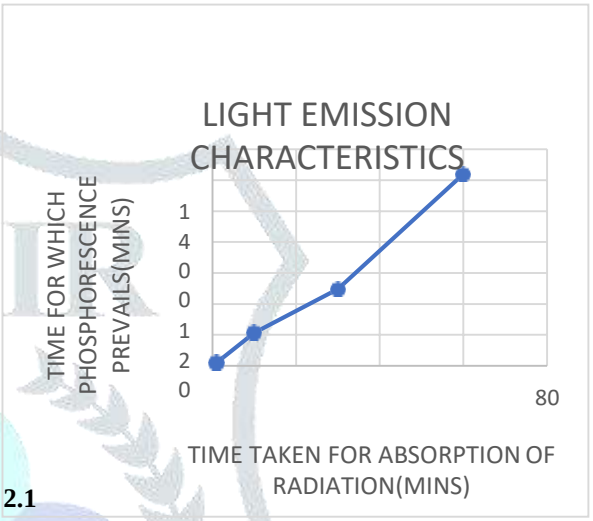
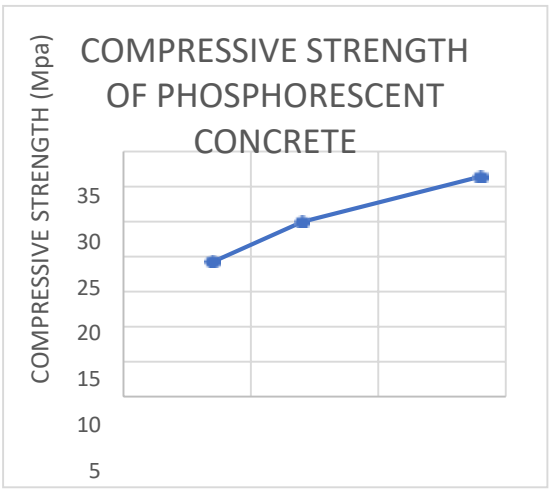


Fig 2.1

From Fig 2.1 it is observed that as the time for which the phosphorescent material is subjected to radiation keeps increasing, the time for which the phosphorescence is reemitted also increases. So, longer periods of exposure to radiation is suitable for longer period of phosphorescent glow.

Compressive strength of concrete

M30 concrete cube of dimensions 75mm X 75mm X 75mm is cast and its compressive strength for 7, 14, 28 days are estimated.



There is a steady increase in compressive strength without failure and the design strength of concrete is achieved.

Conclusion

By imparting photo luminescent properties in concrete, a self sustainable concrete is obtained. This investigation suggests that the percentage of phosphorescent material can be increased by 50% to improve the glow. The effect of photo luminescent properties on the strength of the concrete is studied descriptively. The implementation of photo luminescence induced concrete at a large scale would prove to be an ideal alternative for the illumination of roads and to light up the rural households of the country. It would be fruitful to pursue further research on this concept in order to help the construction industry to provide effective solutions to this existing problem of lack of energy resources.

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