



Bio-Add



An Eco-Friendly Product Fabricated Through Additive Manufacturing

CENTRE FOR ADDITIVE MANUFACTURING
CHENNAI INSTITUTE OF TECHNOLOGY



List of Contents:

1. Abstract
2. Problem Statement
3. Solution
4. Innovation
5. Fabrication
6. Budget plan
7. Future Plan
8. Future Requirements
9. Acknowledgement



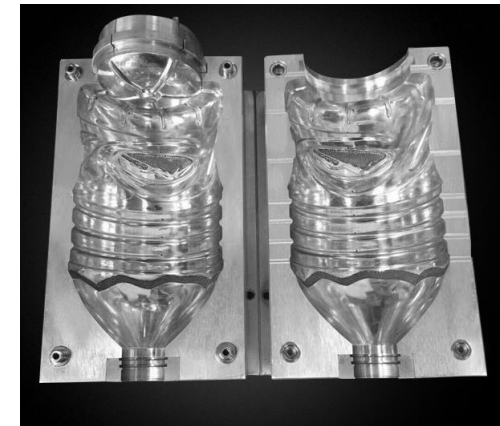


Abstract

In the present situation the usage of plastics are very high. The improper disposal of these plastics causes **harmful effects and pollution** leading to global warming. Waste management of these plastic are still a very big challenge. This call for an **alternative material** which could replace plastics at the same time **bio-friendly**. The presenting ideology, provides the best solution. An **Eco-Friendly water bottle** was fabricated with a new class of **biodegradable raw material**. The raw material is obtained through reinforcing the **orange peel nano particles with PLA matrix**. It is then extruded into filaments and a bottle was fabricated using **Additive Manufacturing** technology. The proposed product is **harmless, decomposable**, and provides a **high nutritional content** to the water. The work aims to provide a product with **high sustainability** and quality in a **low cost** to the society.

Problem Statement

- The currently used water bottles are manufactured from conventional plastic materials such as **polyethylene terephthalate(PET), polypropylene, polycarbonate or polyvinyl chloride**.
- These material when disposed in the environment leads to pollution and **global warming**. Further, the water stored in these containers might have a chance of **reacting with the plastic surface**.
- This causes **harmful health issues** on consuming the water.
- Currently, water bottles are manufactured using a **mould** and die which restrict the **freedom of design**.





Solution

- A new class of **biodegradable** raw material is proposed.
- The bottles made do **not cause environmental pollution** or hazards.
- The stored **water** does not create **harmful effect**.
- Provides a **good nutritional** content to it.
- The adopted manufacturing technique is more **easy to customize**.
- The manufacturing method involves very **less material wastage**, thus it is **much cost effective**.



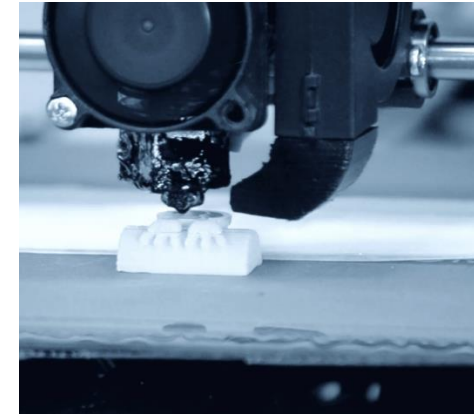


Orange Peel Reinforced PLA (Novel Material)

- Poly Lactic Acid (PLA) is **biodegradable** material.
- It is act as a good **matrix** among all the polymers
- The orange peel is rich in **limonene** which is known for its **anti-cancerous property**.
- The **orange peel** filler material is reinforced with **PLA matrix**
- This new class of raw material adopted in manufacturing of bottles, provides a **good nutritional content** to the water.
- The water present in these does **not create harmful** effect to both **health and environment**.

Fabrication Technique

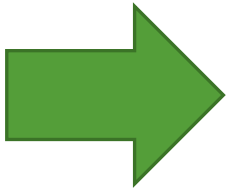
- **Additive manufacturing (AM) or 3D-printing** is an emerging technology in which the component is fabricated **layer-by-layer**.
- **Fused Deposition Modelling (FDM)** is one of the most commonly preferred technique for **polymeric fabrication**.
- The technique is highly **cost effective**, conceives **less material wastage** and provide **freedom of design**.
- It use a CAD model and extract the filament to print the prototypes.



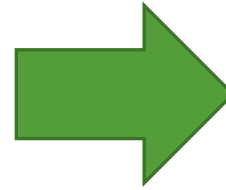
Synthesis of Raw Material



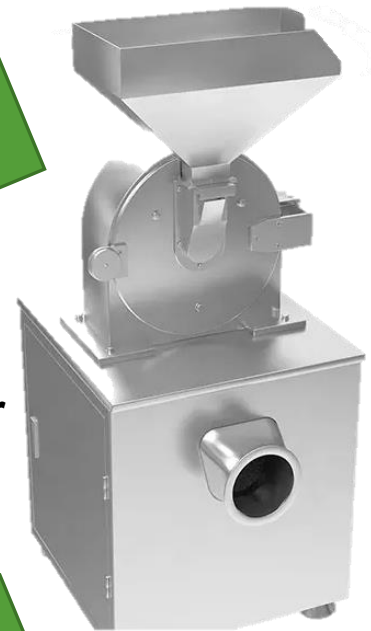
Sunlight Dry



Oven Dry (50 °C)
With open lid



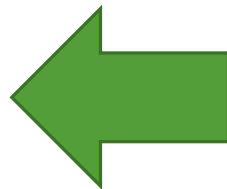
Dried peels
were ball
milled



Mechanical
Size Reducer



Ball Miller



Nano sized
orange peel
particles were
synthesised

Sonication



Without pellets

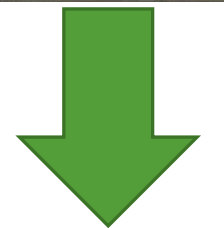
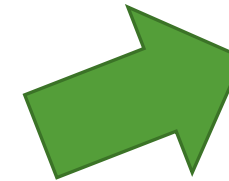
20 ml of ethanol
and filler material
heated for 45 mins
(60 °C)



With pellets

Pellets were added
to the mixture and
again heated for 45
mins (80 °C)

Heated Hot plate at
120 °C

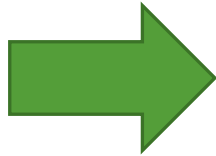


Pellets after
sonification

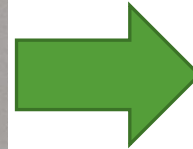
Extrusion of Filaments

Ideal process parameters were chosen. This include:

- Extrusion speed
- Puller speed
- Extrusion temperature
- Pre-heating temperature



Pellets in hopper



Nozzle

Filament is extruded with ideal process parameters



Nozzle

Top View



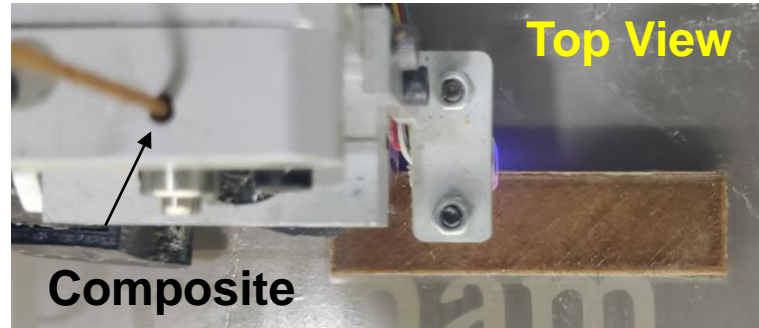
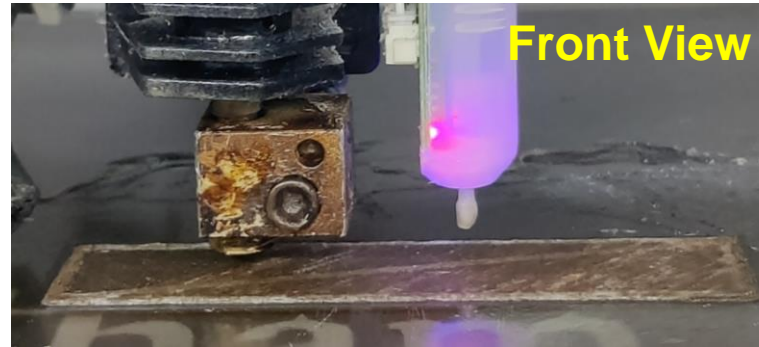
Fabricated Composite



Fabrication



Filament fed to FDM printer

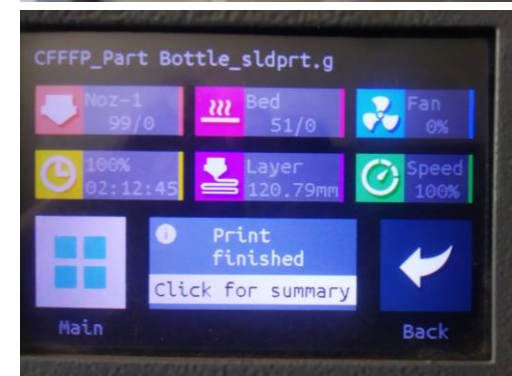
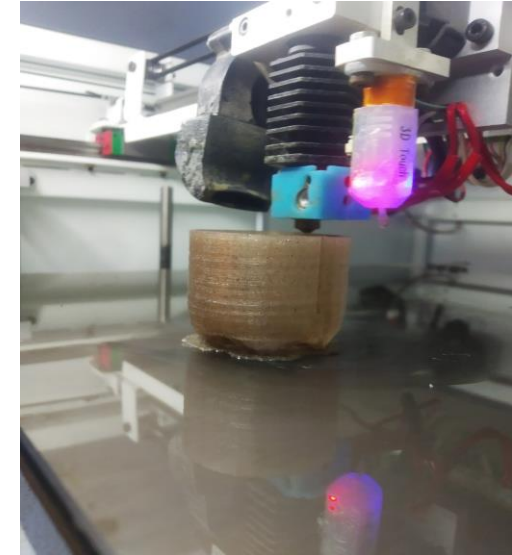


Composite

Fused Deposition modelling (FDM) printer



Printing Process



Fabricated Product



ADDITIVELY FABRICATED ORANGE PEEL REINFORCED PLA – BIO DEGRADABLE WATER BOTTLE

**Dimension: 120 mm height and
40 mm diameter**





Business Model

900 g PLA+ 100 g filler

• Rs. 530

Filament extrusion

• Rs. 400

3D printing

• Rs. 850

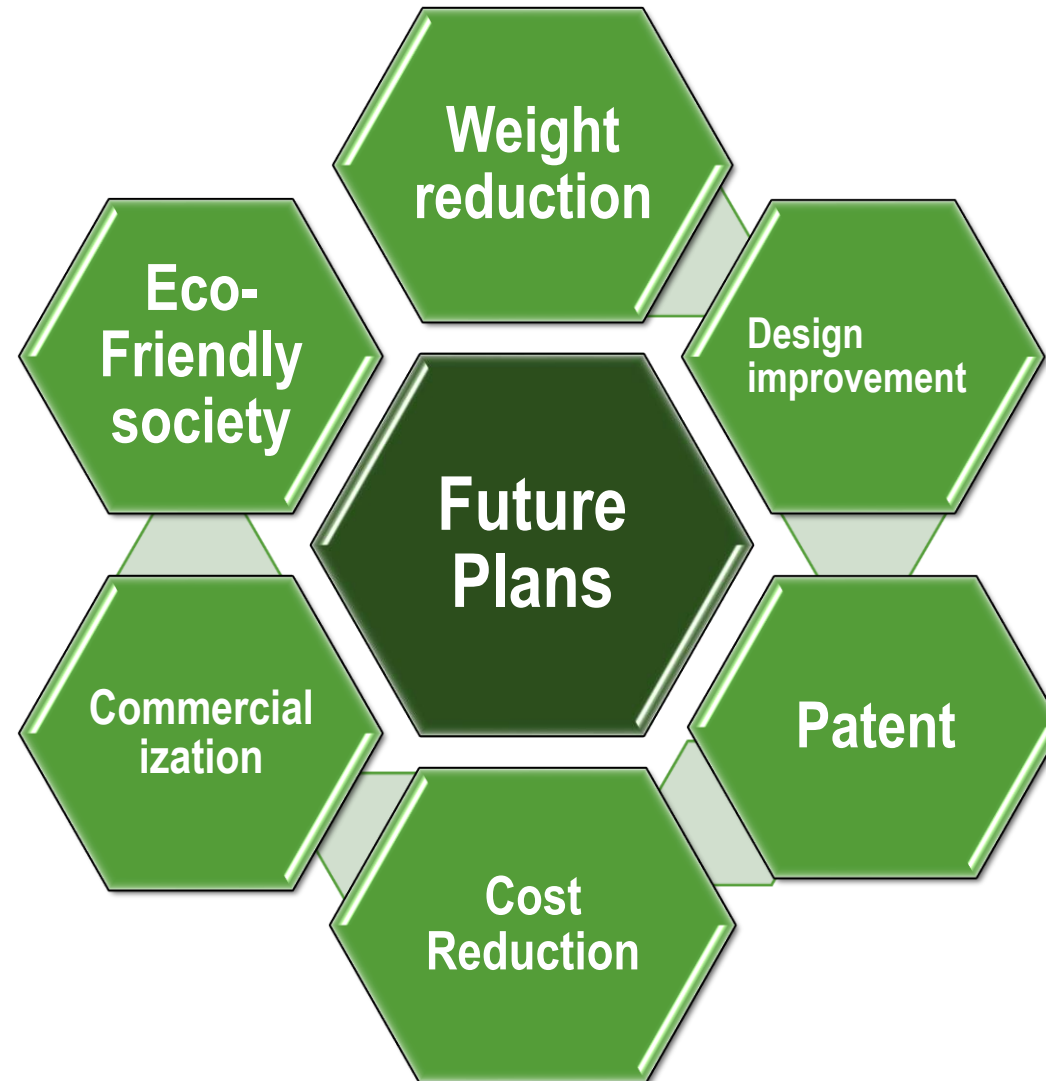
**Total (For
20 nos)**

• Rs. 1780

**Rs. 89 /-
per bottle**



Sales and Marketing Plans





Future
Requirements

Commercialized
FDM printer

Automated
winding set up

Strategy to
improve
Scalability

Marketing



Acknowledgement

We express our gratitude to our **Chairman Shri. P. SRIRAM** for providing the facility and opportunity through CITIL to present this idea. Our sincere to **Dr. A. RAMESH**, our principal, for the provision of the necessary resources and motivation throughout the period of our project. We extend our heartfelt gratitude to the Head of the Centre for Additive Manufacturing **Dr. ARUNKUMAR** for the valuable resources and guidance provided to us throughout the course of the work. Our sincere gratitude is extended to our project guide **Dr. S. MOHAN KUMAR** who provided us with guidance, and timely suggestions during the entire duration of our work. We would also thank our supporting faculty **Mr. V. MURUGAN** who supported in the extrusion and fabrication of prototype.



Thank You!