Use of Waste Plastic As Binding Material In Pavement Block

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Abstract- *Waste plastic bags and the constantly expanding proportion of plastics in municipal solid trash have become important issues. The amount of used plastic bags that have gathered in the twenty-first century has made it extremely difficult to dispose of them. Plastic trash in homes is significant and is growing over time. Although if socioeconomic factors and trash management initiatives have little impact on waste consumption, plastics account for a significant portion of it globally. We must employ it effectively if we are to resolve this problem. This research aims to examine the characteristics of paving blocks made from recycled waste plastic. Pavement blocks are the ideal materials for straightforward laying and finishing on pathways and roadways. Here, the design considerations for pavement blocks using waste plastic bags and the strength characteristics of pavement blocks made of waste plastic are discussed. The ecology and modern civilization will benefit from it. The primary goal is to utilize plastic nature in the field of building with minimal modifications. It may be used in various ways and will undoubtedly be cost-effective.*

Keywords- Polythene Bags, M Sand, Mechanical Properties, Compression Strength, Density.

I. INTRODUCTION

A sizeable fraction of all municipal solid trash is made up of plastic garbage. Hence, a comprehensive waste management system should be required.

One of Ghana's top environmental concerns is solid waste management. There are fewer landfills available, and creating new dump sites is growing more expensive. The only place we have is the landfill, which is run by the MMDAs and a few sanitation organizations.

Some vehicle debris falls into gutters while being transported to disposal locations by sanitation authorities from homes and businesses. Moreover, plastics are being discarded and abused across the nation, posing a hazard to the environment.

1. Polymer's clog gutters and drains, which results in flooding.
2. When filled with rainwater, plastic bottles and containers serve as mosquito breeding grounds.
3. When burned, plastic emits harmful pollutants into the atmosphere.

Waste made of high-density polyethylene (HDPE) is used to make dustbins and bags. These materials can be used in place of leather bags and metallic trash cans.

Waste made of expanded polystyrene (EPS), high density polyethylene (HDPE), trash bottles made of polyethylene terephthalate (PET), and polypropylene fibers.

Municipal Solid Waste (MSW) includes a significant amount of PET plastic, which is increasingly being researched for potential usage in pavement blocks.

Pavement blocks with polymer modifications are used in both building construction and road construction.

Hence, leftover PET plastic may be included into concrete mass in some capacity without significantly altering its other characteristics or slightly reducing its strength (Polymer Modified Concrete).

Waste Voltic bottles discovered on the KNUST campus were crushed into flakes and utilized to make paving blocks for this project.

Design Procedure

Types of plastic bags = PE, PP, PS
Temperature of heating = 14 F -16 F
Exposure condition = Moderate
Degree of supervision = Good
Size of fine aggregate = 1.7mm
Specific gravity of fine aggregate = 2.65
Specific gravity of PS = 1.05
Specific gravity of PB = 0.6

Specific gravity of PP = 0.9-0.92
Specific gravity of LDPE = 0.91-0.93
Specific gravity of HDPE = 0.96-0.97

Plastic Proportion

When plastic is heated at 14 to 16 F it is melted into a liquid form and this liquid is calculated into a ml. if 1/2 kg of plastic bags is heated up to a 450ml of liquid is obtained. similarly the mix proportion of plastic ratio is denoted by liquid(ml).

Design mix proportion

In order to check the workability of the plastic mix we made a trail and error method. After some trails it is found that by fixing plastic liquid quantity constant and the quantity of fine aggregate keeps altering. Finally, a designed mix of excellent workability is obtained. Then a pavement block is casted and the compressive strength is found From the table below the stress of various mix is tabulated.

Design mix tabulation table

Normal mix possessing plastic , fine aggregate And coarse aggregate

Sr. No.	Ratio (P:F.A:C.A)	Workability	Stress N/mm^2
1	1/2:1	Poor	6
2	1/2:2	Fair	7
3	1:2	Good	10
4	1:3	excellent	12

Mix design M40 Grade designed as per IS 10262:2009 and IS 456:2000

Grade Designation:M40
Type of cement: OPC-43grade
Brand of cement: Vikram (Grasim)
Admixture: Fosroc (Conlpast Sp 430 G8M)
Fine Aggregate : Zone-II
Sp. Gravity Cement:3.15
Fine Aggregate:2.61
Coarse Aggregate(20mm):2.65
Coarse Aggregate(10mm):2.66
Minimum Cement(As per contract):400kg/m3
Maximum water cement ratio (As per Contract):0.45
Mix Calculation:-

1.Target Mean Strength=40+(5 X 1.65)=48.25Mpa

2.Selection of water cement ratio:-
Assume water cement ratio=0.4

3.Calculation of cement content:-
Assume cement content 400kg/ m3
(As per contract Minimum cement content 400kg/ m3)

4.Calculation of water:-
400 x 0.4=160kg Which is less than 186kg (As per table No.4,IS:10262)
Hence o.k.

5.Calculation for C.A and F.A.:- As per 10262,Cl. No.3.5.1

$V=[W + (C/Sc) + (1/p) . (fa/Sfa)] \times (1/1000)$
$V=[W + (C/Sc) + \{1/(1-p)\} . (Ca/Sca)] \times (1/1000)$
Where
V=Absolute volume of fresh concrete, which is equal to gross Volume(m3)minus the volume of entrapped air,
W=mass of water(kg)per m3 of concrete,
C=mass of cement (kg)per m3 of concrete,
Sc=specific gravity of cement,
(p)=Ratio of fine aggregate to total aggregate by absolute volume,
(fa),(ca)=total mass of fine aggregate and coarse aggregate (kg) per m3 of

Concrete respectively, and Sfa, Sca=Specific gravities of saturated surface dry fine aggregate and coarse aggregate respectively.

As per Table No.3,IS-10262,for 20mm maximum size entrapped air is 2%.

Assume F.A. by % of volume of total aggregate=36.5%
$0.98=[160 + (400/3.15) + (1/0.365) (Fa/2.61)] (1/1000)=Fa=660.2$ kg

Say Fa=660 kg
$0.98=[160 + (400/3.15) + (1/0.635) (Ca/2.655)](1/1000)=Ca=1168.37$

Say Ca=1168kg
Considering 20 mm:10mm=0.6:0.4
20mm = 701 kg
10mm = 467 kg
Hence Mix details per m3

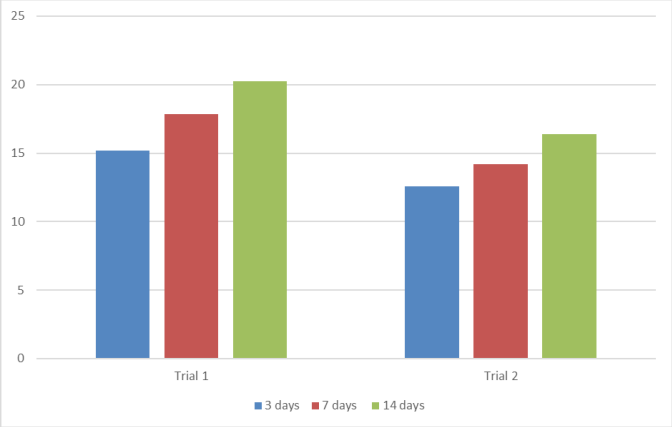
Cement = 400 kg
Water = 160 kg
Fine aggregate 20 mm = 701 kg
Coarse aggregate 20 mm = 701 kg
Coarse aggregate 10 mm = 467 kg
Admixture = 0.6% by weight of cement = 2.4 kg
Recron 3S = 900 gm

TESTS AND RESULTS COMMPRESSIVE STRENGTH OF PAVEMENT BLOCK

The tests are required to determine the strength of specimen and therefore its suitability for the job.

Out of many tests applied to the paver, this is the outmost important which gives an idea about all the characteristics of specimen. By this single test one judge that whether specimen has been done properly or not.

Size of the cube = 314.36cm^2
Ratio of mix
(P:F.A) = 1:3



Compression test in KN/m^2

Sr. NO.	Trials	Compressive strength in KN/m^2		
		3 Days	7 Days	14 Days
1	Trial 1	15.18	17.86	20.25
2	Trial 2	12.60	14.21	16.36

Compression Test Result

Size of the cube = 0.189 m^3

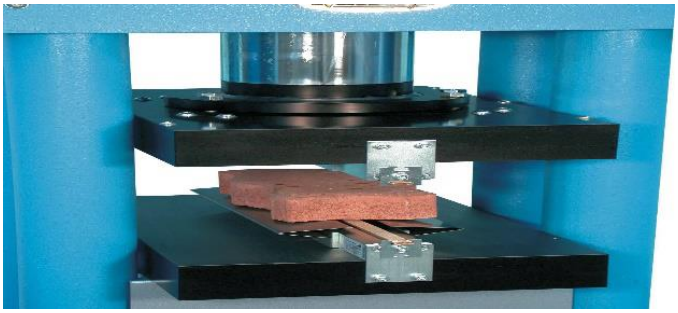
Ratio of mix with quarry dust of 30 %
(P:F.A) = 1:3

Sr. No.	Trails	Compressive Strength In KN/m^2		
		3 Days	7 Days	14 Days
1	Trial 3	13.36	15.50	17.70
2	Trial 4	11.29	13.30	15.67

Compressive Test Result

Split Tensile Strength test

The tensile strength of paver block is one of the basic and important properties. This is a method to determine the tensile strength of paver block. The Paver block is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The paver block develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of specimen to determine the load at which the paver block members may crack.



Sr. No.	Trials	SPLIT TENSILE STRENGTH IN KN/m^2		
		3 DAYS	7 DAYS	14 DAYS
1	TRIAL 1	12	13	15
2	TRIAL 2	10	10	12
3	TRIAL 3	9	11	11
4	TRIAL 4	10	10	10

Split Tensile Strength Test

Water Absorption Test

The casted specimen was subjected to a water absorption test, to study the character of plastic block. After the drying period is completed, the specimen was immersed in water tank is left for 24 hours.

The blocks shall then be removed from the water and allowed to drain for one minute by placing them on a 10 mm or coarser wire mesh, visible surface water being removed with a damp cloth, the saturated and surface dry blocks immediately weighed.

After weighing all blocks shall be dried in a ventilated oven at 100^0 to 115^0 C for not less than 24 hours and until two successive weighing at intervals of 2 hours show an increment of loss not greater than 0.2 percent of the last previously determined mass of the specimen.

Sr. No.	Specimen	Dry Weight	Wet Weight	% of Water Absorption
1	A	710	710	1.42
2	B	705	712	1.00
3	C	708	715	0.98
4	D	712	723	1.54

ACID RESISTANCE TEST

HYDROCHLORIC ACID (HCL)

Chloride attack is particularly important because its primarily causes corrosion of reinforcement. The BIS earlier specified the max chloride content in binder as 0.05%. But it has been revised that the allowable chloride content in binder to be 0.1%.

The cubes were cast the size of 0.01891m3 and kept at a room temperature. After 5 days the cube were removed from the mold and cured in the oven 120^0C for 7 days.

In conventional blocks after 24 hours the cubes were removed and cured 28 days in normal water, Then the cubes are immersed in a 1% and 2% concentric HCL acid and calculation of durability factors were completed.

PERCENTAGE OF LOSS OF WEIGHT (WITHOUT Q.D)

Sr. No.	Specimen	Initial Weight (kg)	Final Weight (kg)	% Of Loss Of Weight
1	A	3.640	3.535	2.88
2	B	3.590	3.480	3.06
3	C	3.580	3.450	3.63
4	D	4.065	3.855	5.16

Efflorescence Test

The Presence of alkalis in bricks is harmful and they form a grey or white layer on brick surface by absorbing moisture. To find out the presence of alkalis in bricks this test is performed. In this test a brick is immersed in fresh water for 24 hours and then its taken out from water and allowed to dry in shade. The plastic sand brick has low alkali content and so a little white patch is formed over the surface.

Fire Resistance Test

The plastic is highly susceptible to fire but in case of plastic sand bricks/pavers blocks the presence of sand imparts insulation. There is no change in the structural properties of block of bricks up to 180 C above which visible cracks are seen and the blocks/bricks deteriorate with increase in temperature.

Hardness test

In this test a scratch is made on brick surface with steel rod(any hard material can be used) which was difficult to imply the bricks or blocks were hard. This shows the brick possess high quality.

II. CONCLUSION

The examination of the aforementioned study came to the conclusion that waste plastics can be utilized to make pavement blocks. The building of stiff pavements can use this modified pavement block.

The block is made of quarry dust, coarse aggregate, fine aggregate, and plastics, with varied percentages of each ingredient used in different paver blocks. Its length, durability, and, most importantly, its potential to reduce plastic waste are all studied.

REFERENCES

[1] Ganesh Tapkire, Satish Parihar, Pramod Patil, Hemraj Kumavat, " Recycled Plastic used in Concrete Paver Block" International Journal of Research in Engineering and Technology(IJRET), Vol:3 June-2014 , pISSN:2321-7308

[2] Pramod Sambhaji Patil, " Behavior of Concrete which is Partially Replaced with Waste Plastic" march 2015 Dhule, India

[3] Kasib Malak, " Use of Waste Plastic in Concrete Mixture as Aggregate Replacement" A R Digitech International journal of engineering,Education and Technology(ARDIJEET) ISSN 2320-883X April 2015

[4]]Eric Ababio Ohemeng, Peter Paa-Kofi Yalley, John Dadzie & Susan Dzifa Djokoto, " Utilization of Waste low density polyethylene in High strength concrete pavement blocks Production" Civil and Environmental Research ISSN 2224-5790 (paper) ISSN 2225-0514(online) ,2014

[5] IS 15658:2006 "Precast concrete block for paving-specification" Bureau of Indian standard New Delhi (2006)