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Design of Pavement Blocks Made from Waste of Plastic, Glass & Aluminum Foil Dust

[1]Shubham Giri, [2]Shivam Ghundare, [3]Diguraj Ingale, [4]Akshay Bolbhat, [5]Shreedhar Patil Sir

[1]Student, [2] Student, [3] Student, [4]Student, [5]Professor
[1,2,3,4,5]Department of Civil Engineering,
[1,2,3,4,5]D.R. DY Patil School of Engineering & Technology, Pune, India

Abstract : The aim of the project is to recycle the plastic waste into a paver block and to reduce the cost of the paver block when compared to that of a convention concrete paver block. Plastic waste has become a major problem these days. As plastic is non bio degradable material it blocks drains, pollutes rivers and wreaks havoc on the environment. As the degradation of the plastic waste is a very slow process so here is an idea of mixing sand into melted salvaged plastic to make a solid, durable material as a paving slab. Hence, we have a "eco-friendly" paving block. Unlike other processes of making paver blocks, which involves cement as a binding material. Instead, we approach towards melted plastic waste(PW) for binding the fine aggregates with a small proportion of crushed waste glass and aluminum foil dust. The proposed process is non-destructive in that the blocks are merely baked at low temperature, sufficient to melt the waste plastic that gets diffused within the body of the blocks. The compressive strengths after addition of waste plastic are same as normal block strength. And also reduce the water absorption capacity of block is reduced compare with nominal block.

PW is used in varying proportions of 50% 60% to replace cement and tested to achieve satisfactory results. The blocks are likely to add energy efficiency in buildings and help create economic value to manufacturers, thereby, encouraging the ecosystem of plastic waste management involving all actors in the value chain.

IndexTerms **- Plastic waste, plastic pavement block, eco-friendly paver block, aluminum foil, glass waste.**

I. INTRODUCTION

Plastic waste is a non-biodegradable waste which cannot decompose and this creates water, land pollution and air pollution. Also, while we burn the plastic waste in dumping ground, the percentage of plastic waste is increasing rapidly. It is estimated that the plastic waste will double after a decade as we use hundreds of Trades of plastic in our daily life. We can recycle, reuse the plastic waste. As a civil engineer we have to innovate something new related to this, which is a boon or civil engineering. So, here we try to do something innovative as PLASTIC PAVER BLOCKS.

Cement manufacturing process involves one of the biggest mining activities in India leading to greater environmental degradation. In the current study, an experimental investigation was carried out to recycle PW as a substitute to cement as a binding constituent. Conventional paver block utilizes approx. more than 200 kg/m3 of cement contributing significant quantity of carbon dioxide (CO2) emissions Therefore, it is possible to use PW as a substitute to cement as binding material and reduce plastic wastes to minimize the carbon footprint and reduce the environmental pollution and associated health hazards.

Through this study, an attempt is made to minimize the plastic waste by reusing it. The study compromises two types of plastics- Low Density Polyethylene (LDPE) and all mixed type. The PW categorized as binding material at 50%, 60% and 70% proportion for LDPE and all mixed type PW. The ratios were denoted as P50, P60 and P70 respectively. The experimental investigation on compressive strength, water absorption, setting time, abrasion, hardness, effect due to extreme temperatures was carried out to predict behavior under loading conditions, durability and performance when applied as construction material.

Considering the outcome of the experiment, cement-less paver blocks are effective enough to be used as paver blocks made out of melted PW as binding material. This would effectively help in reducing load on the landfill. Also, relevant stakeholders can explore more in producing cement-less paver blocks in larger scale with innovative automated manufacturing process. The economic assessment also indicate that such production of PW paver blocks is economically viable.

II. MATERIALS

2.1 ***Plastic Waste :-*** Plastics are extremely versatile, light weight with high durability also they have resistance to chemicals, water and thermal and electrical insulation properties. With lesser production cost, ability to combine with other materials, it becomes the material of choice with intelligent features. Due to these benefits, recycling and reusing PW as construction material becomes an opportunity to challenge its opposing negative impacts.

2.2 ***Waste Glass :-*** Glass makes up a large component of household and industrial waste due to its weight and density. The glass component in municipal waste is usually made up of bottles, broken glassware, light bulbs and other items. Reuse of this waste will reduce the load on recycling and segregation units. Glass recycling uses less energy than manufacturing glass from sand, lime and soda.

2.3 ***Aluminum Foil :-*** Aluminum is the third most abundant element and most abundant metal in the Earth's crust. It is concentrated in a number of high grades, natural bauxite deposits. Because of its low density, high tensile strength and resistance to corrosion, aluminum is widely used for the manufacturing of aluminum foils.

2.4 ***Crushed Sand as fine aggregates :-*** Easily available in the local area, have more density than natural sand. And gives a good finishing to the paver blocks.

III. PREPARATION OF TEST SPECIMENS

Plastic wastes are heated in a metal bucket at a high temperature which results controlled heating of the plastic waste. When the PW are thoroughly melted and form a hot slurry mix, add other materials i.e., crushed glass waste, aluminum foil dust with crushed sand. The materials are added in design proportions at molten state of plastic and mixed well. The metal mold is cleaned and smoothen with oil by using waste cloth. Now the hot mix is transferred to the mold and tapped by layer for better compaction. The sample is allowed to cool down which is completely settled in 30 minutes. Then the blocks are carried out from the mold and allowed to dry. And tested out after 24 hrs.

Fig 1. PW, Crushed Glass, Aluminum dust

Fig 2. Mixing and molding of the Sample

IV. EXPERIMENTAL RESULT

4.1 ***Compressive Strength***

For cement-less paver block, the samples get hardened immediately after the final setting time of ~ 30 minutes and the compression test can be conducted in few hours. The compressive strength we achieved from LDPE is 10.25 kN/mm^2.

Fig 3.1. Sample in CTM

Fig 3.2. Reading of Dial Gauge

Fig 3.3. Sample after failure

Plastic paver blocks of equilateral triangle size of (260x260x260)mm with 60mm thickness.

The maximum load at failure reading was taken and the average compressive strength is calculated using the following equation.

Compressive strength (N/mm^2) = (Ultimate load in N / Area of cross section (mm^2))

4.2 ***Water Absorption***

The cement-less paver block showed negligible water absorption. And due to very low water absorption the sample shows more durability.

4.3 *Bulk Density*

The bulk density of LDPE and all mixed cement-less paver block ranges approximately between 11.5 to 13.95 kN/m3 which far less than traditional concrete paver blocks. Lower the bulk density of the cement-less paver blocks is advantageous as it makes easier for handling in construction and transportation.

4.4 *Setting Time & Hardness*

The cement-less paver blocks gained its full strength approximately in 3-hour duration and did not require curing age with the setting time 30 minutes.

V. RESULTS

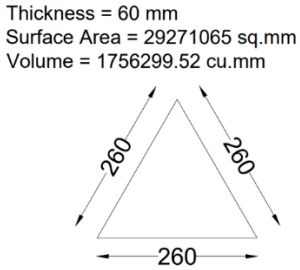

Fig 4. Mold Dimensions

Table 1. Compressive Stress of the Sample Tested

Proportion Name	PW	Crush Sand	Waste Glass	Aluminum Dust	Compressive Stress (kN/mm^2)
PS 1	0.5	0.4	0.08	0.02	9.85
PS 2	0.6	0.25	0.12	0.03	10.25

VI. CONCLUSION

The following conclusions were drawn from the experimental investigation :-

- The utilization of waste plastic in production of paver block has productive way of disposal of plastic waste.
- The cost of paver block is reduced when compared to that of concrete paver block.
- Paver block made using plastic waste, coarse aggregate, glass waste, aluminum foil dust.
- It doesn't require curing.
- Though the compressive strength is low when compared to the concrete paver block it can be used in gardens, pedestrian path.
- It can be used in Non-traffic and light traffic road.

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