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The Use of Waste Plastic in the Manufacture of Bricks

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Abstract - *Current world is facing grave circumstances of waste management, particularly plastic throw away. Daily thousands of tonnes of artificial are vacant to the nonsense but there is no sufficient process to satisfaction and reuse the plastic world. A great quantity of plastic is been remaining or burned daily which leads to the spot of surroundings and air. Build up of plastic desecrate in the surroundings is harmful to both plant and animal life. The plastic waste in the form of PET (Polyethylene terephthalate) has an important environmental challenge and its recycling faces a big problem due to its non-degradable nature. In this work an attempt has been made to manufacture the bricks by using waste plastics in range of 60 to 80% by weight of laterite quarry waste and 60/70 grade bitumen was added in range of 2 to 5% by weight of soil in molten form and this bitumen- plastic resin was mixed with laterite quarry waste to manufacture the bricks. The bricks manufactured possess the properties such as neat and even finishing, with negligible water absorption and satisfactory compressive strength in comparison with laterite stone to satisfy the increasing demand of conventional building materials.*

Keywords: *Poly ethylene terephthalate (PET), Laterite quarry waste, Bitumen, plastic-soil bricks.*

1. INTRODUCTION

The problem of disposing and organization hard desecrate materials in all countries has become one of the main ecological, economical, and social issues. A total desecrate management system including source decrease, reuse, recycling, land-filling, and burning requirements to be implement to control the growing desecrate removal problems. Usually a plastic is not recycled into the same type of plastic products made from recycled plastics are often not recyclable. The use of eco-friendly plastics is growing. If some of these get mixed in the other plastics for recycling, the cultivated plastic is not recyclable because the variance in properties and melt temperatures. The purpose of this project is to evaluate the possibility of using granulated plastic waste materials to partially substitute for the coarse aggregate in concrete composites. Among different waste fractions, plastic waste deserves special attention on account non eco-friendly property which is creating a lot of problems in the environment. In India approximately 40 million tons of solid waste is produced annually. This is increasing at a rate of 1.5 to 2% every year. Plastics constitute 12.3% of total waste produced most of which is from discarded water bottles. The plastic waste cannot be disposed of by discarding or burning, as they produce unrestrained fire or contaminate the soil and vegetation.

2. METHODOLOGY

2.1 Waste plastic:-

By definition the plastics Can be made to different shapes when they are heated. in closest environment it exists in the different forms such as cups, furniture's, basins, plastic bags, food and drinking containers, and they are become waste materials. Accumulation Of such wastes can result into hazardous effects to both human and plant life.

Fig 2.1 waste plastic

2.2 River sand:

Sand is naturally occurring granular material which is composed of mineral particles and finely divided materials. The composition of sand varies depending on the local rock conditions settings and non-tropical coastal region is silica dioxide (Si02) in the form of quartz. Sand are now used in all the construction process.

Fig 2.2 River sand

2.3 Mix Design:

The mix proportion were in the ratio of (1:2,1:3,) These are the ratio which represent the plastic, river sand respectively. We had use weight batching to find the quantity of material for the size (19X9X9)cm brick.

Table 2.1 Mix Design

Ratio	Plastic in kg	Sand in kg
1:2	0.7089 kg	1.65 kg
1:3	0.53 kg	1.85 kg

Fig 2.3 Mix Design

2.4 Manufacturing of Brick

In first step we should collect the waste plastic bags and bottles. Next the collected waste bags are cleaned with water and dried to remove the water present in it after this the plastics are burned out by using stones and firewood. The stones are arranged to hold the drum and the Firewood is placed in the gap between the stones and it is ignited. The drum is placed over the above setup and it is heated to remove the moisture present in it. Then the plastic bags are added to the drum one by one and the river sand is added to the plastic when it turns into hot liquid. The sand is added is mixed thoroughly using rod and trowel before it hardens. The mixture has a very short setting hence mixing process must not consume more time on the other hand the process should be complete. These mixtures are then pouted in to the brick mould and they are compacted using steel rod and surface is finished using trowel. Before placing the mixture into the mould, the sides of the mould are oiled to easy removal of bricks. After completion of proper mixing we place mix into required mould. In these projects we use the normal brick sizes (19x9x9 cm). After 1 days remove the brick from the mould

Fig 2.4 Manufacturing of Brick

Observation done during our project

- Initial setting time of brick was 2min.
- Final setting time of brick was 60min.
- Total losses of plastic were 50% in gases form (20gm of bottle).
- Total time required for making of one brick was 25min.
- Time required to melt the plastic was 15min

3. CALCULATIONS

3.1 Mix Design Calculations

a) Ratio (1:2)

Size of brick = 19 X 9 X 9 cm
= 0.19 X 0.09 X 0.09 m
Volume of brick = 0.00153 m^3
Sum of proportion= 1+2 = 3
Amount of plastic = $\frac{0.00153}{3}$ x 1
= (5.1 x 10^{-4}) x 1390 …… (1390 PET density)
Amount of plastic = 0.7089kg of plastic.

Amount of sand= $\frac{0.00153}{3}$ x 2
= (1.02 x 10^{-3}) x 1620 …. (1620 Sand density)
Amount of sand=1.65kg of sand.

b) Ratio (1:3)

Size of brick = 19 X 9 X 9 cm
= 0.19 X 0.09 X 0.09 m
Volume of brick = 0.00153 m^3
Sum of proportion= 1+3=4

Amount of plastic = $\frac{0.00153}{4}$ x 1
= (3.825 x 10^{-4}) x 1390… (1390 PET density)
Amount of plastic = 0.53 kg of plastic.

Amount of sand= $\frac{0.00153}{4}$ x 3
= (1.14 x 10^{-3}) x 1620 …. (1620 Sand density)
Amount of sand = 1.85 kg of sand.

3.2 Compressive strength test Calculation: -

Fig 3.1 Compressive strength test Calculation

Compressive strength = Maximum load / Area of the specimen = P/A
Where,
P - Maximum load (KN)
A - Area of the specimen (mm^2)
Bricks surface area = 19 cm x19 cm = 171cm^2

= 17100 mm^2

Maximum load = 80 KN, 75 KN, 110 KN,

For 1:2 brick ratio 1, 2 & 3 respectively

= 60 KN, 70 KN, 75 KN, and For 1:3 brick ratio 1, 2 &3 respectively

Plastic brick (1:2)

1) 80000/17100 = 4.67
2) 75000/17100 = 4.38
3) 110000/17100 =6.43

The Average compressive strength = 5.16 N/mm2

Plastic brick (1:3)

1) 60000/17100 = 3.50
2) 70000/17100 = 4.09
3) 75000/17100 = 4.38

The Average compressive strength = 3.99 N/mm2

3.3 Water absorption test calculation:-

Water absorption in % by wt. = $\frac{w2-w1}{w1} x100$

Where,

W1 = Weight of dry Brick (kg)

W2 = Weight of wet Brick (kg)

a) Plastic brick (1:2)

Water absorption of Sample brick 1 in %
$\frac{3.250-3.200}{3.200}$ x100 = 1.56

Water absorption of Sample brick 2 in %
$\frac{3.290-3.270}{3.270}$ x100 = 0.61

Water absorption of Sample brick 3 in %
$\frac{3.300-3.240}{3.200}$ x100 = 1.85

Average % of water = 1.34

4. RESULT

4.1 Compressive strength:

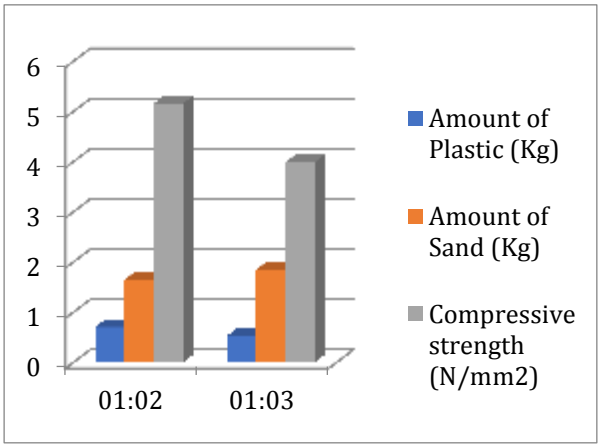

Fig 4.1 Compressive strength

From the above graph 5.1 Compressive strength shows that the Mix design ratio between plastic and sand are 1:2, and 1:3 and the compressive strength are 5.16 N/ mm2, and 3.99 N/ mm2 respectively. After the compression test, it clearly shows that the Mix Design Ratio between the plastic and sand 1:2 gives more compressive strength 5.16 N/ mm2 rather than the other ratio.

4.2 Percentage of water Absorption:

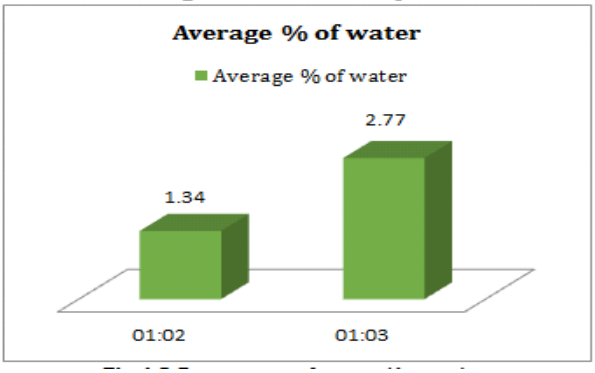

Fig 4.2 Percentage of water Absorption

From the above graph 5.2 Percentage of Water Absorption shows that the for mix ratio 1:2 has 1.34% of Water Absorption whereas mix ratio 1:3 has 2.77 % of Water Absorption. As per the test result, mix ratio 1:2 is good in resisting water absorption as compared to mix ratio 1:3.

5. CONCLUSION

The Plastic sand bricks possess more advantages which include Cost efficiency, Removal of waste products thus abolishing the land requirement problem for dumping plastic, Reduction in the emission of greenhouse gases by the conversion of flue gases in tosynthetic Oil etc., This method is suitable for the countries which has the difficult to dispose /recycle the plastic waste. The natural resources consumed for the manufacturing Of Plastic sand bricks are very much less when compared to its counterparts. Plastic sand brick possess more advantages which includes cost efficiency, resource efficiency, reduction in emission of greenhouse gases, etc. Plastic sand brick is also known as "Eco-Bricks" made of plastic waste which is otherwise harmful to all living organisms can be used for construction purposes. It increases the compressive strength when compared to fly ash bricks & clay bricks. By use of plastic sand bricks, the water absorption presence of alkalies was highly reduced.

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