SSRG International Journal of Civil Engineering
ISSN: 2348 – 8352 /doi:10.14445/23488352/IJCE-V8I1P101
Volume 8 Issue 1, 1-3, January 2021

Comparative Study On Conventional Hdpe Paver Blocks With M-Sand And Bagasse Ash As Constituent Materials

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Abstract
Plastic wastes are increasing at an alarming rate and adversely affecting the environment as they are not easily degraded. The amount of waste plastic bags being accumulated in the 21st century has created big challenges for their disposal. The waste plastic in the household is large and increases with time. In each country, waste consumption is different. This project is about recycling HDPE (High-Density Poly Ethylene) plastic into pavement blocks and studies their characteristics. Pavement blocks are perfect material on the pathways and streets for simple laying. The main aim is to use the plastic nature in the construction field with limited additions. It will be the most economical and can be applied in different forms. The limited additions are such as M-Sand and Sugarcane Bagasse ash. This Project acts as a compressive study between Conventional HDPE Paver blocks with the paver blocks that contain the above constituent materials mixed in it. This also absorbs less water than the Conventional Cement paver blocks used mostly. The research concluded that if made and put into use, these pavers will reduce construction costs, especially those for repairs, and assist in environmental conservation. Roads and parking yards will be cheaply constructed, and with the increased durability, accessibility and economic growth are improved.

Keyword: *HDPE Plastic waste, Paver blocks, M-sand, Bagasse ash*

I. Introduction

The pavement in construction is an outdoor floor or superficial surface covering. Paving materials include asphalt concrete, stone such as flagstone, cobblestone, and sets, artificial stone, bricks, tiles, and sometimes wood. Landscape architecture pavements are part of the hard scape and are used onside walks, road surfaces, patios, and courtyards. Paver block technology was introduced in India in construction a decade ago for a specific requirement, namely footpath, and parking areas. Now paver block is being adopted extensively in different use. In this investigation, various properties such as compressive strength, split tensile strength, and water absorption of paver blocks consisting of plastic wastes, unconventional materials such as quarry dust, and fine aggregate of various percentage replacement is used.

Cement concrete tiles and paving blocks are precast solid products made out of cement concrete. The product is made in various sizes and shapes viz. rectangular, square, and round blocks of different dimensions with designs for interlocking adjacent tiles blocks. The raw materials required for the manufacture of the product are Portland cement and aggregates, which are available locally in every country. This pavement is less susceptible to rutting, minimum fatigue or thermal cracking, low Stripping due to moisture and offers great durability, little or no impact on processing and also produces eco-friendly construction and costs less.

A. Materials Used

- HDPE(High-Density Polyethylene plastic wastes)
- M-Sand
- Bagasse Ash
- Coating of Lime Hydrate(whitewash)

HDPE Plastic Wastes

By definition, plastics can be made into different shapes when they are heated. In the closest environment, it exists in the different forms such as cups, furniture's, basins, plastic bags, food and drinking containers, and become waste material. Accumulation of such wastes can result in hazardous effects to both human and plant life. Therefore, the need for proper disposal and, if possible, use of these wastes in their recycled forms occurs.

M-Sand

Manufactured sand (M-Sand) is a substitute for river sand for concrete construction. Manufactured sand is produced from hard granite stone by crushing. The crushed sand is cubical with grounded edges, washed, and graded as a construction material. The size of manufactured sand (M-Sand) is less than 4.75mm. Due to the depletion of good quality river sand for the use of construction, manufactured sand has been increased. Another reason for the use of M-Sand is its availability and transportation cost. Since manufactured sand can be crushed from hard granite rocks, it can be readily available at the nearby place, reducing transportation cost from far-off river sand bed.

Baggage ash

Bagasse ash is a by-product of sugar factories found after burning sugarcane bagasse, which is found after the extraction of all economical sugar from sugarcane. The disposal of this material is already causing environmental problems around the sugar factories. On the other hand, the boost in construction activities in the country created a shortage in most concrete making materials, especially cement, increasing in price. Hence utilization of this material in this project would provoke a reasonable factor in disposal management of bagasse ash.

Coating of Lime Hydrate

Lime is a calcium-containing inorganic mineral composed primarily of oxides, and hydroxide, usually calcium oxide and/ or calcium hydroxide. It is also called whitewashing. Since plastic is not a good insulator of heat, this can be done on the blocks after molding since the lime acts as a good thermal insulator.

1.2 Tests Carried Out

The standard tests that should be carried out to test a good paver block as per IS standard provisions are as follows:

- Compressive test
- Water absorption test
- Efflorescence test
- Fire resistance test
- Hardness test

II. Methodology

- Collection of Materials
- Shredding of HDPE
- Batching
- Melting
- Mixing
- Molding
- Finishing

The above flowchart states the different types of Paver Blocks we decided to manufacture. We produce three types of pavers as first conventional HDPE paver blocks along with HDPE plastic waste and M-Sand as another type, and then lastly HDPE Plastics waste with Bagasse ash as constituent materials as the third type.

Our study manufactures 9 bricks as each of the above carries 3 blocks for each type. This study deals with the different strengths according to the constituent materials we used here. This also shows that the Plastic wastes and the M-Sand and Bagasse ash were of different properties, and it also shows different behaviors. The plastic material should be collected from the factories' waste and hospital waste and industries waste, food packages, and plastic bottles. This will come under the HDPE plastic-type. The disposal of materials is already causing environmental problems around the factories.

III. Mix Ratio

Table 1 Mix ratio

S.no	Material constituents	Mix ratio
1	HDPE Plastic materials (Monolithic)	-
2	HDPE Plastic: Bagasse Ash	1:1
3	HDPE Plastic: Bagasse Ash	1:2
4	HDPE Plastics: M-sand	1:1
5	HDPE Plastics: M-sand	1:2

The above table describes the mix proportion made in this particular study and the various constituent materials used in this comparative study, which creates a renewable and eco-friendly environment with extremely low costs.

IV. Result

The Paver blocks are made by melting the HDPE Plastics wastes in a monolithic manner and M-Sand as constituent material in another case and Bagasse ash as another constituent material in the last case. These paver blocks were manufactured and treated properly. Necessary tests were also conducted as per Indian standard codal provisions for pavement blocks, and their results are obtained and cross-verified for the quality of these bricks.

Figure 1 Paver block from Plastic wastes

The below table provides data about the tests conducted 24 hours from the brick of different ratios in the mold prepared in the steel of I shape. The different types of constituents mixed in the pavement brick made along with the HDPE Plastics. The interpretation of the results obtained is described in detail below.

Table 2 Compressive strength of bricks

Mix No	Mix ratio	Constituents	Compressive Strength (N/mm^2)
MIX1	-	HDPE Plastic (Mono)	15
MIX2	1:1	HDPE + Bagasse ash	16
MIX3	1:2	HDPE + Bagasse ash	17
MIX4	1:1	HDPE+ M-sand	16
MIX5	1:2	HDPE+ M-sand	17

Table 3 Stress value of bricks

Mix No	Mix	Constituents	Stress value
MIX- 1	-	HDPE Plastic (Mono)	10
MIX-2	1:1	HDPE + Bagasse ash	12
MIX-3	1:2	HDPE + Bagasse ash	13
MIX-4	1:1	HDPE+ M-sand	12
MIX-5	1:2	HDPE+ M-sand	13

A. Discussion of Results

This Paver block is strong as the conventional concrete paver blocks, and any other forms of pavers exist in the current day.

This is more Eco-friendly than all other existing forms of pavement blocks and reduces the release of co2 into the atmosphere.

The compressive strength is 17 N/mm2, which is almost equal to the compressive strength of concrete paver blocks, and also beyond this, the block tends to bend despite breaking.

Lime Hydrate coating is given to the blocks after finishing to prevent heat.

The Pavers are more utilizable in places such as car parking, pathways, etc., and in some places, roads are laid using this with very low production cost.

V. Conclusion

Thus, the analysis concluded that waste plastics could be used in pavement block production. This modified pavement block is applicable in the construction of rigid pavements. This pavement block that has been manufactured using HDPE plastic wastes is strongly durable than other types of pavement blocks and it should also withstand heavy loads.

The findings of the paper also state that it does not create any harm to the environment, whereas the cement and concrete blocks affect the environment, thereby releasing co2 content in the environment. Therefore, these blocks are made absolutely at the very low cost of production by yielding more benefits.

The future scope of the project is to construct an entire element in a framed structure only with the use of Plastic wastes so that it creates numerous beneficial and progressive growth in the future field of the construction industry, and these type of Plastic buildings will play an important role in reducing global warming and prospectively protects the environment also by disposing of the plastic wastes that accumulate the major portion of the earth and remains non-degradable for millions of years in a progressive manner.

Thus, the long-term performance of plastic waste in concrete and its environmental impact after its service life is recommended to be explored further

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