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Assessment of Use of Plastic Waste in Manufacturing of Tiles

Prof.Pramod.R.Thorat.¹, Potdar Amar S.², Gharge Priyanka S.³, Mane Reshma D.⁴,
Jadhav Sandeep S.⁵

Asst. Professor, Dept. of Civil Engineering, AITRC, Vita, Maharashtra, India¹

Students, Dept. of Civil Engineering, AITRC, Vita, Maharashtra, India^{2,3,4,5}

ABSTRACT: This study has been undertaken to investigate the use of plastic waste for prepared floor tiles which can be recycle the plastic waste. At present nearly 9.46 million tonne of plastic waste generates annually in India. The degradation rate of plastic waste is also a very slow process. Hence project is helpful in reducing plastic waste in useful way. Sample of 300mm x 300mm x 15mm size sample are prepared. To evaluate different physical and mechanical properties, tests like water absorption, compression test, flexural test and flash and fire point tests are carried out as per IS specifications on plastic tiles and this tests were compared with the porcelain tiles, vitrifiedtiles and paver block. The result obtained have shown better results as compared to other tiles. This tiles can be better alternative to the paver block and other traditional tiles.

KEYWORDS: Recycle, Plastic waste, Floor tiles, Mechanical properties, Physical properties, Paver block.

I. INTRODUCTION

Plastic is defined as synthetic or semi-synthetic materials which are polymeric and are composed of large molecules of organics substances known as monomers. The large molecules that are from the during a process known as polymerization are known as polymers.

Plastic waste is increasing due to increase in population, urbanization and development. The disposal of waste plastic has become a serious problem globally due to their non-biodegradability. Annually approximate 500 billion plastic bags are used worldwide. Over one million sea birds and 100000 marine mammals are killed annually from plastic in our oceans. To overcome these defects we can use the plastic in construction sectors as raw materials in different ways like by preparing tiles, bricks, pavement and also used for irrigation. The waste plastic will be large in household time in many countries the composition of waste is different, that it is affected by the socioeconomic character waste management programs and consumption pattern recycling the plastic has advantage since it is widely used and has a long service life. For the first time in South India, plastic waste will be recycled to manufacture tiles in Vizag.

“The idea was to evolve a solution to the huge threat looming on the environment due to plastic waste. Only 20 per cent of plastic waste is recycled and the rest is dumped, causing a huge impact all over including marine life. There is a huge scope to recycle these wastes.”

1.1 Objective

- To determine the suitability of polyethylene bags in the development of plastic tiles for construction.
- To assess the effect of plastic waste materials on the physical and mechanical characteristics of plastic tiles.

II. LITERATURE REVIEW

2.1) Archit Hardikar, et.al (Feb 2019):

In this paper “Comparative Analysis of Tiles Made from Recyclable LDPE Plastic Waste” they studied there is a need for use of materials made from recyclable plastics taking into considerations the adverse effects of plastic waste.

2.2) Kanchan Basale, et.al (April 2018):

In this paper “Review Paper on “Manufacturing and Testing of Plastic Tiles” they studied the general objective of this research work was to contribute to the environment decontamination. The measurement of physical and mechanical properties show that plastic waste tiles whose proportion in plastic 40% give better result than micro-concrete tiles.



III. METHODOLOGY

3.1 Manufacturing

- **Material Specification:**

The basic material is used for manufacturing of tiles is thin plastic bags or LDPE (50 micron) Plastic.

Material	Size	Shape	Weight
Iron Mould	30 x 30 x 3 cm	square	13.4 Kg
Iron Plate	30 x 30 x 3 cm	square	7.5 Kg

Table 3.1 Specification.

3.1.1 Procedure For Making Plastic Tiles:

In this research, the component manufactured was made from the waste plastic bags. Following are the steps involved in its manufacturing. Preparation of tiles consist of a thermosetting casting method.

1. Plastic Collection

The plastics wastes are collected from residential, commercial, institutional and industrial areas.

2. Manual Sorting

Each plastic waste type was separated from each other and unwanted materials were removed from the waste.

3. Melting

This was done by gradually adding plastic bags in machine. The source of heat was electricity. As the plastic reached at viscous level. We would add more plastic.

4. Filing Mould

We poured the mixture into mould and fill the mould by hand or steel rod and spread the material evenly. After that put the steel plate on it.

5. Compression

Then keep it the mould for compression on plastic belling machine up to 120 to 130 Pa. for 30sec. Capacity of these machine is 200pa.

6. Demoulding

Compressed mould is taken for the Demoulding. The top plate is removed and mould is placed in the water up to 10min and removes the plastic tile.

7. Finishing

Give Finishing of the tiles for proper shape by knife.

3.2 Experimentation

For checking the properties of LDPE (50 micron) for made tiles following test were done on the component.

3.2.1 Water Absorption Test (IS 10545-3:1995 Part-3)

The Test Procedure Was Followed In Below:

The test specimen was completely immersed in water for 24 hours. Then the specimen is taken out the water and allowed then to drain for 1 minute. Then the specimen were wiped off and weighted immediately and weight of each



specimen is noted. This can be represented as then this specimen were dried in a ventilated oven at $107 \pm 7^\circ\text{C}$ for 24 hours. The dry weight of each specimen was recorded and of it is represented by W_1 .
 Water absorption % = $\frac{W_2 - W_1}{W_1} \times 100$

Where,

W_1 = weight of dry tile

W_2 = weight of wet tiles

Sr. No	Description Of Specimen	Area mm^2	Dry Weight Of Specimen (W_1)	Wet Weight Of Specimen (W_2)	Water Absorption %
1	Plastic Tile	300X300	1426	1429	0.021
2	Porcelain Tile	300X300	1219	1288	5.66
3	Vitrified Tile	300X300	1785	1823.5	2.05
4	Paver Block	75800	6570	6778	3.16

Table 3.2.1 Water Absorption Test.

3.2.2 Compression Test -(IS 15622-2006)

The Test Procedure Were Followed In Below:

The specimen shall comprise of compression testing machine which shall be equipped with two steel bearings blocks for holding the specimen. the specimen on top through which load is transmitted shall be spherically seated and the block below on which the specimen is shall be rigidly fitted when the bearing area of the steel blocks is not sufficient to cover the bearing area of the specimen to steel bearing plates meeting the requirement.

Compressive strength of tile = max compressive load / min c/s area

Sr. No	Description Of Specimen	Cross Sectional Area In mm^2	Compressive Load In KN	Compressive Strength InMpa
1	Plastic Tile	300X300	900-950	10.56
2	Porcelain Tile	300X300	3	0.03
3	Vitrified Tile	300X300	5	0.05
4	Paver Block	75800	700	9.2

Table 3.2.2 Compression Test.



Fig.3.2.2 Compressive Test On Tile.

3.2.3 Flexural Test (IS 516-Part 8)

The Test Procedure Was Followed In Below:

The load shall be applied from the top of the specimen in the form of simple beam loading through a roller spaced midway between the supporting roller. the load shall be applied without shock and increased continuously at a uniform rate of 6 KN/minute. the load shall be increased until the specimen fails and the maximum load applied shall be recorded.

Thickness of the plastic tile is, $t = 15\text{mm}$

Thickness of the porcelain tile and Vitrified tile is, $t = 6\text{mm}$

The flexural strength of the specimen shall be calculated as follows, Flexural strength, $F_b = M/I = \sigma b/y = E/R$

$$\sigma b = (M \cdot y) / I$$

$$Z = I / y$$

$$\sigma b = M / Z$$

Where,

F_b = Flexural strength, in N/mm^2

M = mass = 30Kg

I = moment of inertia mm^3 .

b = width of the tile in mm.

σ = bending stress in N/mm^2

y = distance of extreme layer of section from natural axis in mm.

L = Center to center distance between two support.

Sr.No	Description Of Specimen	Mass (M) (Kg)	Moment (M) (N.mm) $M = [(M \times 9.81) \times L] / 4$	$Z = I / Y$ (Mm^3)
1	Plastic Tile	30	11.036×10^3	12250
2	Porcelain Tile	13.5	4.96×10^3	1800
3	Vitrified Tile	12	5.518×10^3	1800
4	Paver Block	-	-	-

Sr.No	Description Of Specimen	L	Flexural Strength Mpa
1	Plastic Tile	150	0.98
2	Porcelain Tile	150	2.75
3	Vitrified Tile	150	2.45
4	Paver Block	-	-

Table 3.2.3 Flexural Test



Fig 3.2.3 Flexural Test On Tile

3.2.4 Flash And Fire Point

For plastic tile

- The flash point of material is the lowest temperature at which the application of test flame causes the vapors from the material and momentarily catches fire in the form of a flash under specified condition of test
- The fire point is the lowest temperature at which the application of test flame causes the material to ignite and burn at least for 5 sec under specified condition of test.

Description	Plastic Material
Flash Point	280°C
Fire Point	340°C

Table 3.2.4. Flash And Fire Point.



Fig 3.2.4 Flash And Fire Point Of Plastic Tile.



Fig 3.2.5 Plastic Tile.

IV. RESULT

1. Water absorption of the plastic tiles is less (0.002%) than the porcelain tiles, vitrified tiles and concrete paver block.
2. Compressive strength on plastic tiles is 10.56 N/mm².
3. Flexural strength of plastic tile is 0.98Mpa and plastic tile is not break.
4. Flash and fire point on a plastic tile give a good result.
 - Flash Point - 280°C
 - Fire Point - 340°C

V. CONCLUSION

Reduction in plastic waste it saves our environment and also reducing the amount of plastic. Waste plastic is generated by consumer and industry. It also reduces greenhouse gas emission and helps for prevent global climate change. The plastic tiles are more durable than traditional tiles with respect to various perspectives as written in result. Manufactured tiles float on water making it suitable for marine application.



VI. FUTURE SCOPE

After completion of above project is noted that this plastic tile presenting uneconomical but in future research on that issue will be possibility make that this tile economical.If we use fire proof reagent, modern method, colour reagent for making this tile then it will more glossiness and efficient.We will change the percentage of plastic waste also there are possibility to change the binding material like resin– melamine, resin polyesters et.al this are the chemical which will be economical.Plastic tile are floating on water so It will be suitable for marine application.

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BIOGRAPHY



Prof.Pramod.R.Thorat
ADARSH INSTITUTE OF TECHNOLOGYAND
RESERCH CENTRE , VITA



Mr. Amar Subhash Potdar.
ADARSH INSTITUTE OF TECHNOLOGYAND
RESERCH CENTRE , VITA .



Miss. Priyanka ShankarraoGharge.
ADARSH INSTITUTE OF TECHNOLOGYAND
RESERCH CENTRE , VITA .



Miss. Reshma Dashrath Mane.
ADARSH INSTITUTE OF TECHNOLOGYAND
RESERCH CENTRE , VITA .



Mr. Sandeep Subhash Jadhav.
ADARSH INSTITUTE OF TECHNOLOGYAND
RESERCH CENTRE , VITA .



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