Utilization of Waste Plastic In Manufacturing of Paver Blocks

Prof. Naikwadi S.R.[1], Mr. Avinash Dongare[2], Mr. Tejraj Bhosale[3], Mr. Vaibhav Chindhote[4], Mr. Atharva Walke[5]
[1, 2, 3, 4, 5] Dept of Civil Engineering
[1, 2, 3, 4, 5] Anantrao Pawar College of Engineering & Research, Pune, India.

Abstract- *Plastics are rapidly growing segment of the municipal solid waste. Disposal of waste materials including waste plastic bags has become a serious problem. Amount of waste plastic bags being accumulated in 21st century has created big challenges for their disposal. The waste plastics in house hold is large and increases with time. In each country waste consumption is different, since it is unaffected by socioeconomic characteristics and waste management programs, but the level of plastics in waste consumption is high. In order to overcome this issue, we have to use it in effective way. This project is about recycling waste plastic into pavement blocks and study their characteristics. Pavement blocks are perfect materials on the pathways and streets for simple laying and finishing. Here the strength properties of pavement blocks comprising of waste plastics and the design considerations for pavement block incorporating waste plastic bags is presented. It will be a boon to modern society and environment. In many developing countries LDPE sheets, bags and water sachets are a major waste problem because local collection and recycling systems do not exist. As a result, LDPE has no value and is dumped causing aesthetic, environmental and public health issues. The degradation rate of plastic waste is also a very slow process. Hence the project is helpful in reducing plastic waste in a useful way. In this project we have used plastic waste in different proportions. Plastic is used as binding material and replace cement to reduce the cost of paver block when compared to that of conventional concrete paverblocks.*

The aims of this study is "Utilization of Waste Plastic in Manufacturing of Paver Blocks" that helps in reducing plastic waste in a useful way

Keywords- Pavement Block, Recycling, LDPE, Pathways, cement.

I. INTRODUCTION

Solid waste management is one of the major environmental concerns in India. Land fills are becomings car cean the cost in building landfill sites are increasing. During transportationofwastesfromhomesandindustriesbythesetransfer stationtothe dumping sites some fallout from the trucks into gutters. But generally the level of plastics in waste composition is high. The plastic wastes are blamed for series of health, safety and environmental problems. Non-biodegradability of plastics is attributed towards causing waste management problems and choking of the drains in urban cities. Due to such huge plastic waste, the adverse impacts are observed in environment like reducing natural scenery of environment, health issues in both human and animals, clogging of drains, pollution of soil and pollution of water bodies like ocean, rivers and lakes. The pollution of water bodies due to plastic directly affects the marine ecosystem causes ecological imbalance. Due to such issues it is necessary to treat waste plastic properly and scientifically.

Also as India is a developing country with its population growing much rapidly. Its construction business to accommodate this significant growth. As increase in construction business there is a significant demand of economic resources too. So use of waste plastic the construction industry can be a economical solution. This waste plastic can be used in the manufacturing of construction materials. This can be an effective, easy way to dispose off plastic and also this can reduce the load over the need of construction materials. As plastic has longer life we can use it in paver block. The replacement of plastic waste for cement provides potential environmental as well as economic benefits.

II. MATERIALS USED

1) Waste Plastic:

By definition the plastics can be made to different shapes when they are heated in closest environment it exists in the different forms such as cups, furniture's, basins, plastic bags, food and drinking containers, and they are become waste material. Accumulation of such wastes can result into hazardous effects to both human and plant life. Therefore, need for proper disposal, and, if possible, use of these wastes in their recycled forms, occurs. This can be done through process of plastic management. Waste management in respect to plastic can be done by recycling. If they are not recycled then they will become big pollutant to the environment as they

not decompose easily and also not allow the water to percolate in to the soil and they are also poisonous.

Plastic is a material which melts while it is heated, it changes from solid state to liquid state. This liquid nature gives a smoothening surface and helps in binding with the sand when sand is poured in the melted plastic.

Fig 1: Waste Plastics

Fig 2: Resin Code

2) Sand:

Sand is the most common and very important in all construction work. Sand is used as fine aggregate. The properties of sand were determined by in accordance with the code IS: 2386 (Part-1), (passing from 600 microns retain on 300 microns).

Fig 3: Sand

III. OBJECTIVES

1. To check weather plastic waste (LDPE) can be used in constructing paver blocks.
2. To make paver blocks out of waste plastic (LDPE) and compare it with conventional concrete paver blocks.
3. To compare the strength, life span, construction cost, time required for making paver block.
4. To determine the suitability of waste plastic bags in the development of pavement blocks for construction and to reduce the burden of waste plastic by reusing into pavement.
5. To reduce the cost of paver block when compared to that of conventional concrete paver blocks.
6. To reduce waste plastic quantities on land and water pollution.

IV. LITERATUR REVIEW

Zainab Z and Ismail (2007)

They have conducted comprehensive study based on large number of experiments and tests in order to determine the feasibility of reusing plastic sand as partial replacement of fine aggregate in concrete. They conducted tests on concrete samples for dry/fresh density, slump, compressive and flexural strength and finally toughness indices on room temperature They have collected waste plastic from plastic manufacture plant consist of 80% polyethylene and 20% polystyrene which was crushed (varying length of 0.15- 12mm and width of 0.15-4mm). Concrete mix were produce with ordinary Portland cement, fine aggregate (natural sand of 4.74mm maximum size), coarse aggregate (max size below 20mm) and addition of 10%, 15% and 20% of plastic waste as sand replacement. Their test results indicate sharp decrease in slump with increasing the percentage of plastic, this decrease was attributed to the presence of angular and non-uniform plastic particles. In spite of low slump however, the mixture was observed with good workability and declared suitable for application. Their tests also revealed the decrease in fresh and dry density with increasing the plastic waste ratio; however increase was reported in dry density with time at all curing ages. Decrease in compressive and flexural strength was observed by increasing the waste plastic ratio which can be related to decrease in adhesive strength between plastic waste particles with cement. However, load-deflection curve of concrete containing plastic waste showed the arrest of propagation of micro cracks which shows its application in places where high toughness is required. The study has shown good workability in spite of low slump but w/c content kept constant in all samples. They should have reduced the water

content in order to improve the strength when workability was not an issue.

Ganesh Tapkire, Satish Parihar, Pramod patil and Zemraj R Kumavat (June-2014)

In this paper Recycled plastic aggregate used in various proportion in concrete mix and check there suitability

.Amount of waste plastic being accumulated in 21st centuries has created big challenges for their disposal, thus obliging the authorities to invest in felicitating the use of waste plastic coarse aggregate in a concrete is fundamental to the booming construction industry. Disposal of plastic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. In recent time use of such, Industrial wastes from plastic bottles, pallets, carry bags; polypropylene (PP) and polyethylene Terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. If plastic wastes can be mixed with the concrete mass in some quantity or in some form, without affecting the fundamental and other properties or slight negotiation in strength the strength of concrete. Industrial wastes from polypropylene (PP) and polyethylene Terephthalate (PET) were studied as alternative replacements of a part of the conventional aggregates of concrete. Three replacement levels.10%, 20%, 30% by Weight of aggregates were used for the preparation of the concrete.

Pramod S. Patil, J.R.Mali and Ganesh V.Tapkire (2014)

This study presents the use of plastic recycled aggregate as replacement of coarse aggregate for production of concrete. They used forty eight specimen and six beams/cylinders casted from variable plastic percentages (0, 10, 20, 30, 40 and 50%) used as replacement of coarse aggregate in concrete mixes. They have conducted various tests and observed decrease in density of concrete with increase percentage of replacement of aggregate with recycle plastic concrete. They also reported decrease in compressive strength for 7 and 28 days with increase in percentage of replacement of coarse aggregate with recycle plastic aggregate. They have recommended feasibility of replacing 20 % will satisfy the permissible limits of strength. Again these researchers limited their research to only compressive strength property and no work was carried out to study the other important properties of concrete. Their research also lacks use of various admixtures in concrete to cater for the loss in strength.

Youcef Ghernouti, Bahia Rabehi, Brahim Safi and Rabah Chaid (2015)

The study present 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 cooled and crushed to obtained plastic sand having finesse modulus of 4.7. Fine aggregate in the mix proportion of concrete was replaced with plastic bag waste sand at 10%, 20%, 30% and 40% whereas other concrete materials remain same for all four mixes. In fresh properties of concrete it was observed from the results of slump test that with increase of waste content workability of concrete increases which is favorable for concrete because plastic cannot absorb water therefore excessive water is available. Bulk density decreases with increase of plastic bags waste. In harden state, flexural and compressive strength were tested at 28 days and reductions in both strengths with increasing percentage of plastic bag waste sand in concrete mix. Plastic waste increases the volume of voids in concrete which on other hand reduce the compactness of concrete simultaneously speed of sound in concrete is also decreased. Strength reduction in concrete mix was prime concern; however they recommend 10 to 20% replacement of fine aggregate with plastic aggregate. Use of admixtures to address the strength reduction property of concrete with addition of plastic aggregate is notemphasized.

Dinesh.A, Dinesh.S and Kirubakarn .K (2016)

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. 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. Hence, these waste plastics are to be effectively utilized. High-density polyethylene (HDPE) and polyethylene (PE) bags are cleaned and added with sand and aggregate at various percentages to obtain high strength bricks that possess thermal and sound insulation properties 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 an on-degradable pollutant. This alternatively saves the quanta of sand/clay that has to be taken away from the precious river beds/mines. The plastic waste is naturally available in surplus quantity and hence the cost factor comes down. Also Coloring agents can be added to the mixture to attain desired shades. Hence in this thesis, an attempt is made to study regard the properties of the brick which is manufactured using plastic wastes.

B.Shanmugavalli, K.Gowtham, P.Jeba Nalwin and B. Eswara Moorthy (2016)

The aim of this project is to replace cement with plastic in paver block and to reduce the cost of paver block when compared to that of convention concrete paver block. At present nearly 56 lakhs ton of plastic waste is produced in India per year. The degradation rate of plastic waste is also a very slow process. Hence the project is helpful in reducing plastic waste in useful way. In this project we have use plastic waste in a different proportion with quarry dust, coarse aggregate and ceramic waste. The paver blocks were prepared and tested and the result were discussed.

B.Shanmugavali and P.Jeba Nalwin 2017)

The utilization of waste plastic in production of paver block has productive way of disposal of plastic waste. The cost of paver block is reduced when compared to that of concrete paver block. Paver block made using plastic waste, quarry dust, coarse aggregate and ceramic waste have shown better result. It also shows good heat resistance.

Lairenlakpam Billygraham Singh and Suresh Thokchom (2017)

The present work is performed to manufacture bricks or building blocks from sand and waste plastics. The bricks are produced by mixing waste plastic and sand after heating at 200oC. Two specimens of bricks, one with sand and waste CDs; another with sand and waste water bottles are produced and tested for some physical and mechanical properties. The sand-plastic bricks are lightweight and present a waxy surface. The results of sand plastic bricks are compared with those of traditional local bricks. It is observed that sand plastic bricks have low water absorption, low apparent porosity and high compressivestrength.

Mr.N.Thirugnana sambantham (2017)

In this paper we studied that the author has used polyethylene bags as binding material with fine aggregates. Different materials like cement, sand, fly ash were tested to know there physical properties and chemical composition. Paver blocks were casted with proportion (1:3, 1:4, 1:5) for plastic sand. Compression strength, water absorption, efflorescence, hardness, fire resistance, soundness test were conducted on blocks. Results are compared with fly ash bricks. After testing, it is shown that, the plastics paver gives more strength when compared with fly ash bricks. The water absorption and presence of alkalis was highly reduced.

Ronak Shah, Himanshu Garg, Parth Gandhi, Rashmi patel and Anand Daftardar (2017)

In this, they find a solution to utilize the waste plastic which is danger to ecological balance and to prevent the day to day increase of waste plastic. Throughout world the waste plastic causes bad effects. In order to get away from this issue they used the extruder machine. This machine changes the plastic wastes into construction materials. They also made an attempt to reduce the soil used for manufacturing burnt clay bricks and also to provide economic and ecofriendly bricks. Then they compared the plastic dust brick and burnt brick and obtained the result that the plastic dust brick has high compressive strength about 6.6 N/mm^2 which is greater than the compressive strength 3.5 N/mm^2 of red clay bricks.

M Mukesh Chavan, Shubham Tamhane, Sunil Chavan and Rushikesh Phuge(2019)

From the observation it is possible to use plastic in concrete, and it is having the bonding property. In general plastic is used in manufacturing and construction of bricks, roads, etc. It is the best way of disposal of plastic waste and it is a partial solution to the environmental and ecological challenges associated with the use of plastics.

D Hemalatha (2019)

This effort towards reuse of waste plastics and demolition waste brings out a novel technique that is plastic pavement block. Ordinary paver block can be replaced with plastic paver block, since it is having benefits such as replacement of cement, reducing cost, simple method ofmanufacturing.

Jeevan Ghuge, Saurabh Surale, Dr. B.M. Patil and S.B. Bhutekar (2019)

They reported a manufacturing of paver block by using waste and recycled materials, using waste and recycled materials in concrete mixes for paver blocks becoming increasingly important to manage and treat both the solid waste generated by industry and municipal waste. This study demonstrates use of waste plastic for manufacturing the concrete paver blocks and with this efficient disposal way of plastic waste is possible.

V. METHODOLOGY

Material Collection:

For this research the required plastic as a raw

material is collected from Katraj Dumping Yard, Pune and surrounding locality and the required recyclable plastic is segregated and we have taken the required waste plastic i.e. Low-Density Polyethylene

After taking the waste LDPE mostly in the form of carry bags and bottles, it is crushed to small fragments.

Crushed sand of size between 4.75mm to 600µ was taken from our college campus.

Fire wood is collected from our college campus.

Preparation of Mould:

There are different size and shapes of paver blocks. Such as trihex grooves paver blocks, square shape paver blocks, interlocking paver blocks, rectangular shape paver blocks. But we preferred rectangular shape paver block.

Mould for paver block is made in our workshop. Size of mould was 25cm X 12.5cm X 6cm.

Fig 4: Cutting Of Material

Batching:

Fig 5: Making of Mould

The collected waste plastic bags are weighted and the sand of size between 600µ and 300µ has been taken. The sand and the plastic bags were weighed in various trial mixes among which the plastic were taken for burning process.

Table 1: : **Mix Proportions of Plastic and Sand**

Sr. No.	Mix Ratio	Plastic (Kg)	Sand (Kg)
1	1:1	0.5	0.5
2	1:2	1.25	2.5
3	1:2.5	1.250	3.125
4	1:2	1.5	3

Procedure for making of paver block:

1. Sand of sieve size between 600µ and 300µ microns were sieved firstly.
2. A plastic was collected (LOW DENSITY POLY ETHYLENE)
3. Plastic serves to bind the materials together. But before we use the plastic it must be separated from plastic containing chlorine because it becomes toxic if it is chemically altered.
4. The proportions used in this experiment are 1:1, 1:2, 1:2.5, 1:3 ratios that is: plastic to sand (in kilogram) is used.
5. The stones are arranged to hold the utensil and the fire wood is placed in the gap between the stones and it is ignited. The utensil is placed over the above setup and it is heated to remove the moisture present in it.
6. When the plastic starts melting at a temperature of 150 to 250°C it changes from liquid state to plastic state.
7. After getting a liquid state, sand is added in to the melted plastic.
8. The sand added is mixed thoroughly using rod and trowel before it hardens.
9. Apply oil to the mould so as to get the friction resistance when the block should be removed after placing.
10. The mixture of this plastic and sand is then poured into a mould and kept for drying for 2hours.
11. After the completion of 45 minutes the block gets hardened and it is removed from the mould.

Fig 6: Burning Arrangement

Fig 7: Mixing Of Material

Fig 8: Unmoulded Block

REFERENCES

[1] Aeslina abdul kadir, Noor Amira Sarani, " An overview of waste recycling in fired clay bricks." International journal of intregrated Engineering vol.4 No. 2(2012).

[2] Amit Gawande, G. Zamare., V.C Renge., Saurabh Tayde, G. Bharsakale. "An overview onwaste plastic utilization in asphalting of roads", Journal of Engineering Research And Studies (JERS), Vol.III, Issue II(2012).

[3] B.Shanmugavalli, B. Eswara Moorthy, "Reuse of Plastic Waste in Paver Blocks". ISSN:2278-0181 : Vol. 6 Issue 02, February-2017.

[4] Dinesh S., Dinesh A. and KirubakaranK. "Utilization of Waste Plastic in Manufacturing of Bricks and Paver Blocks" International Journal of Applied Engineering Research ISSN 0973-4562, Volume 11(No.03), 2016.

[5] Ganesh Tapkire. Satish Parihar. Pramod Patil. Hemra, R. Kumavat. Recycled Plastic used in Concrete Paver Block. International Journal of Research in Engineering and Technology,(2014).

[6] JeevanGhuge, Saurabh Surale, Dr. B.M. Patil, S B Bhutekar , Utilization of Waste Plastic in Manufacturing of Paver Blocks, International research journal of engineering and technology (IRJET) Volume: 06, Issue: 04, page no. 1967-1970 (2019).

[7] Kevin Klarens, Michael Indranata, Luthfi AlJamali, and Djwantoro Hardjito, "The use of bottom ash for replacing fine aggregate in concrete paving blocks", Matec Web of conferences 138, 01005,2017.

[8] Koli Nishikant, Aiwale Nachiket, InamdarAvadhut, Abhishek Sangar, "Manufacturing of concrete paving block by using waste glass material", International Journal of Scientific and Research Publications Volume 6, issue 6, 61, June2016.

[9] Maneeth P D, Pramod K , Kishor Kumar, Shanmukha Shetty, Utilization of Waste Plastic in Manufacturing of Plastic Soil Bricks, International Journal of Engineering Research & Technology (IJERT), Vol. 3, Issue 8, page no529-536(2014).

[10] Manish Kumar sahu, Lokesh Singh, "Critical review on types of bricks type 14: plastic sand bricks", International Journal of Mechanical and Production Engineering, Volume- 5, Issue-11, ISSN: 2320-2092 Nov.-2017.

[11] Mohan D.M, Vignesh, "Utilization of plastic bags in pavement blocks" Volume 119 No. 15, 1407-1415 ISSN: 1314-3395,2018.

[12] Nitin Goyal ; Manisha., "Constructing structures using eco-bricks", Internatonal Journal of Recent Trends in Engineering & Research, Vol.2(4), pp. 159-1642016.

[13] Nivetha, C. Rubiya, M. Shobana, S. Vaijayanathi, G. Production of Plastic Paver Block from the Solid Waste. ARPN Journal of Engineering and Applied Science2016.

[14] Poonam Sharma. Ramesh kumar Batra. (2016). Cement Concrete Paver Blocks for Rural Roads. International Journal of Current Engineering and Scientific Research,(2016).
[15] Pramod S. Patil, "Innovative techniques ofwaste plastic used in concrete mixture".IJRET ISSN: 2319- 1163 pISSN: 2321-7308 (2014).
[16] L.Ramesh, "Recycled plastics used as coarse aggregate for constructional concrete" project reference no 37S1114.
[17] R.Mahadevi, S.Abirami, et.al, "An experimental investigation on concrete paver block by using PVC plastic material",International Research Journal of Engineering and Technology (IRJET), Volume: 5, Issue: 03, [March– 2018].
[18] Raghatate Atul M., "use of plastic in a concreteto improve its properties" ISSN2249–8974 IJAERS/Vol. I/ Issue III/April-June, 2012.
[19] S. F. Wong, Temasek Polytechnic, Singapore, "Use of Recycled Plastics in a Pavement System", 35th Conference on Our World in Concrete & Structures:25 – 27 August 2010.
[20] Shanmugavalli, B., Gowtham, K., Nalwin, P.J. and Moorthy, B.E, "Reuse of plastic waste inpaver blocks". Int. J. Eng. Technol, 6(02), 313-316 (2017)
[21] Sunil Bose, Sridhar Raju, "Utilization of waste plastic in Bituminous Concrete mixes", Roads and Pavements, vol 32004.
[22] IS 383 : 2016 – Course and fine aggregate forconcrete
[23] IS 1199:1959. Indian Standard Methods of sampling and Analysis of Concrete. Bureau of Indian Standards (BIS), New Delhi, India.
[24] IS 516:1959. Indian standard Methods of Tests for Strength of concrete. Bureau of Indian Standards (BIS), New Delhi, India.