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Utilization of Domestic Waste Plastic in Manufacturing of Block Along With Quarry Dust and M-Sand

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ABSTRACT -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 the sustainment of ecological balance and to reduce the plastic waste which is increasing day by day. Plastic waste is increasing day by day becomes eyesore and in turn pollutes the environment, especially in high mountains, villages where no garbage collection system exists. A large number of plastics is being brought into the region are discarded or burned air. Hence these plastic wastes are to be effectively utilized. The aim of the project is to replace cement with plastic waste and use it with M-sand along with quarry dust to reduce the cost; when compared to that of the conventional concrete blocks. Hence the project will be helpful in reducing plastic waste in a useful way.

KEYWORDS: High-density polyethylene (HDPE), quarry dust, M-sand, compressive strength, water absorption.

I. INTRODUCTION:

Plastic waste is a major problem all over the world and its side effects are felt throughout the universe. The amount of damage it does is irreplaceable. Waste in its various forms is increasing in landfills. Due to effectsthat plastic has on human life, environmentalists are persistently working to get a solution to the problem of plastic disposal. They are focusing on day-to-day human practices which can help to reduce the disposal problem.Disposal of waste materials including waste plastic bags has become a serious problem. Amount of waste plastic bags being accumulated in 21st century has created big challenges for their disposal. The waste plastics in house hold is in a large quantity and increasing with time due to the increase in population. In each country waste consumption is different, since it is unaffected by socioeconomic characteristics and waste management programs, but the level of plastics in waste consumption is high. In order to overcome this issue, we have to use it in effective way. This project is about recycling waste plastics into blocks along with M-sand and quarry dust and to study their characteristics. 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 about 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. The plastic waste cannot be disposed of by discarding or burning, as they produce unrestrained fire or contaminate the soil and vegetation. M-sand is alternative to river sand and quarry dust is also a waste produced during crushing of rocks in quarry and it also causing a problem in term of disposal.

II. MATERIALS USED

2.1 WASTE PLASTIC:

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 2.1HDPE PLASTIC

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High density polyethylene (HDPE) is used as a binder. Density of HDPE range from 930 to 970 kg/m3. It has strong intermolecular forces and tensile strength than low-density Polyethylene (LDPE). HDPE plastic range from 15-400 micron.

2.2 QUARRY DUST:

Quarry dust is a fine substance which is obtained from crushing of rock. during this process 15-20% of soil wastes are generated and it is termed as quarry dust. These dusty particles scatter in the air and cause air pollution.

FIG 2.2 QUARRY DUST

2.3 M SAND:

Manufactured sand (M-sand) is an alternative of natural sand. manufacture sand is produced by crushing hard granite stone. The size of M-sand is less than 4.75mm.

FIG 2.3 M-SAND

2.4 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 150x150x150 mm.

Table 2.1 Mix Design

SL.NO	MIX RATIO	COMPRESSIVE STRENGTH OF PLASTIC SAND BLOCK (N/mm$^{2)}$
1	1:2	4.92
2	1:3	4.0

2.5 Manufacturing of Brick:

In first step we should collect the waste plastic such as household vegetable chopping board, shampoo bottles, oil cans and bottles. Next the collected waste plastic products are cleaned with water and dried to remove the water present in it after this the plastics are made into small pieces and melted out by using stones and firewood. The stones are arranged to hold the pan and the Firewood is placed in the gap between the stones and it is ignited. The pan is placed over the above setup and it is heated to remove the moisture present in it. Then the plastic pieces are added to the pan 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 poured 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 (150x150x150mm). After 1 days remove the brick from the mould.

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 25min

III. CALCULATIONS:

3.1 Mix Design Calculations

a) Ratio (1:2)

Size of brick = 150x150x150 mm = 0.15 X 0.15 X 0.15 m

Volume of brick = 0.003375 m3

Sum of proportion= 1+2 = 3

Amount of plastic = [(0.003375 x 1)/3]X970 =1.902kg …… (970 HDPE density)

Amount of plastic = 1.90kg of plastic. (30% extra weight of plastic)

Amount of M-sand= [(0.003373x0.75x 2)/ (3)]x1600 = 2.7kg …. (1600 Sand density)

Amount of M-sand==2.7kg

Amount of quarry dust

= [(0.003375x0.25x2)/(3)]x1879.2=1.05kg of quarry dust……(1879.2kg/m3 quarry dust density)

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Amount of quarry dust =1.05kg

b) Ratio (1:3)
Size of brick = 150x150x150 mm = 0.15 X 0.15 X 0.15 m
Volume of brick = 0.003375 m3
Sum of proportion= 1+4 = 4
Amount of plastic = [(0.003375 x 1)/4]X970 =0.818kg …… (970 HDPE density)
Amount of plastic = 0.818kg of plastic.
Amount of M-sand= [(0.003373x0.75x 3)/ (4)]x1600 = 3.03kg …. (1600 Sand density)
Amount of M-sand==3.30kg
Amount of quarry dust
= [(0.003375x0.25x3)/(4)]x1879.2=1.19kg of quarry dust……(1879.2kg/m3 quarry dust density)
Amount of quarry dust =1.19kg

3.2 Compressive strength test Calculation: -

Compressive strength or compression strength is the capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstands loads tending to elongate.Generally, five specimens of bricks are taken to laboratory for testing and tested one by one.In this test a block specimen is put on crushing machine and applied pressure till it breaks. The ultimate pressure at which block is crushed is taken into account. All five block specimens are tested one by one and average result is taken as block's compressive /crushing strength. Compressive strength is calculated using the following equation. Compressive strength (N/mm2) = (Ultimate load in N / Area of cross section (mm2)).

Fig 3.1 Compressive strength

3.3 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 =150x150=22500mm^2

Plastic brick (1:2)
1. 112000/22500=4.97N/mm^2
2. 110000/22500=4.88 N/mm^2
3. 111000/22500=4.93 N/mm^2

Average compressive strength=4.92 N/mm^2

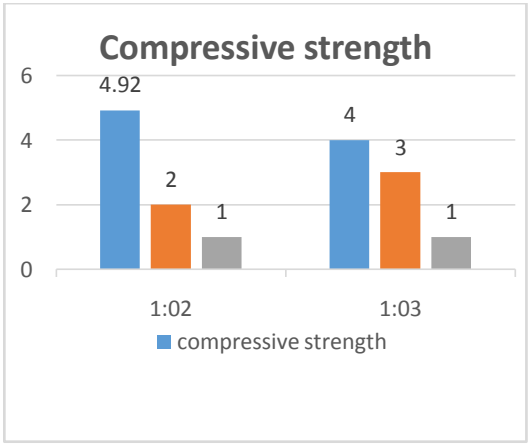
Plastic brick (1:3)
1.90000/22500=4.0 N/mm^2
2. 91000/22500=4.04 N/mm^2
3. 89500/22500=3.97 N/mm^2

Average compressive strength=4.00 N/mm^2

3.4 Water absorption test calculation: -
Water absorption in % by wt. =[(w2-w1)/(w1)]x100
Where, W1 = Weight of dry Brick (kg) W2 = Weight of wet Brick (kg)
Plastic brick (1:2)
1)Water absorption of Sample brick 1 in % =[(4.96 −4.85)/(4.85)]x100 = 2.27%
2)Water absorption of Sample brick 2 in % = [(4.98 −4.88)/ (4.88)]x100 = 2.05%

3)Water absorption of Sample brick 3 in % = [(4.97-4.859)/(4.859)]x100 = 2.28%
Average % of water = 2.2%

IV. RESULT



4.1 Compressive strength:

From the above graph 4.1 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.

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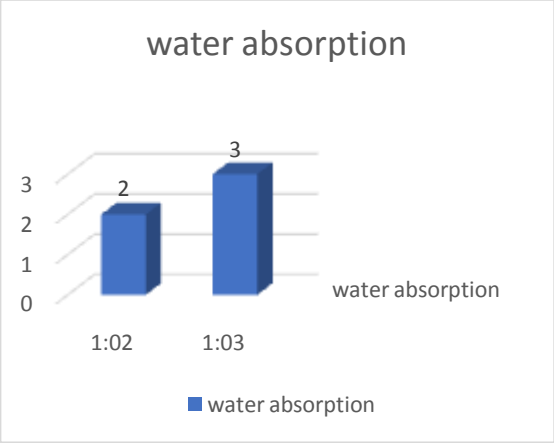
4.2 Percentage of water Absorption:



From the above graph 4.2 Percentage of Water Absorption shows that the for-mix ratio 1:2 has 2% of Water Absorption whereas mix ratio 1:3 has 3.0 % 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.

V. CONCLUSION

- Plastic sand block made using plastic, m-sand and quarry dust has shown better results.
- Plastic sand block is found to have more strength than the normal concrete block.
- This method is suitable in countries where there is a problem of plastic disposal.
- Removal of waste plastic products thus abolishing land requirement problem for dumping plastic
- By use of plastic sand blocks, the water absorption is highly reduced.
- Natural resources consumed for manufacturing Plastic sand block is very less compared to it counterparts.
- Plastic sand block possesses more advantages which include resource efficiency and reduction of greenhouse gases and reducing the problem of disposal of plastic.
- The final end product i.e., plastic sand block has higher strength than fly ash bricks &clay bricks
- Manufacturing cost is reduced further as we are replacing river sand with M-sand and quarry dust.

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