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Effective Utilization of Plastic Waste and Foundry Sand for Casting of Paving Blocks

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Abstract - *In India, about 56 lakh tones of plastic waste is dumped 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 the government. Also in fine aggregate is a major construction material. But now a day there is a scarcity in fine aggregates So we have to look for different materials to reduce the quantity of basic natural materials in the concrete mix without changing any mix design procedure and consideration. The main objective of this experimental work is to compare the effect of foundry sand in concrete with the conventional concrete. Also check the suitability of plastic waste in foundry sand by percentage (%) for making of paving blocks. The study is summarize based on compressive strength, split tensile strength, flexural strength and acid attack test of paver blocks with the replacement of fine aggregate by foundry sand.*

Key Words: Foundry sand, Plastic waste, Paving blocks

1. INTRODUCTION

Paver block paving is versatile, aesthetically attractive, functional, and cost effective and requires little or no maintenance if correctly manufactured and laid. Natural resources are depleting worldwide at the same time the generated wastes from the industrial and residential area are increasing substantially. The sustainable development for construction involves the use of non-conventional and innovative materials, and recycling of waste materials in order to compensate the lack of natural resource sand to find alternative ways conserving the environment. On other hand most of the roads need footpath for pedestrians and a separate lane for cycles. Paver blocks are used for construction of this footpath and cycle lanes; while in some places, paver blocks can also be used for road construction under light traffic conditions. Paver blocks are easier to place and easier to replace than asphalt and concrete roads. Currently about 56 lakh 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. In this work concrete with foundry sand is used to see the effect as compared to the conventional concrete and also check the suitability of plastic waste in foundry sand by percentage (%) for making of paving blocks.

Fig -1: Foundry Sand

Fig -2: Plastic Waste

This paper presents an experimental investigation on the properties of concrete in which fine aggregate is partially replacing by used foundry sand. The only variable considered in this study is volumetric replacement (10%, 20%, 30%, 40%, and 50%) of sand. Out of these 5 replacement levels best 3 were choose by trial works. The concrete was tested for slump test, compression test, flexural test, split tensile test for 7 & 28 days and acid attack test for 7 days. On this outline of the problem of disposal of plastic and foundry sand demand of paving blocks this project work is proposed. The project focuses on manufacturing paving blocks made up of 100% waste plastic and foundry sand.

2. OBJECTIVES

The objectives of proposed project work shall be,

a. Check the suitability of plastic waste in foundry sand by percentage (%) for making of paving blocks.

b. Perform the various tests on conventional paving blocks and plastic paving.

c. Comparison of results of conventional paving block casted of concrete and paving block casted of waste plastic and foundry sand.

d. Determining the suitability of paving block casted of waste plastic & foundry sand using following tests,

- Compressive strength Test.
- Flash and Fire Point Test.
- Softening point Test.
- Abrasion resistance Test.
- Water absorption Test.

3. METHODOLOGY

Procedure of Casting Of Plastic Paving Blocks:

- Collection of the plastic waste in which include plastic bags ,plastic paper, glasses, organic and other waste plastic material.
- Melting a waste plastic at 280°/c temperature.
- Using foundry sand and melted plastic in paver moulds.
- After 1hr removing the moulds.
- Cooling this paving block, after the finishing is required .
- Plastic have a various shape that's why its required a fining of that blocks
- Compare the conventional paver blocks to modified paver blocks.
- To find properties of waste plastics & foundry sand.
- To find out physical properties of Waste Plastics
- To cast Paver Block with Waste Plastics
- To study the Compressive strength in percentage of waste plastics added samples as a replacement of foundry sand.
- Conduct the necessary tests which is required for the project
- Casting of paving block by % of waste plastic and foundry sand was done at S.K. Industry, old Chandur road, Chandur.
- Different tests were carried on conventional concrete block paving block available in market and paving block casted of waste plastic and foundry sand.
- Comparison of results of conventional concrete paving block and paving block casted of waste plastic and foundry sand was done.
- The assessment of such paving blocks was done by conducting various parameters.

4. RESULTS AND DISCUSSION

The casted paver block was of following shape and dimension:

- Area – 200 cm2
- Depth – 6 cm
- Volume – 1200 cm3.
- Density – 858.3 kg/m3

Fig -3: Casted Paver Block

4.1 Compressive Strength Test

Load carrying capacity was determined by using standard procedure, under UTM/CTM. The test is conducted on compressive testing machine.

Fig -4: Failure Pattern of Paving Block under UTM

Table -1: Comparative Results of Conventional Paving Block and Plastic Paving Blocks

Type of paving block	Load carrying capacity N/mm2	Displacement	Remark
Conventional Paving Block	0.5228	0 mm	Load carrying capacity is less and no displacement.
Plastic waste and foundry sand paving block	10% - 0.41 20% - 0.70 30% -0. 65 40% - 0.52 50% - 0.44	18.1mm	Load carrying capacity of 20% is more and displacement is also more.

The safe load carrying capacity =0. 700 N/mm^{2}can be assumed. So such paving blocks can be used at all places where the expected load to come on the surface is less than 0.700 N/mm^2. Such possible uses include footpaths, internal roads in gardens, cycle lanes, open spaces around hospitals except parking, etc.

4.2 Flash and Fire Point Test:

Flash and Fire point test is conducted on plastic paving block to know the safe mixing and application temperature values of particular plastic grade. At higher temperatures plastic materials leave out volatiles. These volatile vapours contain hydro carbons. So, they can catch the fire easily and will cause flash at one point and if it is further prone to heat the material may ignite and burn.

i) 10% Foundry sand in plastic
   a. Fire Point – 140*/c
   b. Flash Point -320*/c
ii) 20% foundry sand in plastic
   a. Fire Point – 260*/c
   b. Flash Point -300*/c
iii) 30% foundry sand in plastic
   a. Fire Point – 180*/c
   b. Flash Point -200*/c

iv) 40% foundry sand in plastic
   a. Fire Point – 180*/c
   b. Flash Point -200*/c
v) 50% foundry sand in plastic
   a. Fire Point – 200*/c
   b. Flash Point -220*/c

From result it is clear that such block can easily be used in Indian condition without much problem of catching fire at normal operating temperatures.

- Flash point = 260*/C
- Fire point = 300*/C

Fig -5: Flash and Fire Point Test

4.3 Softening Test

Ring and ball test is used to determine the softening point of plastic paving blocks. This test consists of two brass ring and two steel ball, using which the softening point of various plastic materials are determined.

The Flash and Fire point test on the plastic paving block was taken using standard procedure by the help of Pensky Marten apparatus. For this, small piece of paving block was cut and used to conduct test.

Fig- 6: Softening Point Test

Results of Softening Test
1. 10% - 100*/C
2. 20% - 160*/C
3. 30% -180*/C
4. 40%- 220*/C
5. 50%-260*/C

The test was conducted using Ring and Ball apparatus and distilled water instead of Glycerin. The material hasn't shown any significant softening at temperature up to 100*/C. The test was aborted at 100*/C. From that, it is quite clear that the material will not soften under normal outdoor temperature.

4. Water Absorption Test

Calculation of the water absorbed by each specimen expressed as a percentage of the dry mass, using the following expression.

A = 100 x (wet mass – dry mass) / dry mass

Table -2: Water Content

Plastic Percent	Wet weight	Dry weight	Water absorption(%)
10%	0.89	0.88	0.011
20%	1.05	0.95	0.095
30%	1.10	1.05	0.045
40%	1.24	1.13	0.088
50%	1.19	1.18	0.0084

Calculation of the average of the water absorption's of the 10 specimens to the nearest 0.1% which is negligible.

4.5 Abrasion Resistance Test

Table -3: Interim Abrasion Limits

Pavement Use	Minimum 28 Day
Heavy Pedestrian use	2.0
Road and Industrial traffic	1.5
Footpaths	1.2
Car parks	1.2

Fig -7: After Abrasion Resistance Testing

Abrasion resistance of plastic paving block where determine again 28 days of age at every age to specimen where tested by all the paving blocks. The cuts specimen where square shape.

- Total revolution according to TS-2824. The volume of abrasion must be smaller than 0.02%
- Abrasion resistance test on paving blocks is negligible.

The abrasion resistance value of paving blocks is 0.2%. It is found negligible.

4.6 COMPARISON OF RESULTS OF CONVENTIONAL CONCRETE PAVING BLOCK AND UTILIZED PLASTIC PAVING BLOCK

Table- 4: Comparative Results of Conventional and Plastic Paving Blocks.

CONCRETE PAVING BLOCK	PLASTIC PAVING BLOCK
Concrete block – Rs-32/-	Plastic block – Rs-13/-
Load carrying capacity – 0.51N/mm2.	Load carrying capacity – 0.7 N/mm2.
Required cement for finishing – 13.5Kg.	Required cement for finishing – 2Kg.
Required Artificial sand – 110 Kg.	Not required artificial sand.
Cost is high.	Economy is achieved.

5. CONCLUSION

1. The safe load carrying capacity was found to be 0.7N/mm2.
2. The Flash point was observed to be 260*C. And Fire point was observed to be 300*C.
3. Softening point was observed to be more than 150*C.
4. Water absorption was found to be negligible.
5. These paving blocks can be used in footpaths, internal roads in gardens, overhead bridges, railway stations, open places near hospitals except parking.
6. The society can be benefited as large amount of plastic waste will be consumed.
7. Good amount of cement and artificial sand can be saved which will result in reduction in carbon footprints and lead to preservation of natural resources.

REFERENCE

[1] Chavan A.J., "Use of plastic waste in flexible pavements", International Journal of Application or Innovation in Engineering and Management, Volume 2, Issue 4, April 2013, Page no. 540

[2] Hiremath P.M., Shetty S., NavaneethRai.P.G, Prathima.T.B., "Utilization of waste plastic in manufacturing of plastic-soil bricks", International journal of technology enhancements and emerging engineering research, Volume 2, Issue 4, 2014, Page no. 102.

[3] Kumar V., Dr. Mishra A.K., "Utilization of Waste Material in Concrete Paver Blocks: A Review". International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 4 Issue IV, April 2016, Page no. 1208.

[4] Nishikant K., Nachiket A., Avadhut I., Sangar A., "Manufacturing of concrete paving block by using waste glass material", International Journal of Scientific and Research Publications, Volume 6, Issue 6, June 2016, Page no. 61.

[5] Nivetha C., Rubiya M., Shobana S., Vaijayanthi R. G.Viswanathan M. E., and R.Vasanthi M. E., "Production of plastic paver block from the solid waste (quarry dust, flyash& pet", ARPN Journal of Engineering and Applied Sciences, Volume 11, Issue no. 2, January 2016, Page no. 1078.

[6] Raut A., Patel M.S., Jadhwar N.B., Khan U., Prof. Dhengare S.W., "Investigating the application of waste plastic bottle as a construction material- a review", Journal of The International Association of Advanced Technology and Science, Volume 16,Issue 12, March 2015.

[7] Shanmugavalli B., Gowtham K., Nalwin P.J., "Reuse of plastic waste in paver blocks", International Journal of Engineering Research & Technology, Vol. 6 Issue 02, February-2017, Page No. 313. (http://cipremier.net/e107_files/downloads/Papers/100/35/100035013.pdf)

[8] Tapkire G., Parihar S., Patil P., Kumavat H.R., "Recycled plastic used in concrete paver block", International Journal of Research in Engineering and Technology, Volume: 03, Special Issue: 09, June 2014, Page 33.

[9] Vanitha S., Natrajan V., Praba M., "Utilisation of Waste Plastics as a Partial "Replacement of coarse aggregate in concrete blocks", Indian Journal of Science and Technology, Volume 8(12), June 2015, Page no. 1.

[10] Wong S.F., "Use of recycled plastics in a pavement system." 35th conference on our world in concrete & structures," August 2010.