

# An Experimental Investigation on Brick by Partial Replacement of Clay with Copper Slag and Sculpture Waste

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**Abstract** - In this experimental investigation is about the partial replacement of clay in brick with copper slag and sculpture waste. The Partial replacement of copper slag and sculpture waste in different percentage such as 0 to 5%. When copper slag is introduced as a replacement material, it reduces the environmental pollution. The Plaster of paris is a hard white substance made by the addition of water to powdered and partly dehydrated gypsum. Since it reduces the production of waste .The experiments are conducted for variation in properties i.e, compressive strength, water absorption, hardness and soundness. The effects of those wastes (copper slag and plaster of paris) on the bricks properties as physical, mechanical properties will be reviewed. This reviewed approach on bricks making from waste is useful to provide potential and sustainable solution.

## 1. INTRODUCTION

Now a days, most of the developed countries face the problems of storage and disposal of waste products. For this reason, recycling and reuse of these waste products prevents environmental pollution.

Copper slag is a by -product obtained during the melting and refining of copper .In current situation 24.6 million tonnes of copper slag is generated around the world.

Gypsum is heated at 128°C, resulting in powdery substance commonly known as plaster of paris. Over the years, million tonnes of waste plaster of paris were generated and disposed in land fill was dumped directly into the environment without any disposal.

Out of the total construction cost, the cost of building materials is about 70% in developing countries like India. Therefore, the utilization of industrial waste helps in reducing the waste generated as a result of rapid industrialization and also helps in reducing the construction cost.

### 1.1 OBJECTIVE OF THE PROJECT

This study involves the addition of copper slag and sculpture waste with clay bricks.

- To investigate the compressive strength of bricks.

- To investigate the physical properties of bricks.
- Comparison of result with conventional bricks based on their performance.

### 1.2 NEED FOR THE STUDY

More land is being used for getting clay for making brick.

When copper slag and plaster of paris is used as a partial replacement, the use of clay is reduced. A new combination of brick manufacturing is obtained. When plaster of paris and copper slag are gives a very fine finishing and good appearance for the brick. High strength can be obtained, so it can be used for main elements of a structure. No dumping of waste and it is used as replacement in clay bricks, concrete.

### 1.3 SCOPE OF THE PROJECT

- The use of combination of clay with copper slag and sculpture waste in bricks would be more efficient as well as environment friendly.
- To minimize the water pollution.
- Disposal problems at the disposing sites, and this have been changed in to useful resource and used in the brick making.
- The cost and other properties of the bricks are equalized to the normal bricks.
- Construction industries will build a new thrust by this research work.

## 2. MATERIALS USED

- Clay
- Copper slag
- Sculpture waste
- Water

### 2.1 CLAY:

Clay is a fine grained natural rock or soil that combines one or more clay minerals with traces of metal oxides and organic matter. Clay soil consist soil particles having size between 0.001-0.01mm.

PROPERTIES:

Specific gravity	2.26
Fineness modulus	5.23
Plastic limit	21.16%
Liquid limit	33.14%

## 2.2 COPPER SLAG

Copper slag is used in the brick one of the alternative materials. It is the waste product of copper from smelting process. It including excellent soundness characteristics, good abrasion resistance and good stability.

PROPERTIES:

Specific gravity	3.42
Fineness modulus	3.29
Moisture content	0.13%
Percentage of voids	34%
Water absorption	0.18%

## 2.3 SCULPTURE WASTE

Plaster of paris is non-combustible and non-flammable .Low chemical reactivity but can act an oxidizing agent under extreme conditions. The powder is mixed with water it re-forms into a paste and eventually hardens into a solid. The plaster of paris has a property of setting into a hard in about half an hour after wetting with water

## 2.4 WATER

Water is a transparent, odourless, and nearly colourless chemical substance that is the main constituent of earth's streams, lakes and the fluids of most living organisms. The water used for mixing of brick and should be potable drinking water having pH 6 to 8.

## 3. EXPERIMENTAL RESULTS ON BRICKS

### 3.1 WATER ABSORPTION TEST

The water absorption of bricks is not related directly to the porosity of the bricks. Some of pores may be through pores which permit air to escape and allow free passage of water in absorption test. The test is done by immersing the brick in water for 24 hours.

$$\% \text{ of water absorption} = ((W_1 - W_2) / W_2) \times 100$$

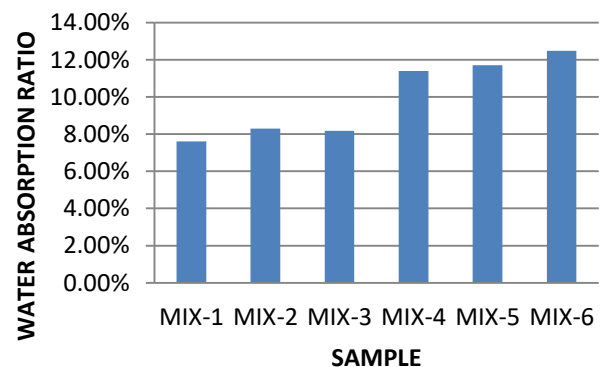
Where,

$W_1$  = Dry weight of brick

$W_2$  = Wet weight of brick

Weight of brick	Mix-1	Mix-2	Mix-3	Mix-4	Mix-5	Mix-6
Initial weight	2.990	2.850	2.986	2.890	2.990	2.810
Final weight	3.220	3.110	3.240	3.220	3.340	3.200
Water absorption ratio	7.6%	8.3%	8.17%	11.4%	11.7%	12.18%

### WATER ABSORPTION RESULT



### 3.2 COMPRESSION STRENGTH TEST

The aim of the experiment test is to determine the maximum load carrying capacity of specimens.

Compression strength of brick is tested with different percentage of materials. After casting the bricks compression strength is calculated for compression testing machine.

$$\text{Compression strength } f_c = (P/A) \text{ N/mm}^2$$

Where,

$f_c$  = Compression stress N/mm<sup>2</sup>

P = Load at which specimen fails in Newton (N)

A = Area of the specimen in mm<sup>2</sup>

sample	Size mm	Area mm <sup>2</sup>	Load N	Compression strength N/mm <sup>2</sup>	Compression strength N/mm <sup>2</sup>
Mix 1	215×100	21500	110000	5.11	5.11
			100000	4.65	
			120000	5.58	
Mix 2	215×100	21500	120000	5.58	5.56
			110000	5.11	
			130000	6.0	
Mix 3	215×100	21500	110000	5.11	5.42
			120000	5.58	
			120000	5.58	
Mix 4	215×100	21500	160000	7.44	7.02
			150000	7.00	
			140000	6.51	
Mix 5	215×100	21500	140000	6.51	6.49
			130000	6.00	
			150000	6.97	
Mix 6	215×100	21500	130000	6.00	6.52
			150000	6.97	
			140000	6.51	

absorbing moisture. To find out the presence of alkalis in bricks this test is performed.

- In this test a brick immersed in fresh water for 24 hours and then it taken out from water are allowed to dry state.
- If the whitish layer is not visible on surface it proofs that absence of alkalis in brick.
- If the whitish layer visible about 10% of brick surface then the presence of alkalis in brick.

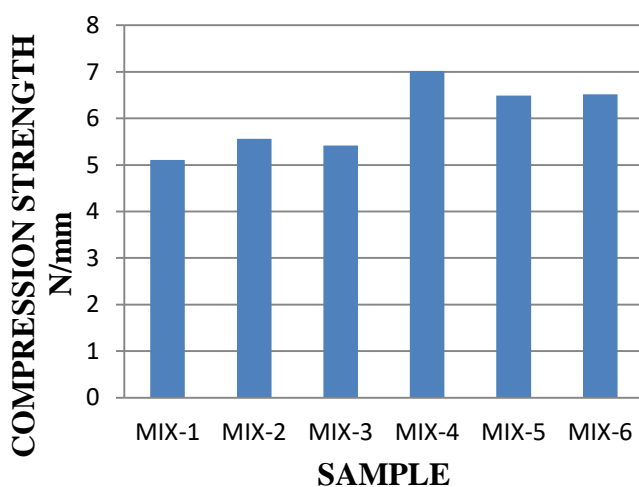
Sample	Effects
Mix 1	Nil
Mix 2	Nil
Mix 3	Nil
Mix 4	Slight
Mix 5	Slight
Mix 6	Moderate

### 3.4 SOUNDNESS TEST

- Two bricks are taken one in each hand and they are struck with each other lightly.
- The bricks should not break and clear ringing sound be produced.



### COMPRESSION STRENGTH GRAPH



### 3.3 EFFLORESCENCE TEST

- The presence of alkalis in bricks is harmful and they form a gray or white layer on brick surface by

### 3.5 SIZE AND SHAPE TEST

- In this test should be of standard size and it should be truly rectangular with sharp edges.

- For this purpose, 20 bricks of standard size are selected at random and they are stacked lengthwise, along the width and along the height.
- Size of brick = 215mm×100mm×70mm

### 3.6 HARDNESS TEST

In this test a scratch is made on the brick surface with the help of a finger nail. If no impression is left on the surface, the brick is sufficiently hard.



### 4. CONCLUSION

- The color, shape and size were found to be satisfactory.
- The brick gives metallic sound when banged with other brick.
- The compression strength was also found to be satisfactory.
- Use of environment waste products like copper slag and sculpture waste helps to keep our environment safe and clean which will also be helpful for aquatic life.
- The brick did not absorb more than 20% of water by dry weight.

- The brick with less mix ratio better compression result as compared to conventional brick.

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