

Recycling of Waste Plastic in Flexible Paver

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Abstract: In India, around 5.6 million tones of plastic waste are generated every year. As we know plastic waste is increasing day by day and is non-biodegradable material. So we can use plastic waste in making paver blocks. Hence, this project is helpful in reducing plastic waste by making plastic paver blocks. The motive of this project is to reduce waste plastic from environment. In this project we have used plastic waste in different proportions with quarry dust. The plastic paver blocks were casted and different tests were carried out as per IS standards. The results obtained show better strength than concrete paver blocks.

Index Terms: Economical paver, plastic waste, paver blocks, quarry dust.

I. INTRODUCTION

Paver blocks are a form of exterior surface covering, typically raised and used by pedestrians, running parallel on either side of road. Pavers can be used to make roads, driveways, patios, walkways and other outdoor platforms. Plastic waste is increasing due to increase in population, urbanization and development. Everyday a million people drink soda, water, cold drinks etc from plastic bottles. Once the drink is finished the bottles are expected to throw out in the trash which only 3% people care about. These bottles creating problems like environmental pollution. The disposal of waste plastic has become a serious problem globally due to their non-bio degradability. Annually approximately 500 billion plastic bags are used worldwide. Over one million sea birds and 100,000 marine mammals are killed annually from plastic in our oceans. To overcome these defects we can use the plastic in construction sector as raw material in different ways such as Plastic Paver Blocks.

II. OBJECTIVES

The research work of reutilizing waste plastic in flexible pavers aims at:

- Increase in strength of paver block.
- Achieving economy compared with conventional paver.
- Reduction in plastic waste.
- Using waste plastic as a binding material with cement.

III. MANUFACTURING PROCESS

For casting pavers crushed aggregate, cement and quarry dust is base material used. Waste plastic is in solid state and required to be melted. This melted plastic shall be taken in such a proportion that it is soluble with other materials. First trail was taken with 2kg of waste plastic. The mixture found was insoluble with aggregates. Further quantity was increased to 2.5kg to which pavers were casted with following procedure.

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Step1: In a metal container plastic waste is heated at temperature 170 to 200°C (Fig.1) until it melts to form a soluble mixture.



Fig.1 Melting of plastic

Step 2: After plastic melts the remaining materials like crushed aggregate and cement is added in the same container (Fig.2) and thoroughly mixed.



Fig.2 Mixing of materials

Step 3: The mixture is poured in moulds and kept for 24 hrs to dry (Fig.3).



Fig. 3 Casting of pavers

Step 4: Finally the pavers are casted and further tests are carried out (Fig.4).



Fig. 4 Plastic Pavers

Proportion of materials for casting pavers:

- 1. Block type 1:** Ratio of 1:1.5
 Plastic = 1kg
 Crushed aggregate = 1.5kg
 Cement = 0.158kg
- 2. Block type 2:** Ratio of 1:1.88
 Plastic = 1kg
 Crushed aggregate = 1.88kg
 Cement = 0.158kg

(Note: Here Cement is used only 10%)

Each paver block has average self weight of approximately 2kg.

IV. THEORETICAL FORMULATION

After preparing pavers from waste plastic in order to check its suitability and consistency the following test were carried out.

1. Compression Test:

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

$$\text{Compressive Strength (N/mm}^2\text{)} = (\text{Ultimate load in N} / \text{area of cross section in mm}^2)$$



Fig.5 Compression test on pavers

2. Impact Test:

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

$$\text{Impact Test (\%)} = (\text{Initial Weight} / \text{Final Weight}) \times 100$$

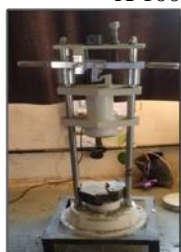


Fig.6 Impact test on pavers

3. Temperature Test:

Since the paver block is made of plastic it is required to know its heat resistance. Hence plastic pavers block is placed in oven for 2 hours



Fig.7 Temperature test on pavers

V. PARAMETRIC INVESTIGATION

After casting and drying for 24 hours the pavers were tested for compressive strength, impact value and temperature resistance. Pavers were casted for ratio of 1:1.5 and 1:1.88 proportion of waste plastic with crushed sand. The amount of cement content was taken as 0.158 parts of volume in both the cases.

A. Compression Test Results

1. For mixture with proportion 1:1.5

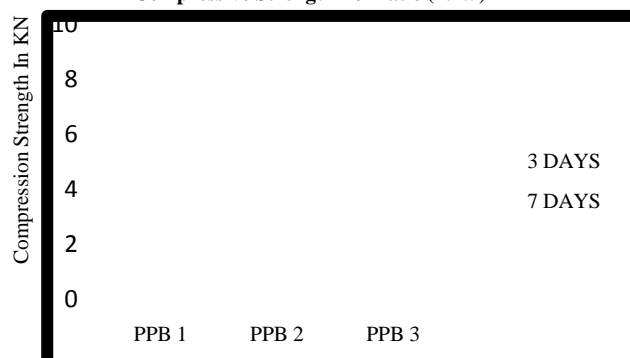
Table 1: Results of compression test for 3 days of proportion 1:1.5

Specimen	Plastic waste	Crushed sand	Cement	Compressive strength (N/mm ²)
PPB-1	1	1.5	0.158	7.65
PPB-2	1	1.5	0.158	6.12
PPB-3	1	1.5	0.158	3.82
			Avg.	5.86

Table 2: Results of compression test for 7 days of proportion 1:1.5

Specimen	Plastic waste	Crushed sand	Cement	Compressive strength (N/mm ²)
PPB-1	1	1.5	0.158	5.35
PPB-2	1	1.5	0.158	3.82
PPB-3	1	1.5	0.158	4.20
			Avg.	4.45

Compressive Strength for ratio (1:1.5)



Graph 1: Variation of Compressive strength of pavers for proportion 1:1.5

The following observations were drawn:

- The graph shows variation of compressive strength for ratio (1:1.5) of 3 days and 7 days.
- The minimum and maximum values for 3 days are 3.82 N/mm² and 7.65 N/mm².
- The minimum and maximum values for 7 days are 3.82 N/mm² and 5.35 N/mm².

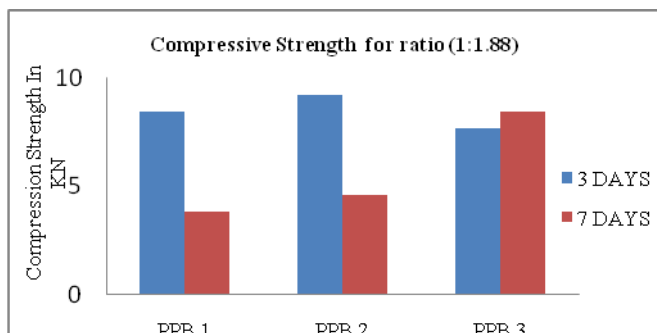
2. For mixture with proportion 1:1.88

Table 3: Results of compression test for 3 days of proportion 1:1.88

Specimen	Plastic waste	Crushed sand	Cement	Compressive strength (N/mm ²)
PPB-1	1	1.88	0.158	8.41
PPB-2	1	1.88	0.158	9.18
PPB-3	1	1.88	0.158	7.65
			Avg.	8.41

Table 4: Results of compression test for 7 days of proportion 1:1.88

Specimen	Plastic waste	Crushed sand	Cement	Compressive strength (N/mm ²)
PPB-1	1	1.88	0.158	3.83
PPB-2	1	1.88	0.158	4.56
PPB-3	1	1.88	0.158	8.41
			Avg.	5.6



Graph 2: Variation of Compressive strength of pavers for proportion 1:1.88

The following observations were drawn:

- The graph shows variation of compressive strength for ratio (1:1.88) of 3 days and 7 days.
- The minimum and maximum values for 3 days are 7.65 N/mm² and 9.18 N/mm².
- The minimum and maximum values for 7 days are 3.83 N/mm² and 8.41 N/mm².

B. Impact Test Results

1. For mixture with proportion 1:1.5

Table 5: Results of Impact test for 3 days of proportion 1:1.5

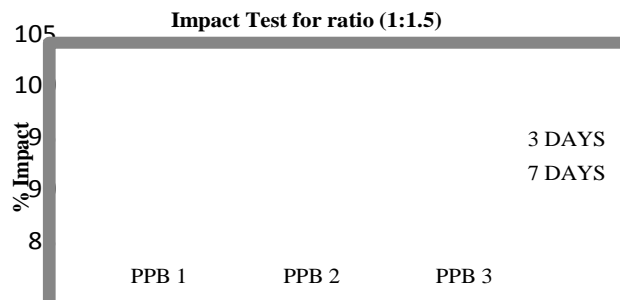
Specimen	Initial weight	Final weight	Impact Value (%)
PPB-1	2.013	1.903	94.53
PPB-2	2.104	1.958	93.06
PPB-3	2.266	2.231	98.45
			Avg: 95.34 %

Table 6: Results of Impact test for 7 days of proportion 1:1.5

Specimen	Initial weight	Final weight	Impact Value (%)
PPB-1	2.015	1.955	97.01
PPB-2	2.188	2.095	95.78
PPB-3	2.070	2.061	99.59
			Avg: 97.46 %

The following observations were drawn:

- The graph shows variation of impact value for ratio (1:1.5) of 3 days and 7 days.
- The minimum and maximum values for 3 days are 93.06% and 98.45 %.
- The minimum and maximum values for 7 days are 95.78 % and 99.59 %.



Graph 3: Variation of Impact Value of pavers for proportion 1:1.5

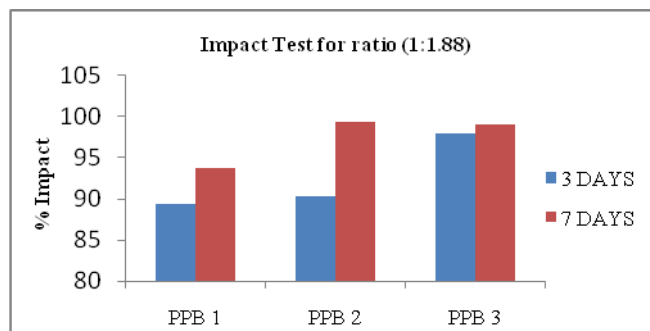
2. For mixture with proportion 1:1.88

Table 7: Results of Impact test for 3 days of proportion 1:1.88

Specimen	Initial weight	Final weight	Impact Value (%)
PPB-1	2.311	2.065	89.35
PPB-2	1.934	1.746	90.37
PPB-3	2.214	2.168	97.92
			Avg: 92.55 %

Table 8: Results of Impact test for 7 days of proportion 1:1.88

Specimen	Initial weight	Final weight	Impact Value (%)
PPB-1	1.812	1.698	93.7
PPB-2	2.004	1.99	99.3
PPB-3	2.057	2.039	99.12
			Avg: 97.38 %



Graph 4: Variation of Impact Value of pavers for proportion 1:1.88

The following observations were drawn:

- The graph shows variation of impact value for ratio (1:1.88) of 3 days and 7 days.
- The minimum and maximum values for 3 days are 89.35 % and 97.92 %.
- The minimum and maximum values for 7 days are 93.7 % and 99.3 %.

C. Temperature Test

Table 9: Results on temperature test

Specimen	Temperature (°C)	Remark
PPB of proportion 1:1.5	50	No change
	100	
	150	

PPB of proportion 1:1.88	50	No change
	100	
	150	

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Since the paver block is made of plastic it is required to know its heat resistance. Hence plastic pavers block is placed in oven for 2 hours

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VI. CONCLUSION

1. Plastic is soluble with a quantity more than 2kg when mixed with plastic, coarse aggregates, cement in proportion 1:1.5:0.58.
2. Maximum compressive strength for plastic pavers was obtained as 9.18 N/mm² for ratio 1:1.5, which is within permissible limit as per IS Standards.
3. Maximum impact value for plastic pavers was obtained as 99.59 % for ratio 1:1.5
4. No effect due to temperature of 150° C was seen on the pavers for both proportions.
5. Pavers using waste plastic cost almost Rs. 20/- per block.

VII. FUTURE SCOPE

The research work carried out can be extended by considering following points:

1. Content of waste plastic used in current work is up to 3kg. The same can be increased up to 7kg with an interval of 1/2 kg.
2. Use of admixture can also be beneficial from strength perspective.
3. In order to achieve economy cement content can be reduced with increase in plastic content.
4. Considering melted weight of plastic the parameters can be compared.

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