

Utilization of Waste Plastic in Tiles

Rahul Kantilal Pawar, Bharat Daga Patil



Abstract: As we humans are continuously developing ourselves for a better livelihood for ourselves and for the next generation. For this ability, we continuously and intensively increasing of plastic in our routine. This causes a very hazardous effect on all living things and also affects increasingly the environment as well as the ecosystem and its inhabitants. Nowadays the problem of plastic waste is increasing immensely causing hazardous effects on the environment. So, it is necessary to think out of the box for minimising plastic waste by searching for every possible solution to minimize plastic waste. On this basis we trying to find out the use of plastic waste as construction material i.e. plastic tiles. This research paper revolves around manufacturing floor tiles using waste plastic without adding any additives such as sand, fly ash etc., and also without using cement and then analysing it with the normal tiles. By using this method plastic waste is reduced to some extent; plastic consumption is increasing day by day there are not many methods to dispose of it. The plastic tiles are compared with the normal tiles to assess the different physical and mechanical properties. The tests that are excited on plastic tiles are compressive strength, vertical flammability tests etc. The result obtained from these tests on plastic wastes is far better than the normal tiles. As per this study it can be considered to use plastic waste as a binding material instead of floor tiles as it proves economical.

Keywords: Waste Plastic, LDPE Tiles, Floor tiles.

I. INTRODUCTION

The scenario that is been seen is that plastic is used in number of sectors such as manufacturing, marketing, transportation etc. But the disposal of plastic is not that easy as it is a non- biodegradable substance and remains on land and environment for numerous years [1]. After the use of plastic, it proves as a hazardous material to the environment and its inhabitants [2] [3]. Wastes are categorized into municipal wastes, hazardous wastes, medical wastes, and radioactive wastes. Recently there are various methods used to dispose of the plastic waste and use it in a number of ways. Plastic is also used in the construction industry as a new engineering material [4]. The researchers are more interested to induct their time and also money because they think that plastic will prove best construction material in future years [5]. Talking about the properties of plastic, properties of plastic are so unique that they can mix with any kind of

material and prove useful [6]-[7]. Plastic can be remoulded into any solid form therefore they are malleable and ductile [10] [11]. Nowadays many methods are introduced to dispose of plastic but there is again a need to find better-advanced techniques and methods to dispose of this non-biodegradable substance. If we do not find ways to dispose of plastic waste properly then it will prove very hazardous to us in upcoming future, Plastic waste can also be recycled [12]- [13]-[18][26]. Plastic recycling is the process of recovering plastic wastes and turning old or scrap plastic into usable products that can re-enter the manufacturing chains [17]. The technique that is used for a long time to dispose of was wasted incinerators, in which the plastic waste is burned at high temperatures [18]-[21]. But the gases that emerge during this process prove to be very harmful to human beings as well as pollute the air and water [20]. Many people also get affected due to these gases and they get prone to many diseases [22].

The researchers say that if the plastic waste is not disposed of as soon as possible then it will remain on earth for more than 5000 years without getting degraded [11]-[18]. Hence, now these days the use of plastic waste is increasing in the construction industry. Plastic waste is used to manufacture paver blocks, tiles, also used in road construction etc. [19]-[21] [23]. The main focus of this research work is to manage the problem of plastic waste through recycling in a comparatively less capital-intensive manner with the main aim of utilizing waste plastic bags composed of LDPE. The tiles that are manufactured from plastic waste prove to be very durable and economical as compared to normal tiles [24]. A tile is a manufactured piece of hard-wearing material such as ceramic, stone, metal, or even glass. Tiles are generally used for covering roofs, floors, walls, or other objects Plastic tiles prove to be very cheaper as all people can afford it [25]. Also, it proves to be a very practicable and efficient method to dispose of plastic waste. As normal tiles cannot be recycled but plastic tiles can be recycled further when not in use [26].

However, the rate of plastic waste generation has increased tremendously, and Management has become a serious issue [27]. Consequently, researchers have suggested the use of plastic wastes in concrete Production for two major reasons: first, to resolve the environmental problem associated with their disposal and second, to reduce construction costs since they are available in great quantities [28].it is an industrial waste product available in abundance it is being widely explored as a filler material for various applications due to some valuable characteristics like lightweight, easy availability, low density, surface_morphology, chemical inertness, thermal_resistance, great workability and large surface area [28]-[30].

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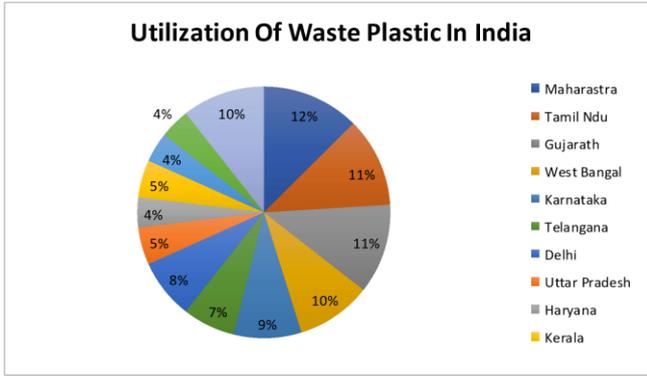


Fig. 1 - State-Wise Waste Plastic Generation

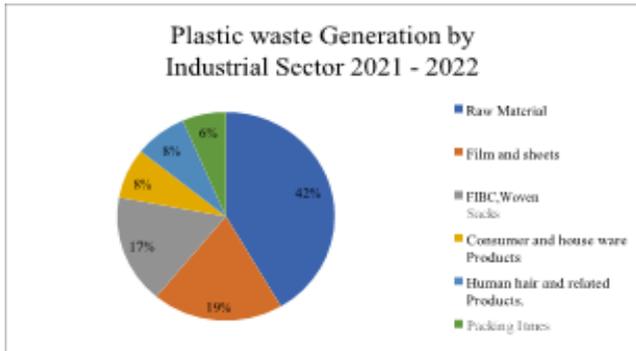


Fig. 2 - Industry Wise Waste Plastic Generation

1) Objective

1. To recycle waste LDPE plastics.
2. Increase strength of Tile.
3. To manufacture plastic tiles from the used plastic bags
4. Reduced cost of Tiles
5. To utilize the plastic waste in a smart way to create something useful such as tiles

II. METHODOLOGY

Steps for manufacturing Plastic Tiles are given below:

1. Collecting Plastic:

- It is important to select the right type of plastic. There are different types of plastic having different properties like chemical and physical.
- LDPE is a very versatile plastic and is often used as flexible film and bag, also it is widely used to make pet bottles, food bags, wrappings, toys, rigid trays, stretch wrap as well as water & ice bag.
- Only LDPE type of plastic is used for this experiment, because other types of plastic are harmful for our health.
- For the experimental point of it requires all types of waste plastic which is commonly available at door step. These collected waste then clean-up by tap water to remove impurities like stone, dust etc.
- For the melting point of view the waste plastic is require to be in same size that's why the collected waste plastic is shredded in uniform shape and size to avoid the coagulation of slurry.



Fig 3. Waste Plastic Collection

2) Shredding:

It is the second step of the plastic manufacturing plastic process. After selecting one of the collections of plastic or selecting of right plastic, we cut the plastic into smaller sizes or smaller pieces using scissors & cutters because it is easy for the melting process. If we can't cut plastic in smaller size or piece then it can't melt properly. So, it is directly affected on plastic tiles manufacturing.

3) Weight the Material:

Weight the plastic material by weighing machine.



Fig. 4 - Weighing of Waste Plastic

4) Melting the Plastic:

Keep mixing the melting plastic until it is a black liquid with no lumps. First take a pan and heat it by small fire or little fire. After that add plastic material. Smaller fire or heat help to melt the plastic. Keep mixing it. Keep adding plastic until it becoming black liquid. Take care from the gases which release in air because they harmful for over health and also take care from instrument which aren't more heated. Don't not stand close to the setup. Take care safety precaution while performing this process.



Fig. 5- Melting Mix Waste Plastic

5) Moulding:

In the manufacturing of this LDPE tiles, it is very necessary to handle molten LDPC plastic as it will cause harm to live. So, we pour appropriate quantity of molten LDPE plastic in to mold so as to make tiles properly. Ensure mold inner surface will coated with oil or oil like material so it is easy to de-mold tile for further procedure



Fig. 6 - Pouring Melted Waste Plastic into Mould

6) Shaping:

Press the mix tightly into the mould, which reduces air gas cavity from the melted waste plastic. Air gaps will reduce the quantity of your finished tile. By using hammer, we can tap or press or applied force for compact material in proper way. For uniform compaction applied any large size weight to achieve the uniformity.



Fig. 7- Compaction of Melted Plastic

7) Settle Down of Melted Plastic:

Once the melted waste plastic spread properly and achieve the required shape trying to tile remove from the mould with good surface of plastic tile. Initially the surface in not finished one it required smoothing of surface by any means like with varnish paper etc.



Fig. 8 - Settled Waste Plastic Slurry

8) Final Set:

After all the process mould will be placed as it is for the cooling down of all the material. Which also gives the strength to waste plastic tiles, it requires very few hours. In this level of settlement, the plastic achieves the property of virgin level.



Fig. 9 - Final Product Tile

III. TEST ON MATERIAL

1. Compressive Test

A compressive test was conducted as per the ASTM D695 standard. The specimen is placed in compression testing machine. The maximum load is recorded. Equipment used in this test are Introns universal tester & Extensometer. Extensometer is extensively used in materials testing. Compressive strength was calculated using the following equations:

$$\text{Compressive strength} = \text{maximum compressive load} \div \text{minimum cross sectional area}$$



Table 1. Test Result of Compressive Test

Sr. No.	Specimen	Compressive Strength MPA	Maximum Compressive strength MPA
1	Specimen 1	17.26	18.05
2	Specimen 2	18.05	
3	Specimen 3	16.50	
4	Specimen 3	17.60	

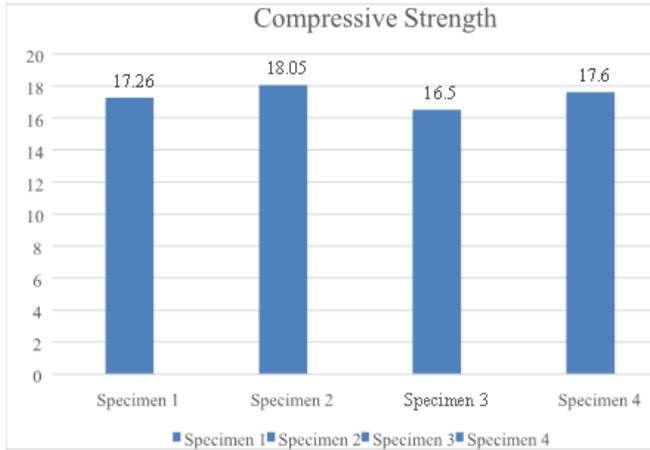


Fig. 10 Graphical Representation of Compressive Strength

2. Vertical Flammability Test

A Test specimen is positioned vertically above a controlled flame & exposed for a specified period of time. During the test, samples are held in a vertical position & determine the speed of propagation of the flame over the material to be tested. This test was done as per IS 15061:2002 the burning rate should not be more than 100 mm/min. Test is conducted on specimen and found the burning rate 55 mm/min, which is slightly above IS code minimum burning rate provision. Which shows the waste plastic tile is flammable, which is not suitable as per IS specification

3. Water Absorption Test

Table 2. Test Result of Water Absorption Test

Sr. No.	Specimen	Water Absorption %	Avg. Water Absorption %
1	Specimen 1	3.40	3.30
2	Specimen 2	3.20	
3	Specimen 3	3.10	
4	Specimen 3	3.50	

It is observed while carrying out water absorption test on test sample i.e., the water absorption percentage is apparently nearer to each other, because the test sample are made with same material i.e., LDPE plastic. As test sample are made with same material no other constituent are use therefore percentage of water absorption is almost same were recorded. However, as compare to other tiles like ceramic tiles the percentage of water absorption of LDPE tiles are lesser. Which shows the tile are more water proof and commonly utilised at footpath covering, which give proper view as well. Water proofing also very important in case residential building, which is very important in case of uneven

settlement of houses due to more percolation of water through open space.

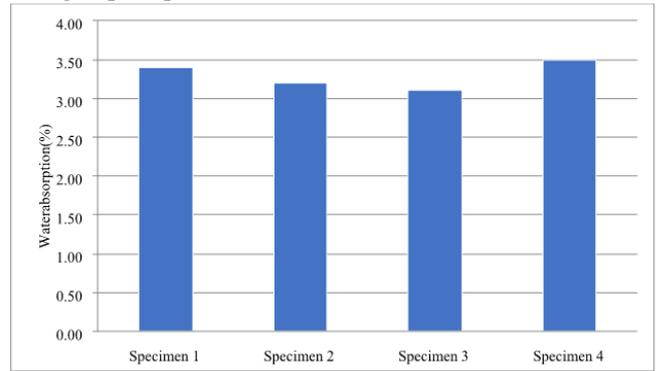


Fig. 11 Graphical Representation of Water Absorption Test

4. Static Friction Test

Table 3. Test Result of Static Friction Test

Sr. No.	Specimen	Coefficient of Static Friction	Avg. Coefficient of Static Friction
1	Specimen 1	0.47	0.48
2	Specimen 2	0.48	
3	Specimen 3	0.49	
4	Specimen 4	0.485	

As result shows the value of coefficient of static friction of waste plastic tiles which were we tested are showing such value that is moderately safe to use as floor tiles or it can be used as bathroom tile. Waste plastic tiles are more rough in nature and that's why it gives the mat finished like touch. Rough surface always provide more friction to moving object which is safe at recreational parks, bathroom, footpath (where rainy season is more as compare to other location). Waste plastic tiles also provide the solution for safe disposal solid waste, which is very common in fast developing cities. Also it minimises the problem of land requirement. Not only in public places but these types of tiles are very common in houses also, which minimises the problem related to knees. Friction test shows the viability of waste plastic tiles in day to day life.

IV. CONCLUSION

Cities like Delhi requires very huge land for the disposal waste plastic, almost hills are prepared in the mid of cities because of disposal problem of waste plastic. The plastic waste is an issue for our environment as well as our ecosystem. Whereas this issue can be converted into an opportunity in construction industry to found out alternate use of this as construction material. As a civil engineer we have privilege for thinking out of the box and may achieve something useful for our society. There is need for thinking by fresh aspect about the 'Utilization of waste plastic in Tiles' then after we can also make our ecosystem healthier for human life. Also, it is really economical i.e., cost saving material to produce the waste plastic tiles.



It is concluded that the use of plastic waste for construction application will improve the sustainability of the environment significantly and to reduce the plastic waste generated in the surrounding which caused several problems.

FUTURE SCOPE

The manufacturing of plastic tiles is more durable, economical than the ordinary tiles. Plastic tiles having less price as compare to the other tiles and plastic tiles easy for manufacturing because plastic is easily available and it's priceless.

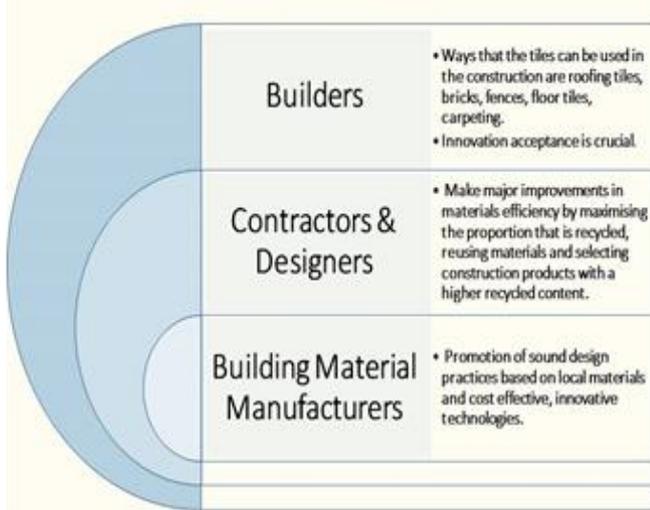


Fig. 12 Utilizaion in Various Field.

Day by day plastic quantities is increase so it's is best way to reduce plastic from the environment and make some economical which more useful for us. In future, plastic tile is more useable there are severable reason by using it. First it having low cost, it is saved to our universe and protect from the pollution and if we think in another way plastic tiles are colourful so it's look more attractive and colourful and longer durability. Plastic tiles are given us hope and a way to work on creative or new things related to the plastic and try to some create some new in civil engineering material which shows some amazing response in future industry and exchange the thoughts of researches, users and industries. It is present-time and beneficial method. In current scenario due to covid-19 rates are increase on every material but the plastic tiles are not expensive to buy, or use.

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