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"MANUFACTURING OF PLASTIC PAVER BLOCKS BY UTILIZATION OF WASTE PLASTIC"

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ABSTRACT

Plastic waste which is increasing day by day becomes eyesore and in turn pollutes the environment, especially in high mountain villages where no garbage collection system exists. Plastic is one of the most disposable materials in the modem world. A large amount of plastic is being brought into the tourist trekking regions are discarded or burned which leads to the contamination of environment and air Plastic waste is increasingly becoming a menace to the environment due to the chemicals used in the manufacture, improper use and disposal. Hence, these waste plastics are to be effectively utilized. High-density polyethylene (HDPE) and polyethylene (PE) bags are cleaned and added with clay aggregate at various percentages to obtain high strength blocks that to control pollution and to reduce the overall cost of construction, this is one of the best ways to avoid the accumulation of plastic waste which is a non-degradable pollutant.

Hence in this thesis, an attempt is made to study regard the properties of the block which is manufactured using plastic wastes. Size of paver block (10x10x6 cm) are used for testing. In this project, we try to different ratio 1:1, 1:2, 1:3, 1:4, for construction of plastic blocks and compare various factors like compressive strength, water absorption, fire resistance, and construction cost with normal blocks. About 11.5 MPa compressive strength is found at 1:3 ratio.

Keyword: *Plastic Waste, HDPE, PE, Aggregate, Paver blocks*

I. INTRODUCTION

Plastic has become the most common material since the beginning of the 20th century and modem life is unthinkable without it. Unfortunately, what makes it so useful, such as its durability, light weight and low cost, also makes it problematic when it comes to its end of life phase. Millions of tonnes of plastic debris end up floating in world oceans broken into micro plastic, the so-called plastic soup micro plastics are found in the most remote parts of our oceans Entanglement of turtles by floating plastic bags, sea mammals and birds that die from eating plastic debris and ghost fishing through derelict fishing gear produce shocking pictures. Moreover, plastic is not inert and chemical additives, some of them endocrine disruptors, can migrate into body tissue and enter the food chain. The massive pollution of world oceans with plastic debris is therefore emerging as a global challenge that requires a global response. The European Union should be a showcase for how to build a coherent strategy to optimize plastic waste policy.

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II. MATERIALS

A) Plastic:- Plastic is a synthetic material made from a wide range of organic polymers such as polyethylene, PVC, nylon, etc., that can be moulded into shape while soft, and then set into a rigid or slightly elastic form. Looking seriously at the global issue of environmental pollution posed by postconsumer plastic wastes, research is being focused in depth on finding out more ways and means to consume this waste material on a massive scale in an efficient and environment friendly manner. PET is used for high impact resistant container for packaging of soda, edible oils and peanut butter. Used for cereal box liners, Microwave food trays. Used in medicine for plastic vessels and for Implantation. Plastic is heat resistant and chemically stable PET is resistant to acid, base, some solvents, oils, fats. PET is difficult to melt and it is transparent.

Fig. 1 Waste Plastic

Table 1 Thermal Behavior of Polymers

S. No.	Polymer	Softening Temp. in °C	Decomposition Temp. in °C	Ignition Temp. range in °C
1.)	PE	100 - 120	270 - 350	>700
2.)	PP	140 - 160	270 - 300	>700
3.)	PS	110 - 140	300 - 350	>700

Plastic have many good characteristics which include:

- Versatility
- Lightness
- Hardness
- Resistant to chemicals, water and impact.

Plastic is one of the most disposable materials in the modern world. It makes up much of the street side litter in urban and rural areas. It is rapidly filling up landfills as choking water bodies. Plastic bottles make up approximately 11% of the content landfills, causing serious environmental consequences.

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Table 2 Type of plastic and variation in bending strength

Type of Plastic	Percentage of Plastic	Bending Strength in Kg	Compression Strength
Poly ethylene	10	325	250
	20	340	270
	25	350	290
	30	400	325
Poly propylene	10	350	280
	20	370	290
	25	385	310
Polystyrene	10	200	155
	20	210	165
	25	215	170
Polyethylene Foam	10	310	250
	20	325	265
	25	335	290
L Polyethylene Foam	10	340	270
	20	360	290
	25	365	310
Laminated Plastics	10	360	290
	20	385	310
	25	400	335

B) Aggregate: Aggregate shall comply with the requirement of IS 383 as for as possible crushed. Aggregate shall be used for ensuring adequate durability. The aggregate used for production of block shall be Sound and free from soft and honeycombed particle the nominal maxi size of coarse aggregate used in Production of paver block shall be 10 mm**.** Aggregate and aggregate dust is a by-product of crushing, with a typical grain size of 10 – 4.75 mm and retain on 0.6mm IS sieve.

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Fig. 2 Aggregate

Table 3 Physical properties of aggregate

S. No.	Description	MORTH 2001 Specification	Result	IS Code
1.)	Impact test	Max 30	4.30%	IS 2386 part 4
2.)	Hardness test by Los Angele's	Max 30	20.13%	IS 2386 part 5
3.)	Flakiness index	Max 30	23.62%	IS 1211 - 1978
4.)	Elongation index	Max 30	29.16%	IS 1211 – 1978
5.)	Water absorption test	Max 2	0.206%	IS 0383 - 1970

III. METHODOLOGY

In order to find the plastic paver blocks that they possess high compressive strength with various mix proportions are made and they are tested using compressive testing machine. The mix proportion were in the ratio of (1:1, 1:2, 1:3, 1:4) These are the ratio which represent the plastic, aggregate respectively.

- In first step we should collect the waste plastic bags and the polyethylene bags are sorted out and remaining are disposed safely.
- Next the collected waste bags are cleaned with water and dried to remove the water present in it after this the plastics are burned out.

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- The drum is placed over the above setup and it is heated to remove the moisture present in it. Then the plastic bags are added to the drum one by one and the aggregate is added to the plastic when it turns into hot liquid.
- The aggregate is added is mixed thoroughly using rod and trowel before it hardens. The mixture has a very short setting hence mixing process must not consume more time on the other hand the process should be complete.

This mixture is then poured in to the mould and they are compacted using steel rod and surface is finished using trowel.

Fig. 3 Cutting of plastic, Melting and Mixing

IV. TESTING PROCEDURE

A. Compressive test: The apparatus shall comprise of compression testing machine which shall be equipped with two steel bearing blocks for holding the specimen. It is desirable that the blocks have a minimum hardness of 60 (HRC) and a minimum thickness of 25 mm. The block on top through which load is transmitted to the specimen shall be spherically seated. The block below on which the specimen is placed shall be rigidly fitted. When the bearing area of the steel blocks is not sufficient to cover the bearing area of the paver block specimen, two steel bearing plates meeting the requirements shall be placed between the steel plates fitted on the machine and the specimen.

Table no. 4 Compressive strength of different ratio for plastic

S. No.	Dimension of block (mm)	Plastic& Aggregate Ratio	Maximum load in KN (P)	Compressive strength (N/mm^2)
1)	100 X60X100	1:1	130	5.01
2)	100 X60X100	1:2	200	7.7
3)	100 X60X100	1:3	300	11.5
4)	100 X60X100	1:4	150	5.77

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Table no. 5 Compressive strength of different ratio for 14 days

S. No.	Dimension of block (mm)	Plastic& Aggregate Ratio	Maximum load in KN (P)	Compressive strength (N/mm^2)
1)	100 X60X100	1:1	70	2.69
2)	100 X60X100	1:2	150	5.77
3)	100 X60X100	1:3	185	7.12
4)	100 X60X100	1:4	240	9.23

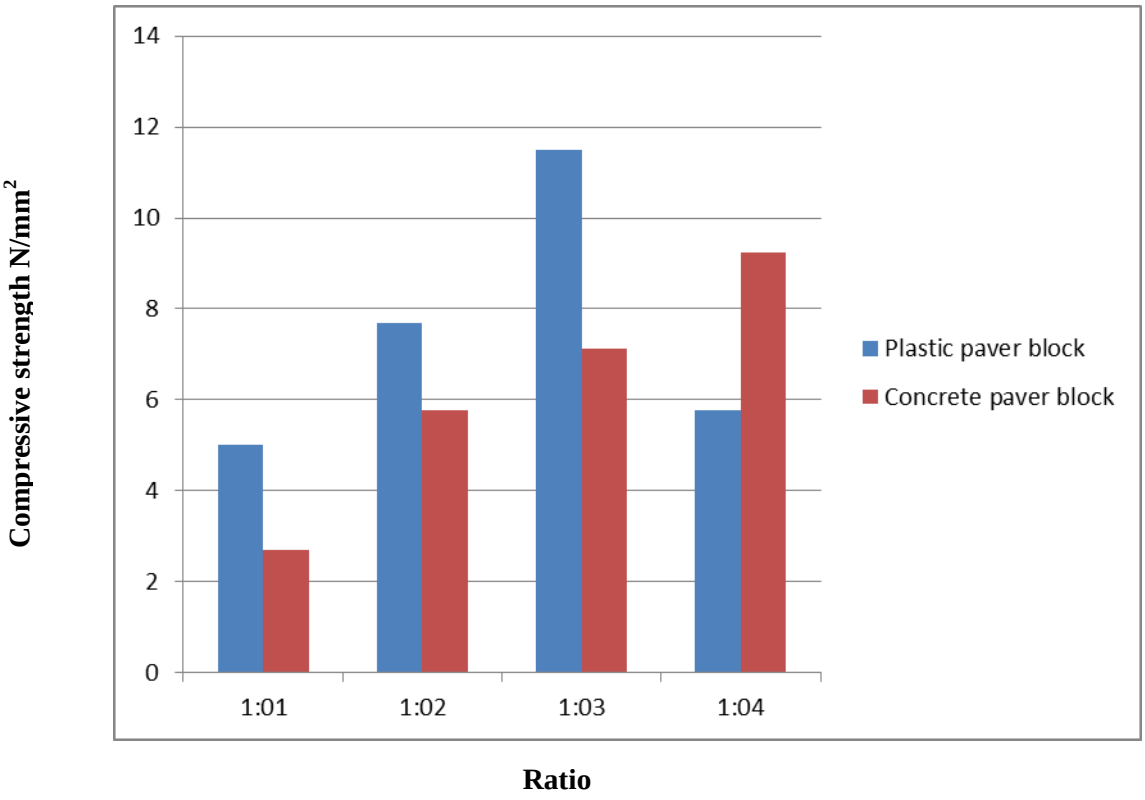

Fig. 3 Comparison of plastic paver blocks and concrete paver blocks

B. Water absorption test: The test specimen shall be completely immersed in water at room temperature for 24 ± 2 h. The specimen then shall be removed from the water and allowed to drain for 1min by placing them on a 10mm or coarser wire mesh. Visible water on the specimens shall be removed with a damp cloth. The specimen shall be immediately weighed and the weight for each specimen noted in N to the nearest 0.01 N.

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Table no. 6 Water absorption of paver blocks

S. No.	Plastic & Agg. Ratio	Weight of dry blocks W_1 (Kg)	Weight of wet blocks W_1 (Kg)	Water absorption (%)
1)	1:1	2.62	2.68	0.06
2)	1:2	2.99	3.04	0.05
3)	1:3	2.92	2.96	0.04
4)	1:4	2.97	3.01	0.04

C. Fire resistance of blocks: The Plastic is highly susceptible to fire but in case of Plastic Aggregate Paver blocks the presence of aggregate imparts insulation. There is no change in the structural properties of block of paver up to 130^0 C above which visible cracks are seen and the blocks deteriorate with increase in temperature.

V. COST ESTIMATE

Labour cost: Labours required

1) Head mason – 1/10 No´s
2) Labour – 3 No´s
3) Bristi – ½ No´s

Head Mason rate – 800 Rs/day

Labour rate- 400 Rs/day

One labour can manufacture 300 blocks

So, Labour cost per unit block = 1480/900 = 1.5 Rs/brick

Material cost:

1.) **Plastic** - Nil
2.) **Aggregate** – 2.5 Rs/Kg

Aggregate required for 1 block = 2.5 kg

Cost of aggregate = 2.5 X 2.5 = 6.25Rs/block

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Transportation cost:

Aggregate

Density of aggregate = 1660 kg/m^3

Volume of truck = 14.5 m^3

Rate for 1 trip of truck = 4000 Rs

Cost of transport of aggregate =4000/23200 = 0.17 Rs/Kg

Cost of aggregate = 0.17 X 2.7 = 0.4 Rs/block

Plastic

Quantity of plastic filled in a truck = 3000 kg

Cost of transport of plastic = 4000/3000 = 1.3 Rs/kg

Cost of plastic = 1.3 X0.57 = 0.7 Rs/kg

Total cost of block:

Cost of block = 1.5 + 6.25 + 0.4 + 0.7= 8.85Rs/block

Profit 10 % of 8.85=.885Rs/block

Total manufacturing cost of block = 9.7Rs/block

VI. CONCLUSION

The generation of waste plastics is increasing day by day. The major polymers, namely polyethylene, polypropylene, and polystyrene show adhesion property in their molten state. Hence, the use of waste plastic for plastic blocks is one of the best methods for easy disposal of waste plastics.

Plastic blocks are made with the help of plastic waste which is otherwise harmful for all living beings. Not only in India but globally the disposal of plastic has become an issue of major concern. In order to deal with this problem new concept of Plastic blocks came into existence. Material which is considered as waste can be utilized in making material for construction. Every year thousands of animals die due to effect of plastic hence if this plastic will be used in making something useful it would be beneficial in preserving our wildlife as well as marine life. These blocks are very cheaper in cost therefore the dream of helter of the poor people can be fulfilled by using these blocks. Drawback of these blocks is that they cannot be decomposed after use. It is also weakening the ozone layer by releasing harmful gases but these problems can be reduced by making plastic. which can decompose. Recycling of the plastic can also contribute or reduce the negative effect of Plastic blocks.

A plastic paver block gives high result as compare to concrete paver blocks with aggregate use. Overall Plastic blocks is a cost efficient and resource efficient building material which can be used to deal with the various environmental problems as well for the reduction in the cast of construction. We can conclude that using the concept of Plastic blocks is cost effective, energy efficient and commercially feasible. Using PET bottles is also Bio-climatic and thus we can say it is a Green construction.

As we know that the cost of conventional block is 15 to 20 Rs/block. Cost of manufactured block is less than the cost of conventional block of same size. So this block is economical than conventional block.

Despite many solutions to reduce plastic pollution, but it is still a big issue. We should use plastic as a construction material as it has low cost and easily available. Plastic paver block provide fire resistance, low water absorption.

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