

# Behavioural Analysis of CO<sub>2</sub> Bricks

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**ABSTRACT:** Greenhouse gas carbon-di-oxide is emitted from various natural and man-made sources like cement production, power plant, use of fossil fuels may affect the environment and leads to global warming. This carbon-di-oxide gas has been utilized for making different types of bricks. Sodium silicate (Na<sub>2</sub>SiO<sub>3</sub>) is used as a binding material. The bricks are casted by, mixing the sodium silicate in the sand and then injecting the carbon-di-oxide gas. Four different samples of bricks were casted – purely river sand bricks, purely M-sand bricks, partial combination of river sand & M-sand bricks and partial combination of river sand & clay bricks. The compressive strength of these different samples is revealed at the ages of one to twenty eight days at normal room temperature. The dimension of casted brick is 190 mm X 90 mm X 90 mm.

**KEYWORDS:** Bricks, Carbon-di-oxide (CO<sub>2</sub>), Sodium silicate (Na<sub>2</sub>SiO<sub>3</sub>), River sand, M-sand

## I. INTRODUCTION

Bricks play the more vital role in the emerging construction field. In these recent days there are thousands of types of bricks were categorized depends upon their use, size, forming method, origin, quality, texture, and materials used. The three basic types of brick manufacturing process are unfired, fired and chemically set bricks. In this production of bricks we introduce a new technique, which is injection of carbon-di-oxide gas into our used material (sand and M-sand).

## II. SCOPE AND OBJECTIVES

### 2.1 SCOPE

- ❖ Injection of CO<sub>2</sub> gas gives hardness to the bricks.
- ❖ Making time and curing time of bricks has been reduced.
- ❖ Usage of water avoided.
- ❖ Eco-friendly bricks.

### 2.2 OBJECTIVES

- ❖ Attempt to make sand bricks by injecting CO<sub>2</sub> gas.
- ❖ The constituent of silica in sand react with CO<sub>2</sub> gas and make the brick harder within few seconds.
- ❖ To do the compressive strength.
- ❖ Trying to make the partial replacement of sand by clay and M-Sand bricks.

- ❖ The comparative results have to be analyzed

### **III. MATERIALS**

#### **3.1. MATERIALS USED**

- ❖ Carbon-di-oxide (CO<sub>2</sub>).
- ❖ Sodium silicate (Na<sub>2</sub>SiO<sub>3</sub>).
- ❖ River sand.
- ❖ M-sand.
- ❖ Clay.

#### **3.1 CARBON-DI-OXIDE (CO<sub>2</sub>)**

Carbon-di-oxide is a colorless gas with a density about 60% higher than that of dry air. Carbon-di-oxide is soluble in water, it occurs naturally in ground water, rivers and lakes, ice caps, glaciers and sea water. It is the most significant long lived greenhouse gas in earth's atmosphere. Since the industrial revolution anthropogenic emissions primarily from use of fossil fuels and deforestation have rapidly increased its concentration in the atmosphere, leading to global warming.

#### **3.2 SODIUM SILICATE (Na<sub>2</sub>SiO<sub>3</sub>).**

Sodium silicate or sodium meta silicate (Na<sub>2</sub>SiO<sub>3</sub>) is also known as water glass or liquid glass. They are used in cements, passive fire protection, textile and lumber processing, refractories, and automobiles. Sodium carbonate and silicon dioxide react when molten to form sodium silicate and carbon-di-oxide.

#### **3.3 RIVER SAND**

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. The most common constituent of sand, in inland continental settings and tropical coastal settings, is silica. It is estimated that the annual consumption of sand and gravel is 40 billion tons and sand is an US \$70 billion global industry.

#### **3.4 M-SAND**

M-sand means manufactured sand. Manufactured sand is produced from hard granite stone by crushing. The crushed sand is of cubical shape with grounded edges, washed and graded to as a construction material. It is used as a substitute of river sand for concrete construction. It is well graded in the required proportion. It does not contain organic and soluble compound that affects the setting time and properties of cement, thus the required strength of concrete can be maintained.

#### **3.4 CLAY**

Clay is a finely-grained natural rock or soil material that combines one or more clay minerals with possible traces of quartz, metal oxides and organic matter. Depending on the soil's content in which it is found, clay can appear in various colors from white to dull grey or brown to deep orange-red.

#### **IV. METHODOLOGY TO MAKE BRICKS**

There are four types of bricks were casted.

1. Purely river sand bricks (S1).
2. Purely M-sand bricks (S2).
3. Partial combination of river sand & M-sand bricks (S3).
4. Partial combination of river sand & clay bricks (S4).

##### **4.1 PURELY RIVER SAND BRICKS**

- a) Calculating the volume of sand required for the brick, whose dimension is 190x90x90mm.
- b) The sand is to sieve in 1.18mm siever.
- c) Then, mix 100ml sodium silicate with sand.
- d) It is filled into the mold.
- e) Making three holes in the sand, which were taken into the mould.
- f) Injecting carbon-di-oxide inside the holes.
- g) Then demould the River sand brick.



Fig 4.1(a) Sieving river sand



Fig 4.1(b) Adding sodium silicate



Fig 4.1(c) Filling and damping sand into mould



Fig 4.1(d) Injecting CO<sub>2</sub> gas



Fig 4.1(e) River sand brick

#### 4.2 PURELY M-SAND BRICKS

- Calculating the volume of M-sand required for the brick, whose dimension is 190x90x90mm.
- The M-sand is to sieve in 1.18mm siever.
- Then, mix 150ml sodium silicate with M-sand.
- It is filled into the mold.
- Making three holes in the M-sand, which were taken into the mould.
- Injecting carbon-di-oxide inside the holes.
- Then demould the M-sand brick.



Fig 4.2 purely M-sand brick

#### 4.3 PARTIAL COMBINATION OF RIVER SAND & M-SAND BRICKS

- Calculating the volume of river sand and M-sand required for the brick, whose dimension is 190x90x90mm.
- The river sand and M-sand is to sieve in 1.18mm siever.
- By combining river sand and M-sand, 150ml sodium silicate is added.

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- d) It is filled into the mold.
- e) Making three holes in the sample, which were taken into the mould.
- f) Injecting carbon-di-oxide inside the holes.
- g) Then demould the brick.



Fig 4.3 Partial combination of River sand and M-sand brick

#### 4.4 PARTIAL COMBINATION OF RIVER SAND & CLAY BRICKS

- a) Calculating the volume of river sand and clay required for the brick, whose dimension is 190x90x90mm.
- b) The river sand and clay is to sieve in 1.18mm sieve.
- c) By combining river sand and clay, 150ml sodium silicate is added.
- d) It is filled into the mold.
- e) Making three holes in the sample, which were taken into the mould.
- f) Injecting carbon-di-oxide inside the holes.
- g) Then demould the brick.



Fig5.4 Partial combination of River sand and clay brick

## V. TESTING OF BRICKS

### 5.1 COMPRESSIVE STRENGTH TEST

Compressive strength is the capacity of a material to withstand loads tending to reduce size. 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. The compressive strength of the bricks is tested by using CTM (compression testing machine). Compressive strength of bricks has been taken for first, second, third, seventh, fourteenth and twenty eighth days.



Fig 5.1(a) Compression testing machine



Fig 5.2(b) Testing brick in CTM

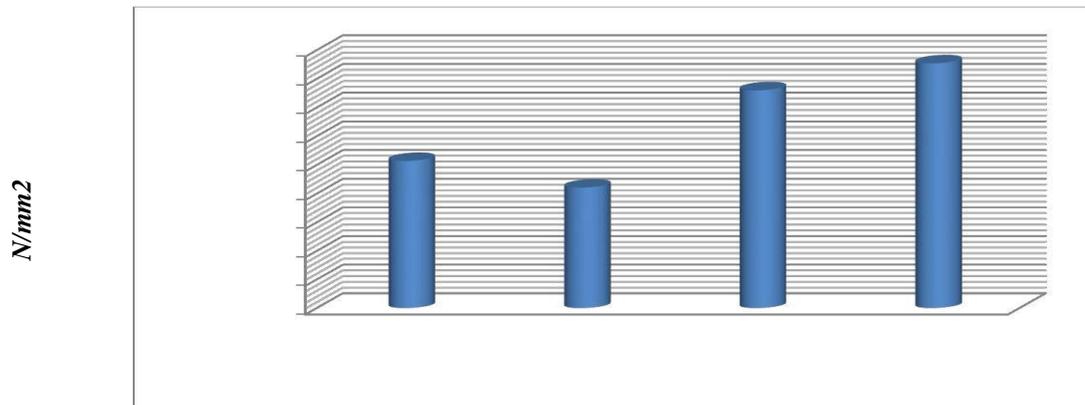
#### 5.1.1 TEST RESULTS

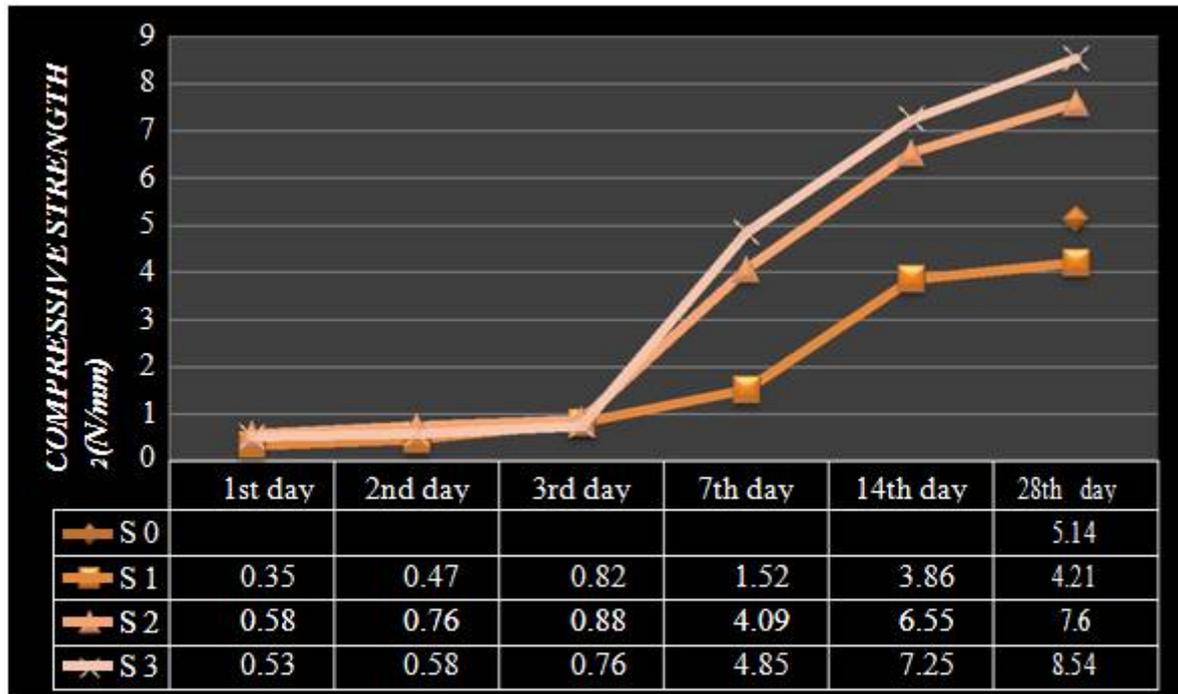
TABLE 5.1 COMPRESSIVE TEST RESULTS FOR 1<sup>ST</sup>, 2<sup>ND</sup> AND 3<sup>RD</sup> DAYS

SI. NO	S A M P L E	ST		ND		RD	
		1 DAY		2 DAY		3 DAY	
		LOAD (KN)	COMPRESSIVE STRENGTH (N/mm <sup>2</sup> )	LOAD (KN)	COMPRESSIVE STRENGTH (N/mm <sup>2</sup> )	LOAD (KN)	COMPRESSIVE STRENGTH (N/mm <sup>2</sup> )
1	S0	-	-	-	-	-	-
2	S1	6	0.35	8	0.47	14	0.82
3	S2	10	0.58	13	0.76	15	0.88
4	S3	9	0.53	10	0.58	13	0.76
5	S4	IT CRUSHED FOR A SMALL AMOUNT OF LOAD, SO IT IS NOT SUITABLE.					

TABLE 5.2 COMPRESSIVE TEST RESULTS FOR 7<sup>TH</sup>, 14<sup>TH</sup> AND 28<sup>TH</sup> DAYS

SI. NO	S A M P L E	7 <sup>TH</sup> DAY		14 <sup>TH</sup> DAY		28 <sup>TH</sup> DAY	
		LOAD (KN)	COMPRESSIVE STRENGTH 2 (N/mm )	LOAD (KN)	COMPRESSIVE STRENGTH 2 (N/mm )	LOAD (KN)	COMPRESSIVE STRENGTH 2 (N/mm )
1	S0	-	-	-	-	88	5.14
2	S1	26	1.52	66	3.86	72	4.21
3	S2	70	4.09	112	6.55	130	7.6
4	S3	83	4.85	124	7.25	146	8.54
5	S4	IT CRUSHED FOR A SMALL AMOUNT OF LOAD, SO IT IS NOT SUITABLE.					





GRAPH 5.2 COMPARATIVE ANALYSIS OF BRICKS

## VI. CONCLUSION

- ✓ Bricks are manufactured by the injection of carbon-di-oxide gas.
- ✓ Usage of water during the production of bricks has avoided.
- ✓ Compressive strength of the bricks was tested.
- ✓ This method is not suitable for Partial combination of river sand & clay bricks, due to the imperviousness of clay.
- ✓ By the analysis, partial combination of river sand & M-sand bricks as achieved more compression strength than comparing conventional fired clay brick and other samples.

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