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Sand Plastic Paver Block using Waste Plastic

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ABSTRACT: The Plastic usage is large in consumption and one of the largest plastic wastes is polyethylene (PE) Plastics are rapidly growing segment of the municipal solid waste. 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. At present nearly 56lakhs tones of plastic waste is produced in India every year. The waste plastics in house hold is large and increasing with time. In each country waste consumption is different, since it is affected by socioeconomic characteristics and waste management programs, but the level of plastics in waste consumption is low. In order to overcome this issue, we have to use it in effective manner for different purposes. This project aims at recycling waste plastics into pavement blocks, and studies their characteristics. Pavement blocks are perfect materials on the pathways and streets for simple laying and finishing. Here the strength properties of pavement blocks comprising of waste plastics and the design considerations for pavement block incorporating waste plastic bags is presented. It will be a boon to modern society and environment.

The aim of this study is to Reuse Plastic Waste dumped in Landfill sites of Country in manufacturing of Paver Blocks. Plastic waste is used as binding material and to replace cement to reduce the cost of paver block when compared to that of conventional concrete paver blocks. The degradation rate of plastic waste is also a very slow process. Hence the study is helpful in reducing plastic waste in a useful way. In this study we have used plastic waste with Sand. The study bears on plastics with transparent bags and films in PP, Polyethylene terephthalate (PET). Plastic waste is melted, and along with some amount of bituminous material and fly ash is mixed with sand. The paver blocks are to be prepared and tested and the results to be interpreted. The proposed tests include water absorption test, temperature sustainability test and compression test. Ultimately we propose to use the waste plastic in construction fields with appropriate additives. It will definitely be a cost effective and efficient mode of waste plastic consumption.

I. INTRODUCTION

Paver block paving is versatile, aesthetically attractive, functional, and cost effective and requires little or no maintenance if correctly manufactured and laid. Mostly concrete block paving constructed in India also has performed satisfactorily. 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 Nonconventional and 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 56lakh tones of plastic waste dumped in India in a 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 is necessary to dispose the plastic waste properly as per the regulations provided by our government. The replacement of cement with plastic waste provides potential to environmental as well as economic benefits. Paving block also known as brick paving is a commonly used as decorative purpose and creating a pavement or hard standing. The main benefit of bricks over other materials is that individual bricks can later be lifted up and replaced. This allows for remedial work to be carried out under the surface of the paving without leaving a lasting mark once the paving bricks have been replaced. In sand plastic paving block the various material are use such as waste plastic, sand and fly ash in the construction of the paving bricks.

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PRESENT SCENARIO OF WASTE GENERATION

Growth of population, increasing urbanization, rising standards of living due to technological innovations have contributed to an increase both in the quantity and variety of solid wastes generated by industrial, mining, domestic and agricultural activities. Globally the estimated quantity of wastes generation was 12 billion tonnes in the year 2002 of which 11 billion tonnes were industrial wastes and 1 billion tonnes were municipal solid wastes (MSW). About 19 billion tonnes of solid wastes are expected to be generated annually by the year 2025. Annually, Asia alone generates 4.4 billion tonnes of solid wastes and MSW comprise 790 million tonnes (MT) of which about 48 (6%)MT are generated in India. By the year 2047, MSW generation in India, is expected to reach 300MT and land requirement for disposal of this waste would be 169.6km^2 as against which only 20.2km^2 were occupied in 1997 for management of 48MT. Generation of all these inorganic industrial wastes in India is estimated to be 290MT per annum. In India, 4.5MT of hazardous wastes are being generated annually during different industrial process like electroplating, various metal extraction processes, galvanizing, refinery, petrochemical industries, pharmaceutical and pesticide industries.

II. LITERATURE REVIEW

1. AUTHOR NAME - -S. Vanitha, V. Natrajan and M. Praba Title - Utilization of Waste Plastics as a Partial Replacement of Coarse Aggregate in Concrete Blocks Published Published – 2008 17 March 2005 The rapid industrialization and urbanization in the country leads lot of infrastructure development. This process leads to several problems like shortage of construction materials, increased productivity of wastes and other products. This paper deals with the reuse of waste plastics as partial replacement of coarse aggregate in M20 concrete. Usually M20 concrete is used for most constructional works. Waste Plastics were incrementally added in 0%, 2%, 4%, 6%, 8% and 10% to replace the same amount of Aggregate. Tests were conducted on coarse aggregates, fine aggregates, cement and waste plastics to determine their physical properties. Paver Blocks and Solid Blocks of size 200 mm X 150 mm X 60 mm and 200 mm X 100 mm X 65 mm were casted and tested for 7, 14 and 28 days strength. The result shows that the compressive strength of M20 concrete with waste plastics is 4% for Paver Blocks and 2% for Solid Blocks.

2. AUTHOR NAME - Eric AbabioOhemeng Title–Utilization of Waste Low Density Polyethylene in High Strengths Concrete Pavement Blocks Production Published – 2013sss The disposal of waste plastics is causing a great challenge in Ghana and the world as a whole as the usage of plastics is growing day by day and it takes centuries for waste plastics to decompose. Hence, there is the need toadopt effective methods to utilize these plastics. The main objective of this research was to investigate the Feasibility of using waste low density polyethylene as partial replacement for sand in the production of concrete pavement blocks. In this study cement, sand, coarse aggregate, and ground plastic were used. The mix proportion was 1: 1.5: 3 (cement: sand: coarse aggregate). The plastic was used to replace the sand by volume at 0%, 10%, 20%, 30%, 40%, 50%, and 60%. It was observed that density, compressive strength, flexural strength, and splitting tensile strength decreased as the plastic content increased. However, the water absorption increased as the plastic content increased. Compressive strengths level ranging from 14.70N/mm2 – 47.29N/mm2 wereachieved when water cement ratios of 0.30 – 0.45 were used. Although, the strengths of the pavement blocks decreased as the plastic content increased, compressive strengths of 20N/mm2, 30N/mm2, and 40N/mm2 which are satisfactory for pedestrians walk ways, light traffic and heavy traffic situations respectively could be achieved if 10% - 50% plastic contents are used. It is concluded that the modified pavement blocks would contribute to the disposal of plastics in the world.

III. METHODOLOGY OF PROPOSED SURVEY

STUDY AREA:- Gondia climate is classified as tropical. The summers here have a good deal of rainfall, while the winters have very little. The average annual temperature is 31°C in Gondia. The average annual rainfall is 1418 mm.

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Table 1 Temperature and precipitation of Gondia in different month

Temp.	January	February	March	April	May	June	July	August	September	October	November	December
Avg.Temperature (°C)	20	24.3	32.7	40	41	40	27.4	27	27.4	25.9	22.2	18.2
Min. Temperature (°C)	13.2	15.3	19.4	30	36.4	30.1	24.3	24.1	23.9	21	15.1	12.7
Max. Temperature (°C)	27.6	31.1	36.2	39	48	38.1	30.9	29.9	30	28.3	28	27.8
Precipitation / Rainfall (mm)	14	11	18	11	10	159	460	427	244	51	4	9

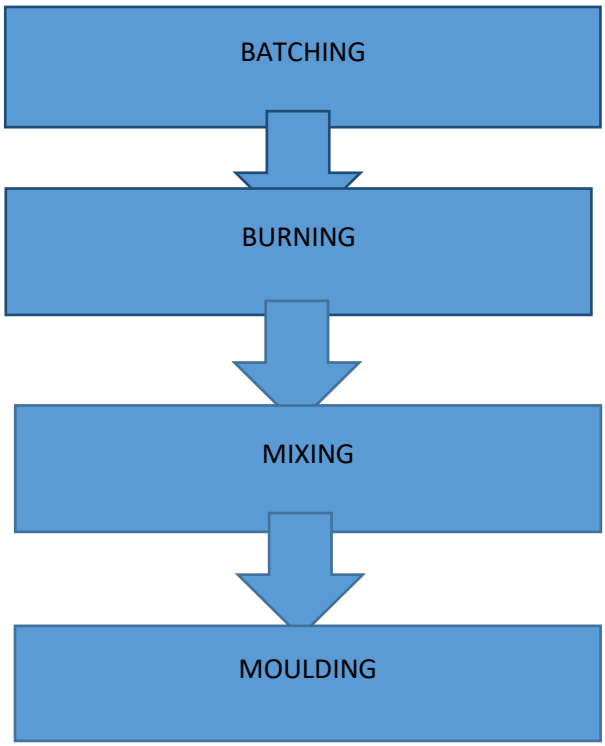
MATERIAL

Following are the materials use in our Pavement block production. There as follows,

- Sand
- Waste plastic
- Bitumen
- Fly ash
- Cement

MANUFACTURINGPROCESS

In manufacturing process of sand plastic paver block there are four stage. First one is batching then burning, mixing and last one is moulding



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BATCHING

The measurement of materials for making brick is termed as batching. Use of weigh system in batching facilitates accuracy, flexibility and simplicity. The collected waste bags are cleaned with water and dried to remove the water present inside the plastic and then weighted. The sand were sieved by using 600 micron sieve. The sand and the plastic bags were weighed in various proportions among which the plastic were taken for burning process. The table shows the batching proportion of the materials.

In order to arrive at appropriate proportions of ingredients for sufficient strength and durability of paver blocks, we used different trial ratios of material and various tests are conducted to assess various properties of paver blocks.

Following table are shows the different ratio of material in paver blocks and result of various test.

Block No	Sand Kg.	Plastic Kg.	Bitumen in Kg.	Fly ash Kg.	Water absorption test %	Compression strength test (N/mm²)	Fire resistance test (up to that temp. There is no deteriorate)
1	2	0.500	0	0	3%	4	51°c
2	2	0.600	0	0	2.74%	10.66	50°c
3	2	0.700	0	0	0.20%	17.33	45°c
4	0.500	0.150	0.50	0.25	2.6%	8	70°c
5	2	0.600	0.200	0.50	2.8%	46.66	80°c

From above table we conclude that the block no 5 has good strength and good fire resistance as compared to other trials of paver block. The bitumen are used to increase strength of paver block and it make good bonding with melt plastic.

Following table no 4.2.2 show the batching ratio of material used for making the paver block.

S. No	Material	For 1 brick (kg)
1	Sand	2 kg
2	Plastic	0.600 kg
3	Bituminous	0.200 kg
4	Fly ash	0.50 kg

BURNING OF PLASTIC AND BITUMINUS

After batching the plastic bags were taken for burning in which the bituminous are thrown in barrel and apply heat on barrel then plastic bags are thrown one by one into the barrel and allowed to melt. For making of paver block we used steel bucket and for applying heat we used black smith furnaces. If we don't have furnaces then we used melting barrel.

To make the melting barrel, cut a simple oil drum in half and attach three legs made of rebar. With the legs attached, the ideal height of the barrel is 50cm, and 80cm wide. Try to make the burner big enough that you can hold a good amount of liquid plastic but not so tall that it is tricky to mix. If you can sink the legs into the ground it will make the barrel more stable for mixing. The barrel is placed over the setup and it is heated to remove the moisture present in it.

MIXING

Mixing of materials is essential for the production of uniform and strengthens brick. The mixing should ensure that the mass becomes homogeneous, uniform in color and consistency. Generally there are two types of mixing, Hand mixing and machine mixing. In this project, we adopted hand mixing. The percentage of fly ash should be 5%, 55% of sand,30% of plastic and 10% of bituminous. The heat is applying at 300 degree. The bituminous are put in bucket then plastic are added

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one by one into the bucket, until the entire plastic content required for making bricks of one mix proportion is added into it. When these plastic thoroughly by using trowel before it hardens. Keep mixing thoroughly until all the plastic has melted and there is a consistent black liquid. Sometimes LDPE lumps can remain even at very high temperatures. Stirring and heating must continue until all lumps are removed and a homogenous paste is obtained, since they affect the strength of the material. This can take up to 20 minutes. Do not let the liquid get so hot that it burns strongly – it will not work as a building material if this happens. A few flames from the liquid is acceptable. Add sand until you have the required mixture and keep mixing so that the plastic, which acts as a binder, is very well mixed in and looks like grey cement. Hence mixing process should not consume more time.

MOLDING

The mixture is then poured into the brick mould and is compacted by using tamping rod or steel rod. The surface is finished by using trowel. Before placing the mixture into the mould, the sides of the mould are oiled to easy removal of bricks. Mould removed after 3 hours. The mould is used for preparing paver block in uniform shape. The size of mould is 150×150×50 mm. The mould were assembled and placed on the base plate. The faces must be thinly coated with mould oil to easily remold after casting. The moulds can be whatever shape you wish – they are constructed.

After 3 hour of removing from the mould the paver block are place in an open atmosphere for 1 hour then block is coated with the cement slurry. For cement coating make a cement slurry then applying on paver block and the thickness of the slurry is 5mm. Then after coating kept paver block in open atmosphere for 24 hour. Due to cement slurry the paver block are give smooth finishing and it helps to maintain the temperature of paver block.

IV. OBSERVATION

WATER ABSORPTION TEST

Water absorption = {[W2 – W1] / W1} x 100

Where,

W1 = Weight of dry brick (kg)

W2 = Weight of wet brick (kg) Ws

S. No	Type of brick	Brick dry weight (kg)	Water absorption in kg after 24 hrs.	Water absorption (%)
1	Concrete paver block	3.135	3.382	7.87
2	Plastic sand paver block	2.294	2.357	2.67

COMPRESSION STRENGTH TEST

Plastic paver blocks of size 15x15x5cm each sides were casted. The maximum load at failure reading was taken and the compressive strength is calculated using the following equation.

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

S.No	Type of Paver block	Compressive Strength(N/mm^2)
1	Plastic sand paver stone	46.66
2	Ordinary concrete paver block	86.66

FIRE RESISTANCE TEST

The Plastic is highly susceptible to fire but in case of Plastic sand bricks/Paver blocks the presence of sand imparts insulation. For these test we placed paver block in oven for 3hr at 80°C. There is no change in the structural properties of block of bricks up to 80˚C above which visible cracks are seen and the bricks deteriorate with increase in temperature.

COMPARISION

Following table are shows the compare between the concrete paver block and sand plastic paver block.

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Characteristic	Concrete paver block	Sand plastic paver block
Compressive strength	86.66	46.66
Water absorption	7.87	2.67
Cost	More	Less
Suitability	Foot path, parking, Road, Petrol pump	Garden road, Walking track ,veranda, pedestrian bridge
Time required to casting	7 day	2 day
Curing	Essential	Not Essential

V. RESULT & DISCUSSION

These paver block are used in various places.

I. Used in foot path
II. Garden road and walking track
III. Pedestrians bridge
IV. Veranda flooring

Advantages

Plastic sand brick possess more advantages which includes cost efficiency, resource efficiency, reduction in emission of greenhouse gases, etc. Plastic sand paver block is also known as “Eco-Paver Block” made of plastic waste which is otherwise harmful to all living organisms can be used for construction purposes. By use of plastic sand bricks, the water absorption presence of alkalies was highly reduced. Owing to numerous advantages further research would improve quality and durability of plastic sand bricks

Following are some advantages of sand plastic paver block

- Cement is replaced with plastic
- Decrease the cost of paving block
- Curing is not important
- Block are light in weight
- To provide economical construction material
- To safe guard to the environment by utilizing waste plastic
- High profit
- Creating jobs

Disadvantages

- Less fire resistance
- Release of harm full gases at time of preparation
- Not suitable for heavy loaded area
- Less compressive strength as compare to conventional paver block

VI. CONCLUSION AND FUTURE WORK

The study concludes that the waste plastics can be used in the paver block production. The Plastic sand bricks possess more advantages which include Cost efficiency, Removal of waste products thus abolishing the land requirement problem for dumping plastic, Reduction in the emission of greenhouse gases by the conversion of flue gases into synthetic oil etc.,

This measure is expected to be highly suitable for the countries like ours which are facing difficulty in disposing/recycling the plastic waste. The natural resources consumed for the manufacturing of Plastic sand bricks and Paver blocks are quite less when compared to its counterparts. The manufacturing cost could be reduced further by replacing the river sand with fly ash or other waste plastic products. Owing to the numerous advantages further research would improve the quality and durability of plastic sand paver blocks.

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(a) The compressive strength of modified pavement blocks is almost half of that of conventional block.
(b) The cost of construction will be reduced and also helps to avoid the general disposal technique of waste plastics namely, land filling and incineration which have certain burden on ecology.
(c) By using the plastics in pavement block, reduces the weight up to 15%.
(d) We also find that plastic pavement block is economical and has several advantages when compared to the concrete pavement block.
(e) Lastly the strongly conclude the use of recycled plastics in pavement block is the best option for the disposal of plastic and ultimately reduces plastic pollution in the environment's

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