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Utilisation of Waste Plastic in Manufacturing of Paver Blocks

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ABSTRACT: The Plastic Pavers is prepared by utilizing the waste plastics. Plastic waste which is increasing day by day becomes eyesore and in turn pollutes the environment, especially in Metropolitans areas. A large amount of plastic is being brought into the separation regions are discarded or burned which leads to the contamination of environment and air. Hence, these waste plastics are to be effectively utilized. The waste plastic is heated and added with sand at various percentages to obtain Paver blocks to control pollution and to reduce the overall cost of construction. Hence in this work, an attempt is made to study regard the properties of the Plastic Paver block which is manufactured using plastic wastes. In this present work the Plastic paver are made by adding 40%, 50%, 60% and 70% of plastic waste by weight of sand required to fill mould of pavers. In that four trail work, it is found that minimum 60% waste additive is required to get desired shape of mould and 70% waste additive Trail is found have minimum compressive strength of 14.7 MPa.

KEYWORDS: Plastic waste, quarry dust, Plastic Pavers.

I. INTRODUCTION

The composition of waste is different in different areas based on the management programs and consumption patterns but the amount of plastic in the overall waste composition is high. The major constituents of plastic waste are polyethylene and polypropylene. There are several methods available to recycle and reuse the waste effectively. Since plastic has long service life, they can be recycled effectively. The biggest problem with plastic bags is that they don't readily breakdown in the environment. It takes 20 – 1000 years based on their composition. The average plastic waste produced in India per year is 15432 tones among which 6000 tones remains uncollected. In India the plastic waste are majorly disposed by burning and only less amount of plastic waste is recycled. The waste plastic will be large in household time. In many countries the compositions of waste is different, that it is affected by the socioeconomic characters, waste management programs and consumption patterns, but generally the level of plastic in the waste composition is high. One of the largest components of plastic waste is polyethylene which is followed by polypropylene. Polyethylene terephthalate and Polystyrene. The large volume of materials required for construction is potentially a major area for the reuse of waste materials. Recycling the plastics has advantages since it is widely used and has a long service life, which means that the waste is being removed from the waste stream for a long period. Because the amount of clay required to make bricks is large, the environmental benefits are not only related to the safe disposal of bulk waste, but also to the reduction of environmental impacts that arise due to burning of plastics. Plastics also help to conserve energy at the home Furthermore, the U.S. Department of Energy estimates that use of plastic foam insulation in homes and buildings each year will ultimately save close to 60 million barrels of oil versus other kinds of insulation. The same principles apply in appliances such as refrigerators and air conditioners. Paver block paving is versatile, aesthetically attractive, functional, and cost effective and requires little or no maintenance if correctly manufactured and laid. Most concrete block paving constructed in India also has performed satisfactorily but two main areas of concern are occasional failure due to excessive surface wear, and variability in the strength of block. Natural resources are depleting worldwide at the same time the generated wastes from the industry and residential area are increasing substantially. The sustainable development for construction involves the use of Non-conventional and

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innovative materials, and recycling of waste materials in order to compensate the lack of natural resources and to find alternative ways conserving the environment. Plastic waste used in this work was brought from the surrounding areas. Currently about 56 lack tones of plastic waste dumped in India in year. The dumped waste pollutes the surrounding environment. As the result it affects both human beings and animals in direct and indirect ways. Hence it necessary to dispose the plastic waste properly as per the regulations provided by our government. The replacement of plastic waste for cement provides potential environmental as well as economic benefits. With the view to investigate the behaviour of quarry rock dust, recycled plastic, production of plastic paver block from the solid waste a critical review of literature was taken up.

II. RELATED WORK

1. **Revathi et al. (2015)** Noticed that used of concrete paver block in road pavement is common. Concrete paver block is better option when light weight traffic for that road, concrete paver block is cheap and low maintains compared to content bituminous road. Pre-cast concrete block made with m40 concrete mix proportions. "Rice husk ash is waste material use in as alternative in a space of fine aggregate with different percentage range 0% to 60%. Density of paver blocks is within the range of 1888-2202 kg/m³ and Density values decreases with increase in Groundnut husk ash. With the use of Groundnut husk ash is suitable making the water absorption is less than 7%".
2. **Reddy et al. (2015)** "Study said that concrete paver block is made with material of nylon fibers and risk husk ash gives good compression strength. for an optimum dose of nylon fibers and risk husk ash is 0.3% and 20% give maximum strength for the concrete paver block".
3. **Neekhara et al. (2015)** Concluded that nylon fibres is used to evaluate strength of paver block. Nylon fibers is high tenacity fibers, nylon fibers is used in construction and Nylon fibers is also thermoplastic polymer. "After performing different percentage of nylon fibers in the concrete paver block it is observed that addition of nylon fibers 0.3% with the percentage of cement in concrete it give maximum strength of 7,14, and 21 days of age".
4. **Navya et al. (2014)** Examined in a new era presents concrete paver block fibers are introduced to increase strength, durability and reduction in crakes, so using fibers in the concrete paver block it improves the properties of paver block so polyester fibres added in paver block top 20mm thickness. "Result Shown that polyester fibers by 0.4% paver block attains maximum compressive, flexural strengths and minimum water absorption found at 7 and 28 days".
5. **Raja et al. (2014)** Analysed that manufacture sand is the best alternative of Fine aggregate for the concrete paver block. To use of the Manufacture sand, "As a result we can achieve compressive strength is 43.80N/mm² in M30 grade paver size 200mmX200mmX50mm. Manufacture sand is good alternative of river sand and cost is also economical".
6. **Mall et al. (2014)** Analysed that Paver Block is a better option for road construction as compared road made of bitumen and gravel in a cost view of the point and better stability. Paver block by using Cement Concrete mixture of Design Mix M35 made with use material 10mm Coarse Aggregate, OPC 43 Grade Cement and Fine Aggregate and paver block are of dimension 200 x 160 x 80 mm. "To study this process uses the partial replacement of Cement with Fly Ash in percentage of 0% to 30% respectively, and added Gypsum constantly 2% by weight of cement and Super plasticizer is used as an admixture which is added 2% by weight of cement so find that 25% of fly ash give higher strength and economic value compare to conventional mix".
7. **Kashiyani et al. (2013)** Study said that addition of polypropylene fibers in paver block to so the change in the result of Abrasion Resistance and Flexural Strength of paver blocks improved with compare standard paver block and reduces the maintenance cost of paver block. Mix proportion for concrete paver block used in top layer is 1:3 (Cement: dolomite powder) and polypropylene fibre with the different percentage rate and 1:1:2:3.75 (Cement: Fine aggregate: Semi Grit: Quarry dust) in the bottom layer of paver block "Result shown that after 28day percentage of polypropylene 0.3% and 0.4% gives good results for abrasion resistance and flexural strength".

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8. **Patel et al. (2013)** Found that foundry sand in various engineering applications can solve the problem of disposing of foundry sand and other purposes. Foundry Sand can be used as a partial replacement of cement in supplementary addition, to achieve different properties of concrete. "The application of a used foundry sand as a replacement with cement is feasible for strength in interlocking paver blocks".
9. **Santos et al. (2013)** Presents this work was to study the use of coal waste to produce concrete paving blocks. "Analysed say that coal is used to replace conventional sand as a fine aggregate for concrete paving blocks. The demand of conventional sand can be minimized and a part of coal tailings can be used and reducing the volume in coal waste deposits".
10. **M Ravi et al. (2012)** this paper analysed that "experimental study on strength characteristics and water absorption of iron ore tailings based concrete paver blocks compared with that of conventional concrete paver blocks". Iron ore tailing is obtained from the mining industry waste handling and disposing them is a problem so used of iron ore in concrete for their improvement in strength. The use of iron ore tailing from 5% to 15% has shown increases in the compressive strength of the concrete compared to normal concrete and 15% to 25% has resulted in lower compression strength compared to that of conventional blocks.

III. MANUFACTURING OF PAVER BLOCKS

Manufacturing process of paver blocks involved following steps

- Batching
- Preparation of burning arrangement
- Mixing
- Moulding & Compacting
- cooling and unmolding

1. Batching: The collected waste plastic bags and plastic water bottle are weighted. And the sand was sieved by using 4.75 mm sieve. The sand and the plastic bags were weighed in various trial mixes among which the plastic were taken for burning process.

<i>Trial mix</i>	<i>Plastic Additive</i>	<i>Quarry dust in kg</i>	<i>Plastic in kg</i>
1	40%	3.253	1.3
2	50%	3.253	1.625
3	60%	3.253	1.925
4	70%	3.253	2.277

2. Preparation of burning arrangement : The stones are arranged to hold the drum and the fire wood 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.

3. Mixing: The weighed plastic materials are dropped in the drum. The plastic wastes are heated in the drum of above 150°. As the result of heating the plastic waste melt and quarry dust 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.

4. Moulding and compacting of waste plastic paver mould: before placing the mixture into the mould, the sides of the mould are oiled to easy removal of block. This mixture then poured into the mould and they are compacted using tamping rod and surface is finished using trowel

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5. Cooling: After moulding and compacting the blocks are allowed to cool for 24 hours.
6. Unmolding: After cooling safely removed the block from mould.

IV. EXPERIMENTAL RESULTS

TESTS ON WASTE PLASTIC PAVER BLOCKS

4.1 COMPRESSIVE STRENGTH TEST:-

Compression testing is a very common testing method that is used to establish the compressive force or crush resistance of a material. Generally five specimens of blocks are taken to laboratory for testing and tested one by one. In this test a paver block specimen is put on crushing machine and applied load till it cracks. The ultimate load at which block is crushed is taken into account.

- **Compressive strength = Maximum load/Area of the specimen**
= P/A

Where, P= load value at breakdown of sample N
A= area of the specimen in mm²



(a) Testing of compressive strength of paver block

Particulars	Sand in kg	Plastic in kg	Compressive strength in MPa
40% of plastic Additive	3.253	1.30	Collapse
50% of plastic Additive	3.253	1.626	7.26
60% of plastic additive	3.253	1.952	12.45
70% of plastic additive	3.253	2.277	14.7

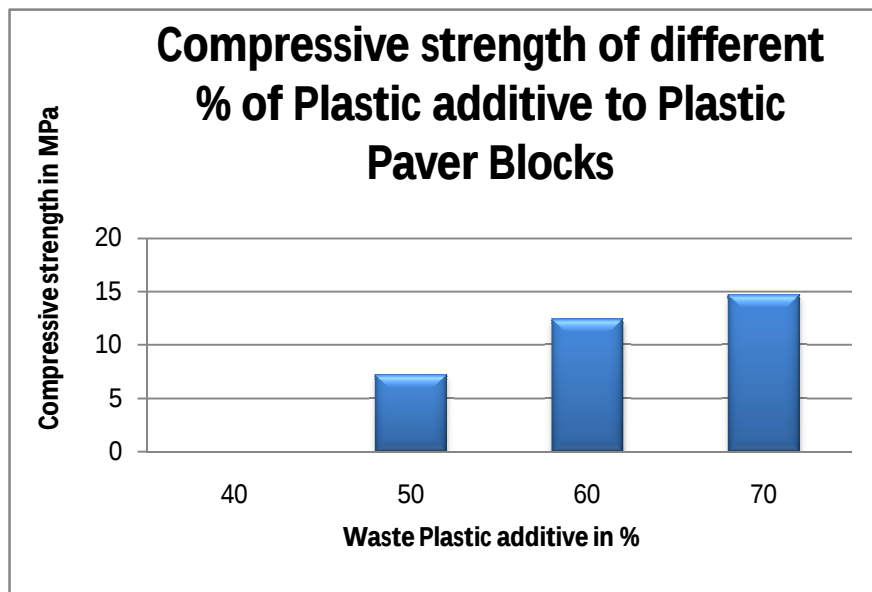
(b) Compressive strength test results

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(c) Compressive strength of different % of plastic additive to plastic paver blocks

From the above graph it is observe that 7.26 MPa is the minimum compressive strength value for 50% of plastic additive and the compressive strength increased to 12.45 MPa for 60% plastic additive and the maximum compressive strength value achieved to 14.7 MPa for 70% plastic additive.

4.2 WATER ABSORPTION TEST:

In this test, blocks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion, those are taken out from water and wipe out with cloth. Then, block is weighed in wet condition. The difference between weights is the water absorbed by block. The percentage of water absorption is then calculated.

$$\text{Water absorption} = \{[W2 - W1] / W1\} \times 100$$

Where, W1= Weight of dry block (kg)

W2 = Weight of wet block (kg)



a) Weight of dry paver block



(b) Weight of wet paver block

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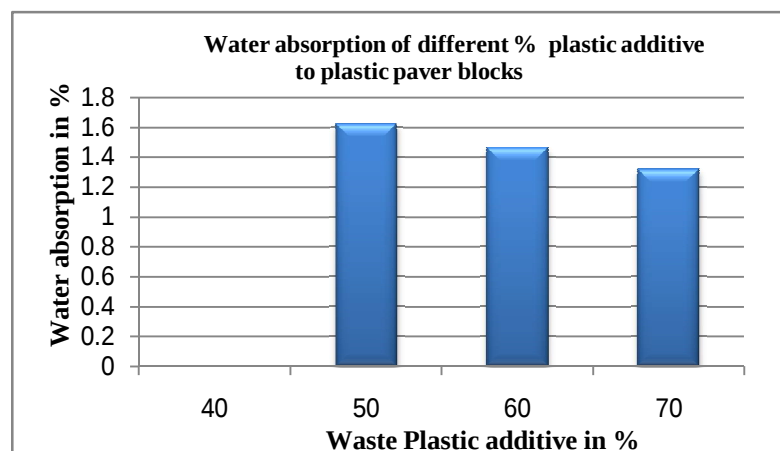
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particulars	50% of plastic additive	60% of plastic additive	70% of plastic additive
Dry weight (kg)	3.70	3.41	3.03
Wet weight (kg)	3.76	3.46	3.07
Water absorption in %	1.62	1.47	1.32

(c) Water absorption test results



(d) Water absorption of different % plastic additive to plastic paver blocks

From the above graph it is observed that the maximum water absorption value 1.62% for 50% plastic additive and the minimum water absorption value 1.32% for 70% of plastic additive.

V. CONCLUSIONS

- From the above results it can be concluded that, the addition of 60% waste plastic is required to get desired shape of paver Block and 70% of waste plastic is required to get the compressive strength of 15MPa.
- The utilization of waste plastic in production of paver block has productive way of disposal of plastic waste.
- Waste plastic paver block can be used in Non-traffic and traffic road.

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