# Utilisation of Waste Plastic in Manufacturing of Paver Blocks

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## Abstract

Due to population growth, usages of plastic materials are increasing day by day, most of the plastic materials are dumped as landfill and they are not effectively reused in most of the applications. Numerous researches in most were carried out using waste rubber in pavement construction. So the aim of this project is to replace cement with waste plastic in paver block and to reduce the cost of paver block in compared to that of conventional concrete paver block at present nearly 56 lakhs tons of waste plastic is produced in India per year. The degradation rate of plastic waste is also very slow process. And in addition with waste plastic waste lime sludge from paper industry which replaces fine aggregate. In this project we have used waste plastic and lime sludge in different proportions with sand. The paver bocks were prepared and tested and the results were discussed elaborately.

**Keywords: Plastics, Compressive strength, Leachate, Oven Test, Sludge**

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## I. INTRODUCTION

Used Plastic bags, pieces of plastic sheets and bottles of diverse sizes, colors and textures are found flying around freely, scattered In the streets, swimming in the gutters, posing a serious environmental threat. These keep the environment dirty and cause blockages to our sewer system. Several attempts were made to discourage plastic bags and other plastic products but yield no result due to its Versatility in daily use. Recycle process and reused of plastic waste products amount for vast manpower and huge processing cost resultantly very small amount of plastic waste is recycled and used and rest going into landfills, incinerators and dumps. Now the question arise how to effectively minimize the impact of plastic waste with minimum cost many researchers have tried for the utilization of plastic waste and few have suggested its utilization in concrete in many forms.

The utilization of waste in the construction industry has two glaring dividends, one, environmental impact is addressed by disposal of the waste and second, the economic impact and this waste has the edge of being available large quantity, everywhere and at low value. Keeping in view the disposal issues of plastic waste, its utility in concrete is studied and experimental by various researches. They have worked on the use of pulverized plastic in concrete as partial replacement of cement as binding material. Testing was conducted on the sample casted by using waste plastic and lime sludge in the laboratory to study the variation of paver block property from conventional paver block.

Plastics have become common materials of our everyday lives, and many of their properties, such as durability, versatility and light-weight, can be a significant factor in achieving sustainable development. However, plastic applications also contribute to the growing amounts of solid waste generated, as plastic products are often used only once before disposal. The disposal problem is not simply technical but it also has social, economic and even political aspects. This is the reason why several different methods have been explored and applied for solving the problems associated with polymer waste handling and disposal. The partial replacement of fine aggregate in concrete by using plastic fine aggregate obtained from the crushing of waste plastic bags. Plastic bags waste was heated followed by cooling of liquid waste which was then cooler and crushed to obtained plastic sand having fineness modulus of 4.7. The experiment results of concrete sample casted with use of plastic bags pieces to study the compressive and split tensile strength by using Ordinary Portland Cement, Natural River sand as fine aggregate and crushed granite stones as coarse aggregate, portable water free room impurities and containing varying percentage waste plastic ham 0.2%, 0.4%, 0.6% 0.8%

and 1.0%. The suitability of recycled plastic as partial replacement to coarse are coarse aggregate in concrete mix to study effect on compressive strength, modulus of elasticity, Split tensile strength and flexural strength properties . Different concrete mix were prepared with varying proportions (0%, 20%, 30% & 40%) of recycle plastic aggregate obtained by heat treatment of plastic waste (160-200 centigrade) in plastic granular recycling machine.

## II. MATERIALS AND METHODS

### A. *Materials*

*1) Waste Plastic:*

Plastic waste used in making paver block was collected from the surrounding shops (Figure 1). It includes plastic bags. The plastic bag used is about 50 microns. The basic properties are provided below which are collected through journal papers.

Fig. 1: Waste plastics

*2) Lime Sludge:*

The lime sludge used in the present study was collected from SESHAYEE Paper Mill, Pallipalayam, Erode (Figure 2). Chemical composition and engineering properties of 20 samples of lime sludge, produced from the lime calcination process, were determined in order to evaluate its potential applications as an engineering construction material.

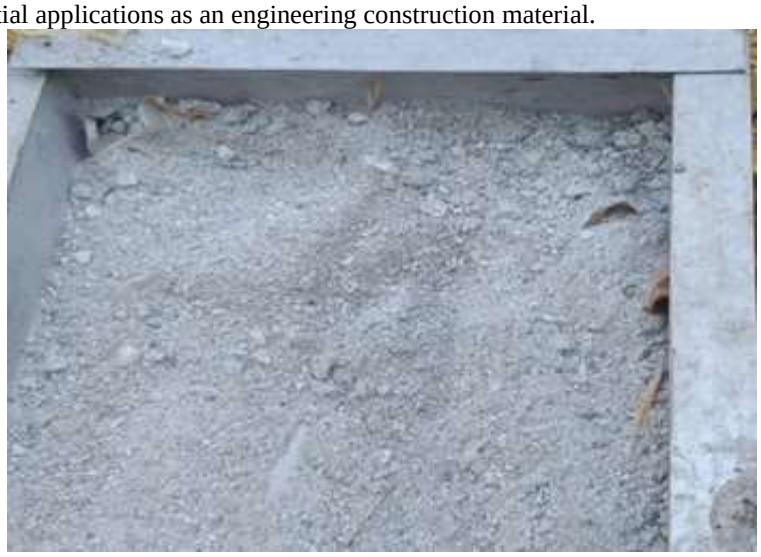

Fig. 2: Lime Sludge

*3) Manufactured Sand:*

Manufactured sand (M-Sand) is popularly known by several names such as Crushed sand, Rock sand, Green sand, UltraMod Sand, Robo sand, Poabs sand, Barmac sand, Pozzolana sand etc. IS 383-1970 (Reaffirmed 2007) recognizes manufacture sand as Crushed Stone Sand'. M-Sand of Specific gravity 2.64 is used.

### B. *Mix Design*

Five numbers of mixes were prepared with different combinations of waste plastics. Lime sludge is partially replaced with M-Sand for different mixes. Waste plastic and fine aggregate was used in ratio of 1:2. Table 1 represents mix proportion for various mixes.

Table - 1
Mix Proportion

| *MIX ID* | *WASTE PLASTIC (Kg/m$^{3)}$* | *FINE AGGREGATE* | | | |
|---|---|---|---|---|---|
| | | *% of replacement* | *Lime Sludge (kg\m$^3$)* | *% of replacement* | *M sand (kg\m$^3$)* |
| *M0* | *779.72* | *0* | *0* | *100* | *1559.45* |
| *M1* | *779.72* | *20* | *311.89* | *80* | *1247.56* |
| *M2* | *779.72* | *40* | *623.78* | *60* | *935.67* |
| *M3* | *779.72* | *60* | *935.67* | *40* | *623.78* |
| *M4* | *779.72* | *80* | *1247.56* | *20* | *311.89* |

Plastic wastes are heated in a metal bucket at a temperature of above 1500° C. As a result of heating the plastic waste melt. The materials lime sludge, fine aggregate and other materials as described in previous chapter are added to it in a right proportion at a molten state of plastic and well mixed. The mould is cleaned through using a waste cloth. Now this mix is transferred to the mould. It will be in hot condition and compact it well to reduce the internal pores present in it. Then the blocks are allowed to dry for 24 hours. So that they are hardened. After drying the paver block is removed from the blocks. The process carried out for preparing the plastic liquid mix is shown in figure 3 and the specimens prepared are shown in Figure 4.

Fig. 3: Process for making Plastic Mix


Fig. 4: Paver block Specimens

## III. RESULTS AND DISCUSSIONS

### *A. Mechanical Properties*

*1) Compressive Strength Test*

Mix M0 denotes 0% sludge (conventional control mix), and similarly M1 denotes mix with 20% sludge ,M2denotes mix with 40% sludge ,M3 denotes mix with 60% sludge and M4denotes mix with 80% sludge. It is noticed that when the percentage of replacement of sludge increases there was a decrement in the compressive strength values. This is due to fineness observed in the sludge when compared to M-Sand. Table 2 represents the compressive strength of various mixes at the age of 7 days. Moreover, Figure 5 graphically represents the compressive strength of various mixes at the age of 7 days.

Table - 2
Compressive strength of various mixes

| *Sl.no* | *Mix ID* | *Compressive strength(MPa)* |
|---|---|---|
| *1* | *M0* | *8.72* |
| *2* | *M1* | *7.29* |
| *3* | *M2* | *7.13* |
| *4* | *M3* | *6.2* |
| *5* | *M4* | *2.4* |

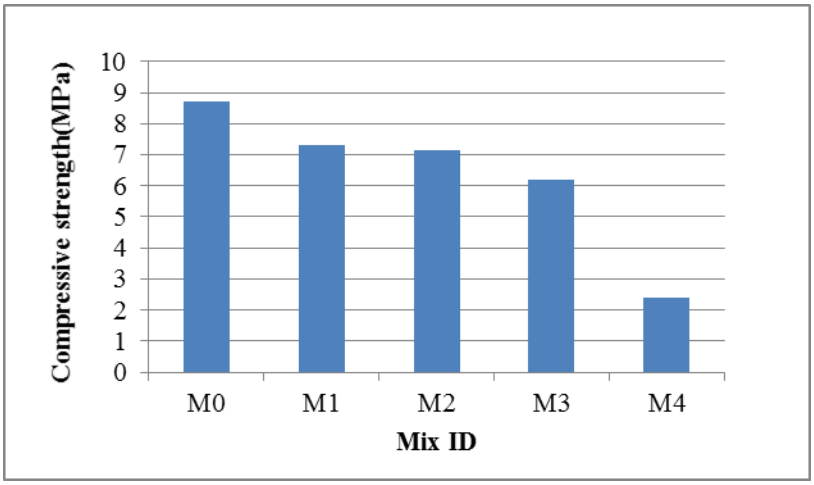

Fig. 5: Compressive strength of various mixes

2) *Water Absorption Test*

In this test first paver block block is weighed in dry condition and they are immersed in water for 24 hours. After that they are taken out from water and wiped out with cloth. Then the difference between dry and wet paver block percentage are calculated. Test conducted is shown in Figure 6. Table 3 represents the water absorption percentage of different mixes.


Fig. 6: Water Absorption Test

Table – 3
Water Absorption of various mixes

| *Sl.no* | *Mix id* | *Water absorption (%)* |
|---|---|---|
| *1* | *M0* | *4.2* |
| *2* | *M1* | *4.7* |
| *3* | *M2* | *6.5* |
| *4* | *M3* | *7.2* |
| *5* | *M4* | *8.5* |

From the test results, it was observed that M0 mix shows better water absorption resistance when compared to all mixes. When the replacement of sludge increases, it leads to more water absorption which lead increase in water absorption percentage. Moreover, Figure 6, shows the water absorption of various mixes.

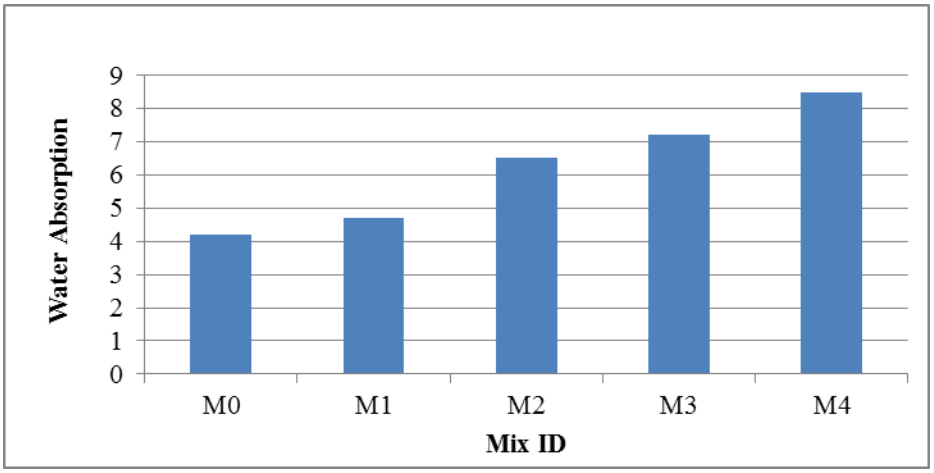

Fig. 7: water absorption

*3) Leachate Test*

A leachate is any liquid that, in the course of passing through matter, extracts soluble or suspended solids, or any other component of the material through which it has passed. Leachate is a widely used term in the environmental sciences where it has the specific meaning of a liquid that has dissolved or entrained environmentally harmful substances that may then enter the environment. It is most commonly used in the context of land-filling of industrial waste. Table 4 represents Leachate test values of various mixes.

Table - 4
Leachate Test of various mixes

| *Mix ID* | *Ca* | *Ba* | *K* | *Na µg/litre* |
|---|---|---|---|---|
| *M0* | *1.4* | *0.4* | *0.1* | *1057* |
| *M1* | *2.7* | *1.2* | *0.2* | *2523* |
| *M2* | *3.1* | *1.4* | *0.3* | *2845* |
| *M3* | *2.9* | *1.3* | *0.24* | *3074* |
| *M4* | *3.2* | *1.5* | *0.4* | *3865* |

*4) Oven Test*

As the paver block is made of plastic we need to know its melting point hence oven test is performed. The paver block is kept in oven for 2 hours in oven and after 2 hours its condition is verified.

Table - 5
Oven Test of various mixes

| *SPECIMEN* | *TEMPERATURE ($^0$C)* | *REMARKS* |
|---|---|---|
| *M0* | *50* | *No change* |
| | *100* | *No change* |
| | *150* | *Melts* |
| *M1* | *50* | *No change* |
| | *100* | *No change* |
| | *150* | *Melts* |
| *M2* | *50* | *No change* |
| | *100* | *No change* |
| | *150* | *Melts* |
| *M3* | *50* | *No change* |
| | *100* | *No change* |
| | *150* | *Melts* |
| *M4* | *50* | *No change* |
| | *100* | *No change* |
| | *150* | *Melts* |

## IV. CONCLUSION

1) The properties such as compressive strength, water absorption, leachate test and oven tests were made for paver blocks and the following conclusions may be drawn,
2) From the experimental investigation, it has been observed that paver blocks made by using waste plastics shows enhanced compressive strength at the age of 7 days.
3) The plastic paver block possesses more advantages which include cost efficiency, removal of waste products thus abolishing the land requirement problem for dumping plastic.
4) In regard of water absorption, paver blocks made with waste plastics shows better resistance against water absorption and can be effectively used in path ways.

5) This method is suitable for the country which has difficult to dispose recycled the plastic waste.
6) The manufacturing cost is reduced due to utilization of waste plastic and lime sludge.
7) Though the compressive strength is low when compared to the conventional concrete paver block, it can be used in gardens, pedestrian path and cycle way. Henceforth, it can be used in less traffic and pathways.

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