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Utilization of Plastic Waste in Foundry Sand Bricks

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Abstract: ***Conventional building material not easily available at low cost. On the other hand the foundry waste Sand is abundantly available and the disposal of waste plastics (PET, PP, etc.) is a biggest challenge, as repeated recycling of PET bottles pose a potential danger of being transformed to a carcinogenic material and only a small proportion of PET bottles are being recycled. 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 Foundry Waste sand and 60/70 grade bitumen was added in range of 2 to 5% by weight of sand in molten form and this bitumen- plastic resin was mixed with Foundry waste sand to manufacture the bricks. In this paper, testing is done to prove this brick good than other and economic comparison is done with conventional bricks.***
Keywords: Waste Foundry Sand, Fly Ash, PET Waste, Bitumen, Compressive Strength Test, Efflorescence Test, Water Absorption Test.

I. INTRODUCTION

Need of green material for construction is increasing day by day, Thus invention and research in this field should be more. The sea sand in replacement of aggregate, fly ash in replacement of cement such studies were done. While using sea sand, the problem of duplication will be faced. Thus introduction or replacement for such materials is needed. On the other hand, the environmental problem of disposal research for plastic waste is growing. Thus the utilization of plastic waste in foundry sand to prepare bricks is done. Plastic waste like PET & PP is collected from localized area, this waste is in form of bottles. Bottles cannot be melt easily, thus it is crushed into small pieces. The foundry sand from industrial area which contain iron, aluminum etc. Firstly the material are collected and further process is done. Secondly, The PET crushed is melted and foundry sand is added to it with proportion like 40-60 %, 35-65%, 30-70%. The bitumen is added as a binder up to 2-3 % by weight of brick

II. EXPERIMENTAL MATERIALS

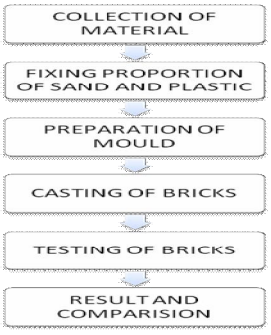
A. Pet Waste

Pet is polythene tetraphalate is plastic which is used to form Bottles. The bottles are used as container for liquids like water, juices etc. While curbside collection schemes have been very successful at recovering plastic bottle packaging from homes, in terms of the overall consumption typically only 30–40% of post-consumer plastic bottles are recovered. Other 60% is waste. Thus this waste is taken for utilization of construction material.

B. Foundry Waste Sand

Casting of mechanical parts is done in foundries. The mould of sea sand is formed and molten metals are poured in it. After cooling the metal get harden and require part is adopted. Sand used as mould is known as foundry sand this foundry sand cannot be used further and disposal of this becomes big problem. Thus reuse it for construction is better option.

III. METHODOLOGY



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Waste foundry Sand consist primary of, uniformly sized, high quality silica sand or lake sand that is bounded to form molds for ferrous (iron and steel) and non-ferrous (copper, aluminum, brass) The waste PET is taken and molten and foundry sand is added in it. But for binding purpose bitumen is added to it . Procedure for preparing of brick is as follow

First, the material is selected for preparation of bricks, afterwards all the properties of material are get studied. Next, material is collected from different sources of their generation. And detailed study of material and its properties is carried out. Third, proportion of plastic and sand is defined by analyzing its properties. Fourth, Mould were prepared for casting of bricks, And Material is prepared for casting of bricks as per proportion and as per defined method of mixing. Next, Different tests were taken for sand bricks. And results get compared with test results of conventional bricks. Finally, results get analyzed.

IV. ACTUAL MIX DESIGN OF PLASTIC SAND BRICKS

The main objective of this research work is to develop an efficient way to effectively utilize the waste plastic which is a great threat for disposal. With the foundry waste sand to manufacture an alternative building material by which both the questions of disposal of waste plastic as well as scarcity of traditional building materials is solved. The foundry waste sand was collected from iron casting foundries.After casting of iron parts sand produced from mold is 100% waste sand. A mould of size 24.5x11x9cm is taken for preparing sand brick. Bricks of different mix proportions were prepared, for each brick 3kg of the laterite soil was added with varying bitumen content of 2, 5 and 10% along with variation in percentage of plastic. Bricks were prepared by compacting through vibration. 9kg of clean sieved foundry waste sand is taken for preparation of sand brick . 70% of plastic (PET, PP) by weight of soil is cleaned and heated to a molten state. Then sieved soil is added at intervals with proper mixing. At the final stage 2% of bitumen by weight of soil is added and mixed for uniform distribution to prepare 3 bricks. The hot mix is poured into the moulds and then compacted by vibration. The bricks are de-moulded after 30 min and air dried for a period of 24hr for proper heat dissipation. Each mix proportion bricks were prepared and tested for compressive strength in the compressive testing machine (CTM)

Fig. a) weighing of material

Fig. b) Mixing of ingredient

Fig. c) Preparation of mould

Fig. d) Casting of bricks

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Bricks were prepared for following different proportion's

A. Brick No 1

Sand = 60 %
PET Waste = 37 %
Bitumen = 03 %
Fly ash = 0 %

B. Brick No 2

Sand = 4%
PET Waste = 37%
Bitumen = 03%
Fly ash = 20%

C. Brick No 3

Sand = 30 %
PET Waste = 37 %
Bitumen = 03%
Fly ash = 30 %

V. RESULTS & DISCUSSION

A. Compression Test

Table 1: Maximum load and compressive strength of different ratio of plastic waste

Sample	Weight(kg)	Density(kg/m3)	Max load at crushing(KN)	Compressive strength(N/mm2)
Brick 1	3.888	1560	192.6	8.73
Brick 2	3.311	1334	210.2	9.53
Brick 3	3.067	1229	157.2	7.12

From the compression test result, it is clearly shows that the value of compressive strength decrease as the ratio of plastic waste increase. The brick sample 2 with 40% sand and 40% PET wasteand 20% fly ash shows the compressive strength of 9.53 N/mm2. Which is almost double than that of convention brick strength.

B. Water Absorption Test

Sample	Weight before(kg)	Weight after(kg)	% water absorbed
Brick1	3.888	3.891	0.10
Brick2	3.311	3.315	0.13
Brick3	3.067	3.073	0.21

Water absorption test shows excellent performance of the plastic waste brick. Good quality of bricks do not absorb more than 20% of water. This concludes that the presence of plastic waste in the bricks helps on the performance of the bricks.

C. Efflorescence Test

Efflorescence test also showed the excellence performance of the sand bricks. There is no absence of grey or a white deposit wasshown on its sand bricks surfaces for all ratios. From this test, we can conclude that no alkalis was presence in this sand brick

D. Hardness Test

In this test, a scratch was made on brick surfaces. When the scratch is made with the help of finger nail on the bricks, very light impression was left on the sand brick surface. So this test results that fibrous concrete bricks are sufficiently hard.

E. Soundness Test

In this test two bricks of same proportion were taken and they were struck with each other. The bricks were not broken and a clear ringing sound was produced. So the bricks are good.

F. Structure Test

In this test, the bricks were broken and the structures of that bricks were examined, whether they were free from any defects such as holes, lumps, etc.In this test, sand bricks can cut into equal parts. The sand brick piece structure was homogenous, compact, and free from defects and this brick pieces look like a cake piece.

VI. COST COMPARISION

A. Labour Cost

Labours required

1) Head Mason: 1/10 No´s
2) Mazdoor: 3 No´s
3) Brist: ½ No´s
4) Head Mason Rate: 800 Rs/day
5) Labour Rate: 400 Rs/day

One labour can manufacture 300 bricks

So, Labour cost per unit brick = 1480/900 = 1.6 Rs/brick

B. Material cost

1) Plastic: Nil
2) Foundry Sand: Nil
3) Fly Ash: Nil
4) Bitumen:
a) Rate of Bitumen: 20 Rs/kg
b) Bitumen Required for 1 Brick: 0.084kg
c) Cost of Bitumen: 20*0.084 = 1.68 Rs/brick

C. Transportation Cost

1) Foundry Sand : Density of foundry sand = 2590 kg/m3 Volume of truck = 14.5 m3

Rate for 1 trip of truck = 4000 Rs.
Cost of transport of foundry sand = 4000/37555 = 0.1 Rs/kg
= 0.1*1.68 = 0.16 Rs/brick

2) *Plastic :* Quantity of plastic filled in a truck = 3000 kg
Cost of transport of plastic = 4000/3000 = 1.3 Rs/kg
= 1.3*1.68 = 2.1 Rs/kg

3) *Fly Ash :* Density of fly ash = 600 kg/m3
Cost of transport of fly ash = 4000/8700 = 0.45 Rs/kg
= 0.84*0.45 = 0.37 Rs/brick

D. Coal Cost

Rate of coal = 3000 Rs/tonne
Coal required = 0.2 tonne per 1000 bricks
Cost of coal for 1000 bricks = 3000*0.2 = 600 Rs
Cost of coal = 600/1000 = 0.6 Rs/brick

E. Total Cost of Brick

Cost of brick = 1.6+1.68+0.16+2.1+0.37+0.6 = 6.51 Rs/brick

F. Profit

Profit = 10% of 6.51 = 0.651 Rs/brick

G. Total Manufacturing Cost of Brick

= 6.51+0.651
= 7.1 Rs/brick.

H. Discussion

As we know that the cost of conventional brick is 8 Rs/brick. Manufacturing cost of sand brick is less than the cost of conventional brick of same size. So this brick is economical than conventional brick.

VII. CONCLUSION

According to the discussion of results the following conclusions are derived by this study:

A. The foundry sand brick consist of waste materials and therefore cost is very low compared to conventional bricks.
B. Since, the waste materials are used, it reduces landfills and pollution problems.
C. The compressive strength of brick is more than that of conventional brick.
D. The compressive strength of brick is 9.53 N/mm^2 which is nearly equal to twice than that of conventional bricks with weight of brick 3.311 Kg but brick 3 is also economical due to its maximum compressive strength as7.12 N/mm^2 which is much more than convention brick strength and its weight is less as3.067 Kg.
E. The bricks were not broken after falling from height of 1 m.
F. The brick has a lesser water absorption than conventional brick. So it can be a better alternative building material.
G. Using the foundry sand brick in a building, total cost will be reduced from 20% to 25%.
H. In site lot of bricks are wasted while cutting only. The labors could not able to cut the bricks exactly what they need. But, foundry sand bricks can be cut into exactly two pieces. By using conventional saw blades. So, we can get any shape and size of foundry sand brick.
I. As we know that the cost of conventional brick is 8 Rs/brick. Manufacturing cost of sand brick is less than the cost of conventional brick of same size. So this brick is economical than conventional brick.

VIII. ACKNOWLEDGEMENT

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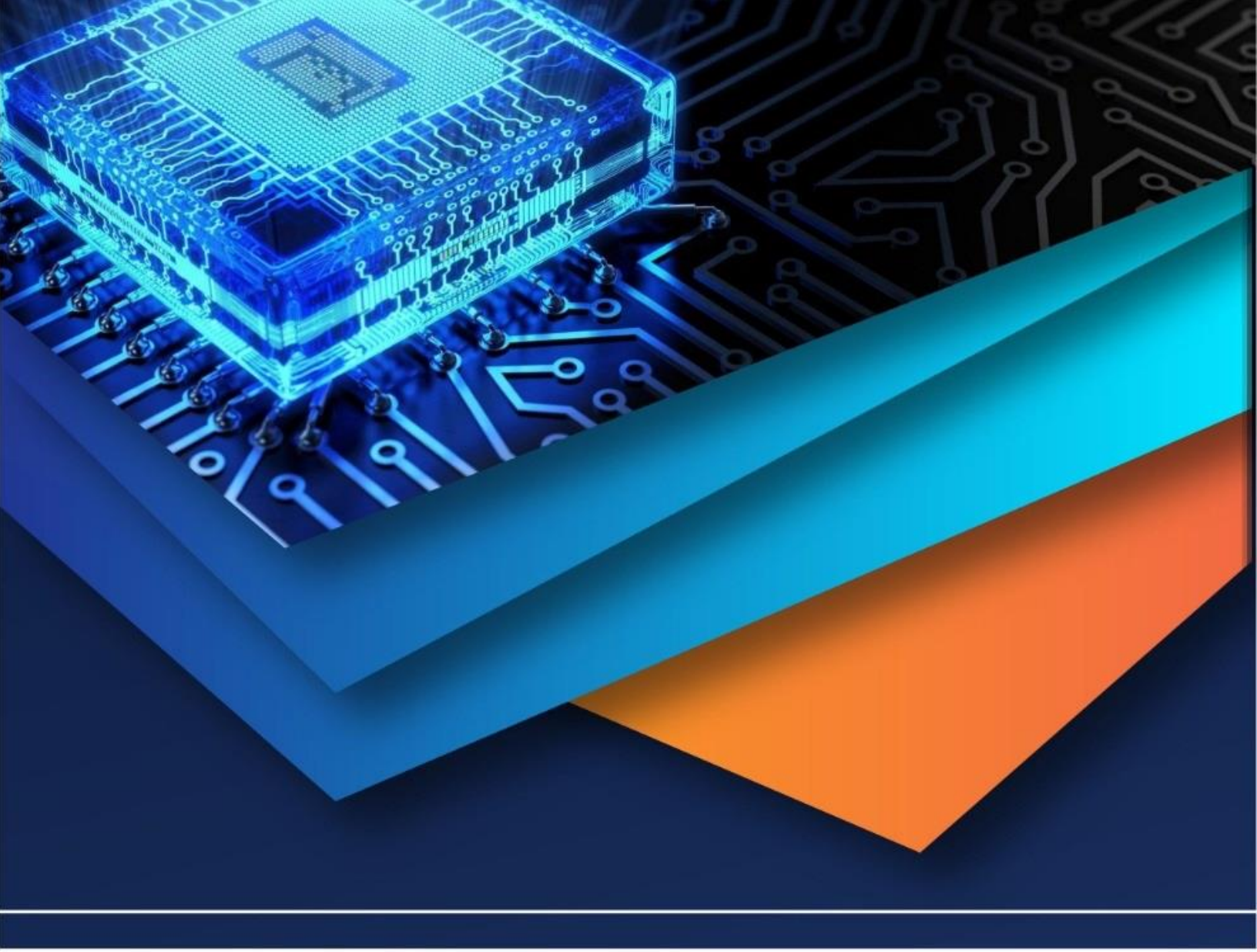

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