“Tech for Impact Bharat – 2022”

Utilization of Waste Plastic in Designing Tiles for Societal Applications – A Step Towards Circular Economy

CSIR – National Physical Laboratory

(Ministry of Science & Technology, Govt. of India)

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Waste Plastic have become a major source of pollution

- **Plastic carry bags and scrap are the biggest contributors to littered waste and every year, millions of plastic bags end up in the environment vis-a-vis soil, water bodies, water courses, etc.**
- **Disposal of Plastic Waste is a major problem.**
- **It is non-biodegradable & it mainly consists of low-density polyethene plastic bags, bottles etc.**
- **Burning of these waste plastic bags causes environmental pollution.**
- Burning **one kilo of plastic releases 3 Kg of carbon dioxide, a gas that contributes to global warming.**
- **In landfill, plastic material may take 1000 years to completely degrade.**

Waste plastics generated in 4 metros (TPD)

	Total waste plastics generated	Uncollected and littered waste plastics
Delhi	689.5	275.5
Mumbai	408	163.2
Kolkata	425.7	170
Chennai	429.4	171.6

(Central Pollution Control Board)

- **Why Waste Plastic reinforced with flyash Tile Project & What we planned?:**

* **The main objective of our innovation is to utilize waste plastic scrap & fly ash for designing of floor tile, interlock tile, paver tile and roof tile in the building of structures and rooms for general public for societal usage.**

* **Novelty and Positioning of the Work:**

Recycling waste plastics from poly ethylene bags, bottles, and other containers in the form of a tile, so that these tiles can be inserted into the panels.

The various challenges like mechanical strength, flame retardancy, water permeability and UV- protection from sunlight & antistatic response are the novelty of the concept.

What is the relevance and importance of plastics recycling and waste to circular economy for India?

- **All government departments are focusing on banning the plastics without realizing that good value can be generated if plastics are properly collected, segregated and recycled.**
- **India needs more infrastructure, recycling parks and incentives for collecting and converting plastics into valuable product or energy.**
- **If govt bodies look at plastic as an opportunity to make value out of it apart from its cost effective packaging medium.** Single use plastics are introduced mainly to bring in hygiene and to avoid human errors in cleaning and reusing.

- **CPCB recommends technologies like gasification, incineration and pyrolysis for disposing non-recyclable plastics into fuel or energy. Technologies are available for processing any kind of plastics from any quantity. The main issue is adapting technologies.**

- **Waste Plastics can be reutilized in four different ways**

1. **Waste Plastic in roads carpeting along-with bitumen**
2. **Waste Plastic to diesel**
3. **Waste Plastic to Tiles &**
4. **Waste Plastic for pyrolysis**

Tiles from Waste Plastic installed by Municipal Corporation, Hyderabad

Waste Plastic tiles reinforced with fly ash installed at CSIR-National Physical Laboratory, New Delhi

Anand Mahindra has recently twitted about these tiles

Whether the products/ methodology is approved by BIS/ Certification agencies/ statutory/ regulatory authorities etc. for implementation by TPPs

- We are in the process of including our products in PWD and GeM. Number of companies shown interest in our technology and we are in process of finalizing the terms & conditions. We are also in process of preparing Guidelines for the Use of Waste Plastic in Tiles

1. **M/s Shayna Ecounified India Pvt. Ltd., New Delhi** – Technology Transferred on July 3, 2017
2. **M/s Addin Infra Pvt. Limited, Rajkot** – Technology Transferred on Feb 28, 2018
3. **M/s Vyzag Bio-Energy Fuel Pvt. Ltd**., Viskhapatnam – Technology transferred on June 22, 2018
4. **M/s Esperanza Global Ecosolutions Pvt. Ltd., Chandigarh –** Technology transferred on December 11, 2018
5. **M/s Bengal One Enviro LLP, Kolkatta** – Technology transferred on May 14, 2019
6. **M/s Ayasya Infrastructures LLP, Hyderabad** – Technology transferred on July 17, 2019
7. **M/s NAS Industries, Thane, Mumbai** – Technology transferred on Feb 21, 2020

Our Next challenge – How Multi Layered Plastics can be recycled?

These tests were conducted at CSIR-National Physical Laboratory New Delhi and National Test House Ghaziabad, UP, India.

Sr. No.	Type of Test	Test Source	Slab	Values	Result
1.	Thermal Stability	CSIR-NPL as per standard thermogram	100 – 150°C	140°C	Pass
2.	Compression vs Crush Strength	ASTM D 3998	10-20 tonnes – No break	> 10 tonnes	Pass
3.	Water Absorption	ASTM D-570-98 (NTH)	0.01 to 0.1	0.05	Pass
4.	Resistance against strong acid (1.0 N HCl)	CSIR - NPL	No deformation	No deformation	Pass
5.	Resistance against strong acid (1.0 N NaOH)	CSIR-NPL	No deformation	No deformation	Pass
6.	Photo oxidation of polymer tiles under UV and sun light	NTH	Minimal fading to complete fading	Moderate fading	Pass
7.	Fire Retardency Test as per ASTM standards	ASTM(D 635-03) NTH	2 to 15 mm/sec	4.4	Pass

8.	**Antistatic behaviour of the waste plastic/flyash tiles**	**406D Static Decay Meter**	2 to 5 sec static decay time	< 2 sec	Pass
9.	**Zero Halogen with no Emission**	**NTH**	No halogen emission like Cl, Br etc.	No halogen emission	Pass
10.	**Hazardous gases release Test**	**NTH**	NOx 1 to 5 ppm ppm SO_2 1 ppm to 5 ppm	No emission No emission	Pass Pass
11.	**Fungus Resistance**	**ASTM G21**	No growth	No growth	Pass
12.	**Sound Transmission Loss & Noise Reduction Coefficient as per ASTM C423**	**CSIR - NPL**	20 dB ± 2.0 dB NRC 0 to 1	35 dB ± 1.0 dB NRC 0.1	Pass

Skid Resistance Test

The average value of skid resistance (British Pendulum Number) was taken and summarised in table.

Tile	BPN (Dry)	BPN (Wet)
Paver Block (20mm)	65	39
Paver Block (60mm)	80	40

The paver tiles fabricated under this innovation can be put to use at external walkways, parks, footpaths, elevator lobbies and pedestrian crossings. For this purpose there skid resistance was analysed using national standard method British Pendulum Skid Resistance Tester (ASTM E303-93). The surface frictional properties of these tiles were studied in dry and wet conditions. Also the effect of temperature change was analysed.

The fabrication of tiles involve melting the plastic waste at 140-150^{o}C for mixing and molding purpose. The evolution of gases during this process is a major issue of concern. The plastic composite was melted in open atmosphere and the gases evolved were analyzed using a standard Gas analyzer under ambient temperature conditions.

Gases	Composition Evolved
CO_2	0.5%
CO	5ppm
SO_x	No evolution
NO_x	No evolution
VOCs	No evolution

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Ministry of Science and Technology
Government of India

IIM CALCUTTA
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Department of Science and Technology, Government of India in association with IIM Calcutta Innovation Park launched Smart Fifty- 50 solutions to Transform India!

The Smart Ideas from all over India that are Sustainable, Motivating, Affordable, Responsible and Transformational, participated in India's biggest funding event.

CSIR - National Physical Laboratory, New Delhi technology on "Utilization of Waste Plastic bags in designing tiles for Societal Usage" (Reg. No. XH101193AX) has successfully made it to Top 50 Innovations in India.

Paver Tile

Roof Tile

राष्ट्रीय भौतिक प्रयोगशाला
NPL - INDIA

Video Link: https://youtu.be/4KrYhRryRtk

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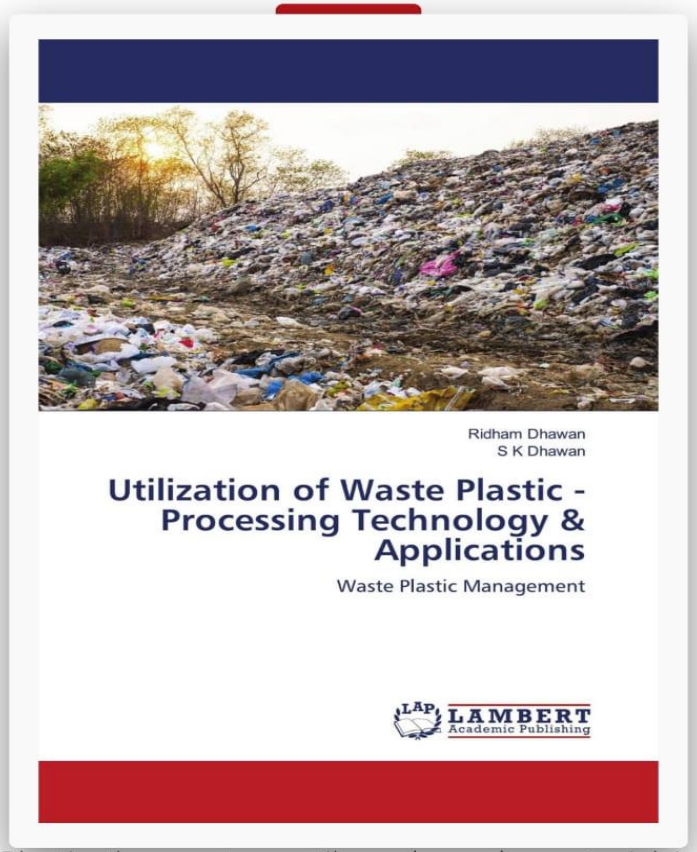
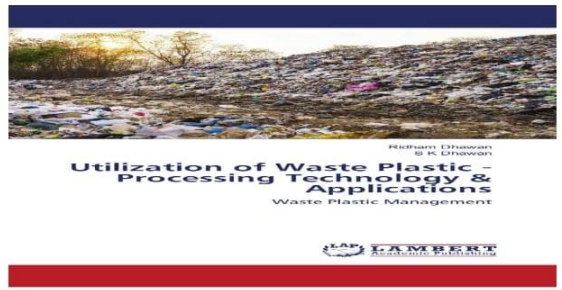


Plastic, the most versatile and wonder material, is the product of spectacular developments in the area of polymer science and technology. The penetration and acceptance of plastics into the social network is so high that it is now difficult to



Utilization of Waste Plastic - Processing Technology & Applications

Waste Plastic Management

LAP Lambert Academic Publishing (2021-07-28)

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Buy at the MoreBooks! Shop

Plastic, the most versatile and wonder material, is the product of spectacular developments in the area of polymer science and technology. The penetration and acceptance of plastics into the social network is so high that it is now difficult to conceive a world without plastics. The very factors that popularize plastics in our modern life are in fact a threat also to our very survival. The extreme durability of plastic defies the natural recycling process of the biosphere. Chemically, it is the most non-biodegradable material man has

penetration and acceptance of plastics into the social network is so high that it is now difficult to conceive a world without plastics. The very factors that popularize plastics in our modern life are in fact a threat also to our very survival. The extreme durability of plastic defies the natural recycling process of the biosphere. Chemically, it is the most non-biodegradable material man has ever produced. This book covers the different techniques, which can be employed to tackle the problem of waste plastic scrap like polyethylene used in packaging materials, LDPE bags, poly propylene, high density polyethylene. Focus will be onto how these problems of waste plastic bags can be solved by designing paver tiles, interlock floor tiles and roof tiles.

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