



# Efficiency of Ecosphere as cement replacement material for strength performance of siporex and Conventional Red Brick

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## ABSTRACT

Cement and aggregates are important constituents of concrete production. The aggregate's share is 75 percent in concrete; and offers concrete volume; these aggregates have the natural resources. It takes enormous amounts of natural resources to produce these constituents. The adverse effect on the ecosystems due to this large quantity depletion of natural resources. The concrete has some of the above-mentioned disadvantages such as heavy weight, low resistance to sulphate or chemical attack, deterioration in the marine structure, enhancing the use of materials other than concrete components and having the same chemical and physical properties. There are many admixtures, polymers, minerals, and by-products used in the present industry to improve above concrete drawbacks, as well as physical and chemical properties.

**Keywords:** ECOSPHERE, compressive strength, water absorption, density

## I. Introduction:

ECOSPHERE which can be used as one of the alternatives to replace cement and sand in concrete and mortar. The key component of ECOSPHERE material is Silica ( $\text{SiO}_2$ -55-65%) and Alumina ( $\text{Al}_2\text{O}_3$ -25-35%) similar to cement and sand, and the chemical and physical properties of ECOSPHERE material are identical to cement and sand; Therefore we can use this material as one of the building materials in the construction industry to meet the current demands of the market and to ensure sustainable construction.

Since 1972, the Siporex Blocks are developed in India, in collaboration with Sweden's International Siporex AB. Siporex (ALC-" Aerated Light Weight Concrete) "is admired worldwide for its exceptional strength, structural and physical properties and is the chosen building material. It is suitable for climate and seismic zones of any kind. Its superior and energy-saving properties, Aerated Light Weight concrete is widely known as an environmentally

friendly commodity worldwide. Increased use of Siporex helps maintain and protect the forest cover of our world. Siporex is structural material, cured by steam, and concrete by cell (aeration). This is available for all types of buildings, and particularly for multi-story buildings, as walls, floors and roof slabs and wall panel. The name Siporex block which is common in the light weight blocks in the current construction industry. Siporex is a lightweight autoclaved aerated concrete that is a fully cured, inert and stable type of silicate calcium hydrate. It is a structural material, about a quarter of the weight of conventional concrete, composed of minute cells which give the material light weight and high properties of thermal insulation. Siporex is a lightweight autoclaved aerated concrete that is a fully cured, inert and stable type of silicate calcium hydrate. It is a structural material, about a quarter of the weight of conventional concrete, composed of minute cells which give the material light weight and high properties of thermal insulation.

## II Properties of material

**Table No 1: Physical and Chemical Properties of ECOSPHERE Material**

Size	50 – 350 $\mu$
Shape and appearance	Spherical and free flow ability
Colour	Gray- light gray- off white
Particle density	0.5- 0.8 gm/cc
Bulk density	0.35 – 0.45 gm/cc
Hardness	5 – 6 moth's scale
Compressive strength	14 – 35 N/mm <sup>2</sup>
Softening point	Above 1450° C
PH value	6.0 - 8.0
Coefficient of thermal expansion	8 X 10 <sup>-6</sup> K
Surface moisture	Less than 0.5%
Solubility	Negligible in water
Oil absorption	16 <sup>-18</sup> gm oil/ 100gm
Specific resistance	10 <sup>11</sup> – 10 <sup>13</sup> $\Omega$ /cm <sup>2</sup>
Water absorption	Less than 5%
Silica	55 – 65%

Alumina	25 – 35%
Calcium oxide	1.5 – 4.0%
Iron oxide	1 -5%
Titanic	0.5 – 1.5%

**Table No 2: Physical and Chemical Properties of Siporex**

TECHNICAL SPECIFICATION	
Density (Oven Dry)	550 – 650 Kg/ Cum
Compressive Strength	As per IS 2185 part III Approx. 35 – 40 N/ mm <sup>2</sup>
Tensile Strength	6 Kg/ cm <sup>2</sup>
Modulus of Elasticity	16000 Kg/ cm <sup>2</sup>
Shear Strength	2 Kg/ cm <sup>2</sup>
Thermal Conductivity	0.142 Kcal/ (hr.)(Deg C)(M)
Resistance to Fire	2-6 hours depends on thickness
Sound Reduction Index	37-49 db depends on thickness
Design Density	800 Kg/ Cum
Moisture content	5% - 8% (Dry Condition)
Coefficient of Thermal expansion	8 X 10 <sup>-6</sup> per Deg C
Melting Point	1100-1200 Deg C

### III. Experimental Work:

Prepared 650 mm X 240 mm X 150 mm format block identical to Siporex block, 230mmX150mmX100 mm (Conventional Red Brick) block, and 150 X150 X 150 mm concrete block. The specimens are prepared using different proportions of the ECOSPHERE materials. We carried out the experimental work with Compressive Power, Water Absorption Test and Density and compared the results with the results of the Siporex block.

**Proportion of Material:** Different Mix proportion with replacement of Sand by ECOSPHERE with different percentages.

- Mix proportion 1 : 1 : 2 (Cement : ECOSPHERE :Sand)
- Mix proportion 1 : 2 : 1 (Cement : ECOSPHERE :Sand)
- Mix proportion 1 : 3 (Cement : ECOSPHERE)

#### Compressive Strength :

The test moulds are prepared by using the 650 mm X 240 mm X 150 mm siporax block, 230mmX150mmX100 mm (Conventional Red Brick) and 150 X150 X 150 mm concrete block to perform the compressive strength test. The mould size is close to that of the Siporex plate. To perform the compressive strength by adjusting the proportion of

sand and ECOSPHERE material and moulds are filled, the compressive test is performed on UTM machine after the 28days of curing and the results are created.

### Water absorption:

For performing the water absorption test, we are using the test specimens which are preparing for compressive study, then weights are taken for specimens before and after curing, from those results we are measuring water absorption.

$$\text{Water absorption (\%)} = [\text{Weight after curing} - \text{Weight before curing}] / \text{Weight before curing} \times 100$$

### Density:

For conducting density test, we are using the test specimens which are already for preparing for compressive test, then weights are taken for specimens before divider by total volume of specimen, from those results we are calculating density.

$$\text{Density (kg/m}^3\text{)} = \text{Weight before curing} / \text{Volume of cube}$$

## IV RESULTS

**Table No 3 Compressive Strength test results for different proportion and comparing results with Siporex blocks**

Sr. No.	Mix	Average Compressive Strength (N/mm <sup>2</sup> ) 28days	Compressive Strength (N/mm <sup>2</sup> ) 28days	Compressive Strength (N/mm <sup>2</sup> ) 28days
		Ecosphere blocks	Siporex Blocks	Conventional Red brick
1	1 : 1 : 2	32.12	21.75	12.5
2	1 : 2 : 1	31.43		
3	1 : 3	26.78		

**Table No 4: Water Absorption test and Density results for different proportion and comparing results with Conventional Bricks**

Sr. No.	Mix	Water Absorption (%)			Density (Kg/m <sup>3</sup> )		
		Ecosphere Brick	Siporex	Conventional Red brick	Ecosphere Brick	Siporex	Conventional Red brick
1	1 : 1 : 2	7.66	5.21	6.16	1086	568	662
2	1 : 2 : 1	6.78			783		
3	1 : 3	4.95			515		

## V Discussions

1. ECOSPHERE's compressive strength decreases with an increase in ECOSPHERE percentage, but it is higher than the siporex block.
2. For an rise in the percentage of ECOSPHERE, water absorption is reduced; it is also lower than Siporex blocks.
3. Density is reduced with increased ECOSPHERE percentage; it is also lower than siporex blocks.
4. ECOSPHERE Bricks ' compressive strength decreases with ECOSPHERE's percentage rise but it is better than conventional bricks.
5. With the percentage of ECOSPHERE, water absorption is reduced; it is also lower than conventional bricks.
6. Density is decreased with an increase in ECOSPHERE level, it is also lower than standard bricks.

## VI Future Scopes

- The compressive strength of light weight blocks with different foaming agents can be checked and compared results with Siporex blocks.
- Fire resistance is the one of the important issue in the steel structure, in the current industry there are many types of polymers, byproducts are used to improve the fire resistance of structural steel. Hence we shall propose to conduct experimental investigation with ECOSPHERE using binding agent, and to check its feasibility.
- The ECOSPHERE material is used in the rubber industry in the manufacturing of Base-isolation.



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