

# Experimental Investigation of Self-luminous in Tiles

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**ABSTRACT:** Self-luminous tiles are essentially used to glow at dark without any use of electrical energy. It is an economical and effective replacement for electric bulbs to save electrical energy. The principal of Self-luminous tiles is to absorb the light and emits its illuminating property in the form of visible light. The materials have been made in the form of fine particles and applied to the crystal layer of concrete tile for perfect emission of light. Self-luminous tile is a tile with a crystal layer coating that can resist the breaking stress and it also fantastically proof against staining. The coating on the tile luminous in the dark after it is charged by sunlight or any form of energy. Hence this coating illuminates the glow itself by charging is called Self-luminous. The materials used are completely organic and therefore it is eco-friendly to the surroundings and pollution-free. The construction industry has made several attempts for further improvement to utilize waste materials as a replacement for concrete tiles for better economical. For Lawns and swimming pools Self-luminous tiles have been installed successfully for the conservation of energy. Therefore the Self-luminous tiles will be a future for the conservation of energy.

**KEYWORDS:** crystal layer, Self-luminous, conservation of energy.

## I. INTRODUCTION

The Self-luminous Tile can be used in our houses. It can be made of two base materials, namely ceramic and concrete tiles. The use of Self-luminous tiles would create a revolutionary in the tile industry on its light-emitting applications. White cement is used instead of Portland cement to increase the strength and durability of the tiles in various aspects. The sodium silicate gel act as a transparent medium for a better reflects reflection. Strontium aluminate is used for a glowing property of a tile for a minimum of 18 hours per day.

### 1.1 Strontium aluminate

Strontium aluminate is naturally odorless and nonflammable. It consist a pale yellow color. It is a crystalline powder in nature that is heavier than water. At the point when Strontium aluminate initiated with europium then it is marked as  $\text{Eu:SrAl}_2\text{O}_4$  and it goes about as a photograph luminescent with long steadiness of brightness.

For bright based purposes, strontium aluminate is an endlessly predominant phosphor substance of its ancestor and actuated with copper and zinc sulfide  $\text{Cu: ZnS}$ . Strontium aluminate is more brilliant and longer sparkling, in any case, it additionally costlier than  $\text{Cu: ZnS}$  and it can't deliver the novel red brightness. It is every now and again utilized in gleam inside the dim, where it transmits the brilliance to notify. Be that as it may, the material has high hardness and it makes scraped area the apparatus taking care of it; subsequently the producers habitually cover the particles with a worthy ointment while adding them to plastic.

Strontium aluminate can be expressed to phosphoresce at longer (yellow to red) wavelengths as well as shorter wavelengths, but the emission is often dimmer in longer wavelength than that of the shorter wavelengths.

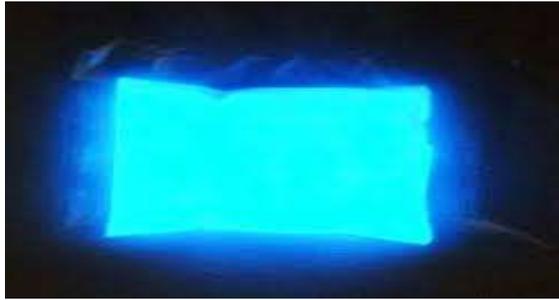


Figure 1. Image of strontium aluminate

1.2 Sodium silicate

Sodium silicate is a reasonable and drab fluid, chiefly comprises of meta-silicate, it is additionally called water glass or fluid glass. This item can be utilized in the assembling of Cement, detached fire assurance, material and production of timber wood, production of stubborn pottery, as glues, and in the arrangement of silica gel. This item showed up as a chipped strong substance or in powdered structure. The concentrated watery arrangements utilized as paste.

In industry, sodium silicates are classified by the different evaluations dependent on their SiO<sub>2</sub>: Na<sub>2</sub>O weight proportion (the proportion can be changed over to the molar proportion by augmentation with the factor of 1.032). The SiO<sub>2</sub>: Na<sub>2</sub>O proportion hasmostly fluctuated from 2:1 to 3.75:1. The SiO<sub>2</sub>: Na<sub>2</sub>O proportion underneath 2.85:1 is named as alkaline. The SiO<sub>2</sub>:Na<sub>2</sub>O proportion above 2.85:1 is named as neutral.

Sodium silicate is stable and does not react in neutral and alkaline solutions. But it is not stable in acidic solutions; the silicate ions react with any acidic solution and formulate the silicic acids, the end product silicic acids are again decomposing into hydrated silicon dioxide gel. The silicon dioxide gel is warmed to drive off the water, the outcome is a hard translucent substance called silica gel. It is generally utilized as a desiccant.

1.2.1Preparation of sodium silicate

- 1) Wear proper safety gloves.
- 2) Heat 3 grams of sodium hydroxide in 5 milliliters of water.
- 3) Once the sodium hydroxide is dissolved in water, and then slowly addsnearly 3 grams of crushed silica gel beads. Heat the solution until the beads dissolve.
- 4) This layer can be applied in the tiles properly.
- 5) The strength of the sodium silicate should be tested before use.

1.3 Properties of strontium aluminate

The luminescence properties of the acquired coating were contrasted with those of a promptly accessible in Sigma Aldrich (SrAl). Here the SrAl took as a kind of perspective. The excitation of Luminescence, discharge, and glimmer were estimated at different temperatures. The ghastly conveyances of the luminosity (durable radiance, glow) from the acquired coating and promptly accessible SrAl are practically indistinguishable. Henceforth it demonstrates that the luminosity radiance focuses of both the acquired coating and promptly accessible powder are identical. In any case, the otherworldly tops under UV (320 nm) excitation at 455 nm (2.72 eV) inside the range of the coating.

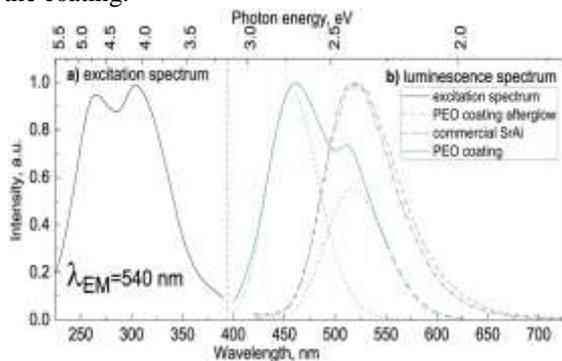


Figure 2.Property of strontium aluminate

1.4.1 Ingredients for the glow in tiles: tiles of different shapes and design that contain suitable luminescent pigment (strontium aluminate having a europium activator).

1.4.2 Purpose of the luminous tiles: after absorbing visible light, the tile will glow in the darkness.

1.4.3 Properties of the Glowing Tiles: Paving tiles are getting charged and aggregate the vitality from the Sun, UV beams, lights, and electric lamps. After switch off the charging source, the tile will gleam in the dimness. Gleam can possibly last dependent upon 8 to 12 hours subsequent to charging for 1 hour by normal source or engrossing

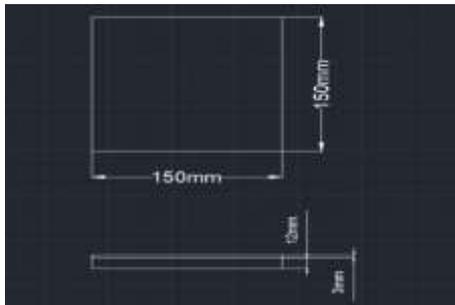
the noticeable light. Sparkle time relies upon ecological conditions. The Bright shine stage is regularly observed during the essential hour after the charging by the normal source or engrossing obvious light.

1.4.4 Features and uses of the self-luminous tiles: These tiles are paved to a prepared surface by using the rubber mallets. The color of the glow can control by the luminescent paving tiles with a flashlight during the laying process in the dark.

- 1) These self-luminous tiles are suggested in the darker regions for the better sparkle.
- 2) These tiles can be paved in a dry place with normal humidity.
- 3) These tiles are harmless to humans and the environment.
- 4) These shining tiles can be planned in various hues, for example, essential green, light blue, yellow, red, orange, blue, pink, and different hues dependent on the luminescent shade.

**II. Dimension of tiles**

The dimension of illuminating tiles for the experiment is taken as 150mm X 150mm in cross-section with athickness of 15mm as shown in the figure below.



**Figure 3. Plan and Dimensions of a Tile**

**III. Making of Self-luminous tiles**

Normal tiles of dimension 150X150mm are made of a 1:2 cement ratio. The placing of the mixture of white cement and fine aggregate in to a square sized mould of size 150mm ×150mm for 24 hrs. Let it cure for 28 days and attain full strength. The test is done for further procedures.



**Figure 4. Casting, Moulding and Curing of a Tile**

The Sodium silicate gel is prepared as per the procedure described before. Strontium aluminate is mixed with sodium silicate and 3mm is applied over the tiles. The full strength is obtained in 24hrs from then.



**Figure 5. Strontium aluminate is mixed with sodium silicate gel applied on a tile**

**Figure 6. Conventional tiles****Figure 7. Self-luminous tiles with coating**

#### IV. Test results

As per Indian Standard 1237, the following basic tests are done for the tiles. A conventional tile is also tested and the results are compared. The tests are perpendicularity, flatness, straightness, wet transverse, compression, and water absorption test. Totally 30 numbers of tiles are manufactured for taking average results in each test.

**Straightness test:** The straightness test can be carried out manually by using the thread. The thread is parallel placed between the plane of a tile and it should not exceed 1% of the length of the tile.

**Figure 6. Straightness test**

**Perpendicularity test:** The gap between the arm of the square and the edge of the tile shall not exceed 2mm.

**Flatness test:** A thread is used to find the flatness value by checking there is no convex or concave surface on the edges.

**Wet transverse test:** The specimen shall be placed horizontally on two parallel supports in the flexural testing machine. The breaking load has recorded and the wet transverse is determined by the formula mentioned in IS1237.

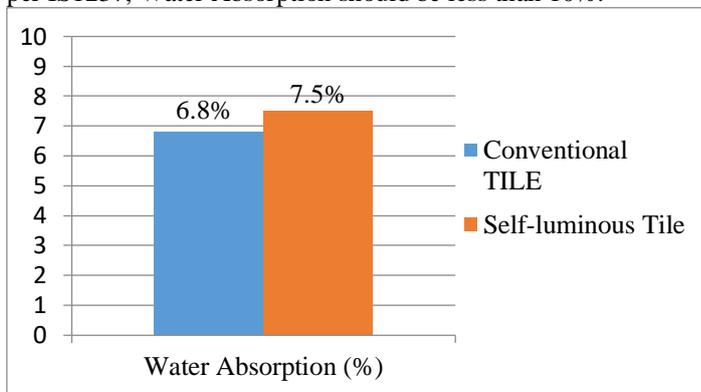
**Figure7.Wet transverse test**

Table 1 shows the values of various tests and the values are compared with permissible IS values.

**Table 1. Comparison of obtained values**

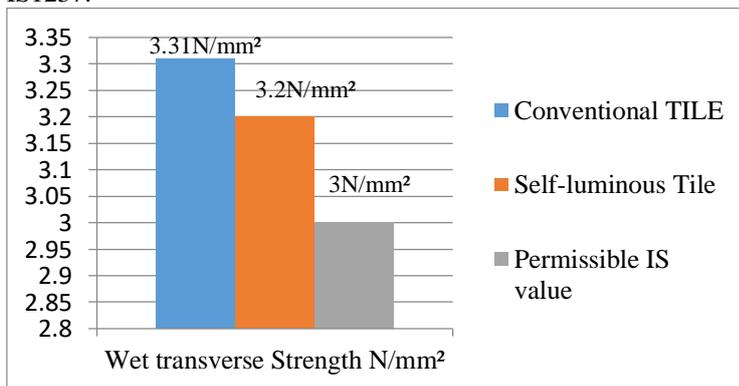
Tests	Permissible values	IS	Conventional tiles values (1)	Model tile values (2)
Flatness of the tile surface	2mm		0mm	0mm
Perpendicularity	90°		90°	90°
Straightness	<1%		0%	0%
Water absorption	<10%		6.8%	7.5%
Wet transverse strength	<3N/mm <sup>2</sup>		1.7N/mm <sup>2</sup>	1.2N/mm <sup>2</sup>
Compressive strength	-		30.6 N/mm <sup>2</sup>	27.74 N/mm <sup>2</sup>

Figure 8 shows the comparison of water absorption test results of conventional (1) and Self-luminous tile (2). As per IS1237, Water Absorption should be less than 10%.



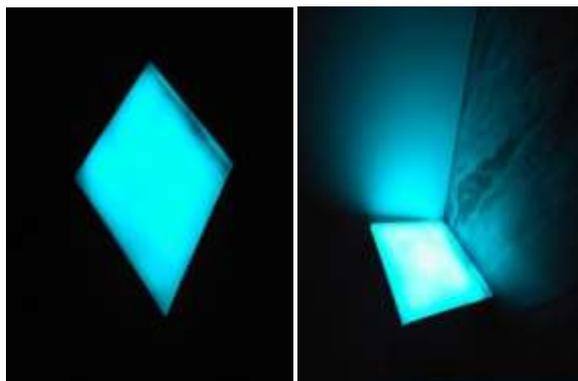
**Figure 8. Comparison of water absorption**

Figure 9 shows the comparison of wet transverse strength of the tiles which shall not be less than 3Mpa as per IS1237.



**Figure 9. Comparison of wet transverse strength**

The Self-luminous tile glows in dark as shown in the figure 10.



**Figure 10.**Self-luminous tiles glows in the dark

**V. Conclusions**

- 1) The Self-luminous tile has almost attained the strength of the standard tiles.
  - 2) This project recommends the use of Self-luminous tiles in swimming pools to reduce electric charges.
  - 3) This type of tiles gives better performance at its cost.
  - 4) It also reduces the cost of electricity.
  - 5) Using this type of tiles in the road guidance system will be very effective and modern.
  - 6) Luminous tile is well suited to areas where it can absorb light energy during the day for a radiant glow at night.
- It also can be used to reduce the accident during night driving and also helps to save energy.

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