

"Waste plastics recycling towards circular economy: A case study"

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Presentation by:

Hemant Goyal Research scholar, Department of Chemical Engineering Indian Institute of Technology, Roorkee

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- Waste plastic recycling
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Introduction

Circular economy aims to eliminate waste and maximize the use of resources.

It is based on three key principles:

- Eliminate waste and pollution.
- Keep raw materials and products in use.
- Regenerate natural systems.

In a circular economy, resources are kept in use for as long as possible through reuse, repair, refurbishment, and recycling, and waste is minimized through the use of sustainable materials and production processes.

It is an alternative to the traditional linear economy where resources are extracted, used, and then disposed off.





Seven Pillars of the Circular Economy



The circular economy is a new economic model for addressing human needs and fairly distributing resources without undermining the functioning of the biosphere or crossing any planetary boundaries



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The benefits of a circular economy



- Reduce greenhouse gas emissions.
- Stimulates creativity and innovation.
- Minimize the demand for raw materials.
- Save money for consumers and companies.
- Create more jobs.
- Boost economic growth.
- Avoid resource price changes.



Source: unctad.org

Waste plastic recycling in circular economy







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Routes of waste plastic management





Routes of waste plastic recycling

- Primary Recycling-Product characteristics similar to those of original product
- Secondary Recycling-Product characteristics different from those of original plastics product.
- Tertiary recycling- Production of basic chemicals and fuels from plastics waste/scrap as part of the municipal waste stream or as a segregated waste.
- Quaternary recycling- Retrieves the energy content of waste/scrap plastics by burning/incineration. This process is not in use in India.

CPCP recommended options:

- Polymer coated bitumen for road
- ✓ Plasma gasification
- Liquid fuel production

Plastic recycling through making useful products

- Converting plastics into useful products such as paving blocks is one of the best option for recycling waste plastic.

In previous works, plastic has been utilized in three ways

- Shredded plastic directly mixed with concrete materials
- 2. Plastic melted separately and mixed with other concrete material to replace cement by some percentages
- Plastic and sand (or/and other concrete materials) mixed and then melted.

Waste plastic (crushed in size 4.75 mm) used as fine aggregates with cement and different ratio of fine aggregates (by IN201941018623(A))



Waste plastic was heated mixed with M sand at different compositions. (by IN202141026517(A))



Products developed out of waste plastic





Army trackway



Wall / floor tiles



Speed breaker (under development)

Value proposition of the products







Field trials of paver blocks



The paver blocks were fixed in front of TIDES, IIT Roorkee and have shown good performance ~2 years.

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Field trials of army trackway





The field trials were conducted by 59, Engineer regiment, Indian Army.

Competitive landscape



Existing prior arts

- Plastic is used as filler material with other cementitious materials.
- Some processes are utilizing plastic as binder with materials like fly ash and sand as filler along with some additional fire retardants.
- Heating and melting of plastic at high temperature

Drawbacks in prior arts

- Use of cement as binder have high carbon footprints (Reduces GWP by 2.5-3 times).
- Heating and melting of plastic at high temperature releases harmful polluting gases.
- High-cost materials and fire retardants are being used which increasing the overall cost.
- ✓ The production cost of wall tiles INR ~15 per sq. ft.
- The cost of paver blocks are competitive to the products available in the market of similar strength.
- ✓ The cost of army trackways is nearly 1/3rd of the currently used metal based product. (Initial evaluation)



- The present process usefully produces cement free paver block, wall tiles, army trackways without complete melting of the waste plastics and using lower temperature and with no emission of gaseous pollutants
- Products are good quality with long life and resale value
- The manufacturing of products has 2-3 times less environmental impacts than the conventional products.
- New designs of paver blocks and wall tiles are under development.
- Process can be applicable for both small scale and large-scale production.

Our team







Our startup

Prayas Greentech Private Limited, incubated at IIT Roorkee

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59, Engineer Regiment, Indian Army is co-developer of trackways.







C O N T A C T S

Department of Chemical Engineering Indian Institute of Technology Roorkee Roorkee - 247667 Uttarakhand India

Tel: +91-1332-285181

Mob: 9897369605

E-mail : pmondfch@iitr.ac.in

hemant.ch@sric.iitr.ac.in

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