

Quick Composter

Objectives:

- To make a compost machine that is quick
- To make compost without odour
- To make a composter that is compact and space efficient
- To make the process user friendly through a machine

Introduction:

Compost is a nutrient-rich organic material formed through the breaking down of organic waste such as food scraps, yard trimmings, and other biodegradable materials. This process is naturally facilitated by microorganisms such as bacteria, fungi, and worms, breaking down the organic matter into a dark, crumbly substance known as humus.

The process can be replaced by the "firing and grinding" method where the natural waste is grinded whilst heated up to a high temperature causing breakdown.

The composting process is rather space intensive, and is either done in a more rural setting or at an industrial scale. Composting in urban areas faces several challenges stemming from limited space, lack of awareness, and logistical constraints. Space constraints often make it difficult for urban residents to allocate sufficient area for composting bins or piles, leading to issues with odor and pests.

Additionally, many urban dwellers may lack knowledge about proper composting techniques, resulting in contamination from non-biodegradable materials or incorrect ratios of green to brown waste. Moreover, the logistical aspect of transporting compostable materials to off-site facilities or managing community composting initiatives can be challenging in densely populated urban environments.

Our solution to this is to design a machine which can replicate the "decomposition" process through Thermo-mechanical process producing compost at the end.

Product Description: [Generalized Form]

The product utilizes a unique "firing and grinding" method to produce compost efficiently and effectively. Organic waste materials are subjected to controlled heating or firing processes, accelerating decomposition and killing pathogens and weed seeds. Once heated, the material undergoes a grinding or shredding phase, breaking it down into smaller particles to further enhance decomposition and facilitate aeration.

This method not only speeds up the composting process but also ensures a more uniform and finely textured end product. The resulting compost is rich in nutrients, free from contaminants, and ready to be used as a valuable soil amendment for gardening,

agriculture, and landscaping applications. Its innovative approach makes it well-suited for urban environments or areas with limited space, offering a convenient solution for sustainable waste management and soil enrichment.

The product in its design should have the following areas of components:

- Heating medium
- Heating area
- Insulating material
- Grinding tool
- Grinding area
- Power outlet
- Control mechanism

Concept Classification Tree:

Based on the structural shape	Based on the number of coils	Based on the position of the process area
<ul style="list-style-type: none">• Rectangular• Cylindrical	<ul style="list-style-type: none">• One• Two• Four	<ul style="list-style-type: none">• Bucket system• Tray system

Concept Combination tree:

Based in the above classifications, we can identify the below combinations:

1. Rectangular-one coil-bucket/tray system
2. Rectangular-two coil-bucket system
3. Rectangular-two coil-tray system
4. Rectangular-four coil-bucket/tray system
5. Cylindrical-one coil-bucket/tray system
6. Cylindrical-two coil-bucket system
7. Cylindrical-two coil-tray system
8. Cylindrical-four coil-bucket/tray system

Design:

We have, from our required broad design requirements, initially designed 5 alternative products. The alternative products are given below:

Concept Selection:

1. We cut all the one coil options since they wouldn't be able to evenly distribute heat and make uneven compost mixture.
2. We cut all of the four coil options since they produce more heat than necessary; also increases both the electricity consumption cost and manufacturing cost.
3. We further got rid of the rectangular models since the compost would fling to the corners and not grind evenly.

The last two options we were left with were:

1. Cylindrical-two coil-tray system
2. Cylindrical-two coil-bucket system

Out of these two, our selection between them came down to these factors:

- Proper heat conductivity
- Proper insulation
- Less hazard
- More user friendly

The *bucket system ranked higher than the tray system* on all these criteria in our design.

Hence: **Cylindrical-two coil-bucket system** is our selected option.

Material list:

1. Stainless Steel plate of 3mm thickness
2. Heating coils
3. Thermo insulation (polyurethane foam)
4. Grinding blade of steel
5. Motor for grinder
6. Cables and power outlet

Material procurement:

1) Steel plate of 3mm thickness.

- For course: Local workshop/hardware store (Madina Market/Bondor)/Daraz

2) Heating coil:

- For course: Local hardware store (Madina Market)/ Daraz

3) Thermo insulation (polyurethane foam)

- For course: Daraz/Local hardware store

4) Grinding blade of steel

- For course: Local hardware store (Madina Market)

5) Motor for grinder

- For course: Local hardware store (Bondor)/Daraz

6) Cables and power outlet

- For course: Local hardware store (SUST gate)

Manufacturing process:

1. The steel plates were cut with the appropriate dimensions as a sheet in its circumferential length and height. (25x8 and 19x6)

2. Two circular plates of 8-inch diameter and another circular plates of 6 inch diameter were cut from the steel plates.

3. The ends (length wise) were welded together to create a circular hollow cylinder. (Twice for two cylinders)

4. The ends of the plates were welded together to the cylinder.

5. Insulating material of 1mm thickness were placed between the two Chambers with cut out spaces for coils, motor and power outlets.

6. The coils, motor and power outlet were all installed one by one with ensuring blades of the inner chamber being able to rotate.

7. The lid was lastly welded with a handlebar on the top of the outer case.

Speculative Market Analysis:

Introducing firing-grinding composter machines into the market presents a promising opportunity poised for substantial growth. Even if 5% of the urban population garden (who have a mean tendency to be of higher-mid class) they would want a machine to solve a problem that inherently plagues them: bringing home compost and nutrient rich fertilizer.

As sustainability also becomes a focal point globally, consumers are increasingly seeking eco-friendly solutions for waste management, particularly in urban areas where space constraints and environmental concerns are pronounced.

By targeting urban gardening enthusiasts, eco-conscious homeowners, and environmentally responsible businesses, the market for composter machines can tap into a niche segment with significant growth potential.

Leveraging compactness, user-friendly system, and efficient composting techniques tailored to urban settings will be crucial in driving adoption.

Competitive Market Cap:

The sale of any composter can depend on various factors such as market demand, production cost and performance. First the prices of composter vary based on size, material and features.

Conducting a market analysis, we found that the prices of our direct competitive composters available in the market are around 30,000-50,000 taka. Some of the composters are even more expensive. We plan to market our product at a 10,000 taka price, which not only would become the cheapest option out there on the market internally, there's also room for expansion in the international markets.

As we are using "firing and grinding" method, the compost will be ready to use after 4 to 5 hours: which is our main selling point for the product since a conventional composter takes up to days to produce compost.

Currently, many of the composters in the market use decomposition technology for making compost. As we aren't using decomposition method, our machine does not produce any odor: another selling point to the customers in urban areas.

Henceforth, customers would purchase composters based on their price, compost preparing time, size and odor-less properties. Considering all these, we are sure that our composter will capture initially push and in a year capture 60% of the market.

Profitability:

Our product's initial cost is valued at a budget around 2500 taka (approximately) (including rise of procurement cost). Since even if we bring this device at an astounding 300% profit margin and a whopping 10,000 taka market price, our closest competitors still can't beat us.

Hence, we'll be making an average of 200% profit markup (deducting holiday sales, retails etc.). If we plan to capture 40% of the gardening market in Dhaka (case study), we could sell units up to 150,000 units per year.

Hence, an annual profit would be: $5000 \times 150,000 = 900,000,000$ taka i.e., 850,000 USD per year.

Current Market Analysis:

From the current market review, we have found out that there is a market demand for composters which would have the following properties:

- space efficient
- quick
- odorless

Composter machines hence forth will gain traction, particularly in urban areas, as residents are embracing gardening and seeking sustainable waste management solutions.

With limited space and a growing interest in urban farming and gardening, compact and efficient composters are in high demand. These machines offer urban dwellers the opportunity to convert kitchen scraps and yard waste into nutrient-rich compost for their gardens, balconies, or community plots.

As urbanization continues and environmental consciousness rises, the market for composter machines tailored to urban gardening needs is expected to see steady growth. Our Quick-Composter would be filling this market demand by introducing a multi-faceted solution.

Specification:

Dimensions:	
1] Outer Chamber:	
Radius	8 inch
Height	8 inch
2] Inner Chamber:	
Radius	6 inch
Height	8 inch
3] Thermo Insulating Layer Thickness	1 mm (circumferential)
Material:	
Outer Surface	Stainless Steel
Inner Surface	Stainless Steel
Thermo insulating Layer	Polyurethane
Blade	Stainless Steel
Power:	600 W
Motor	500 W
Coil	100 (2*50) W
Temperature:	
Outer Surface	35C
Inner Chamber	150C

Here are the key specifications of the Quick Composter:

1. Dimensions:

- Outer Chamber:
 - Radius: 8 inches
 - Height: 8 inches
- Inner Chamber:
 - Radius: 6 inches
 - Height: 8 inches

2. Power: 600 W

3. Required Time: 4-5 hours

4. Temperature:

- The Quick Composter is home compostable, which means it breaks down naturally in moderate heat (between 35C internally) found in home.

Energy Consumption:

Quick composter-approved cycle takes 2 hours to break down food waste and approved bioplastics into an immature compost-like end product.

This mode consumes 0.75 kWh per cycle.

Let,

Number of cycles $n = 6000$ times

So, power transfer $P = n \cdot p' = 6000 \cdot 0.75 = 4500$ KW

Nutrient value of compost:

Carbon: Nitrogen = 30:1

In home made:

High Carbon-

- Mixed paper: (150-200):1
- Newspaper/cardboard: 560:1

High Nitrogen-

- Vegetable scraps – 15:1

Trade-off:

For our composter, there are several trade-offs to consider:

1. Size vs. Capacity: A smaller composter may fit better in your kitchen but may have a lower capacity, requiring more frequent emptying.
2. Odor Control vs. Airflow: Some composters prioritize odor control with airtight seals, but this may impede airflow, potentially slowing down decomposition.
3. Ease of Use vs. Effectiveness: Simple designs may be easier to use but might not provide optimal conditions for composting compared to more complex systems.
4. Cost vs. Features: Higher-end composters may offer features like automatic mixing or filtration systems, but they come at a higher cost.
5. Maintenance vs. Durability: Composters with more moving parts may require more maintenance over time, whereas simpler designs might be more durable but require manual turning of the compost.

Impact:

The impact of using a composter:

1. Reduction of Food Waste: Composting kitchen scraps reduces the amount of food waste sent to landfills, where it would otherwise produce methane, a potent greenhouse gas.
2. Soil Enrichment: Compost is rich in nutrients and organic matter, improving soil health and fertility when added to gardens or landscaping.
3. Reduced Need for Chemical Fertilizers: By providing natural nutrients to plants, compost reduces the need for synthetic fertilizers, which can have negative environmental impacts during production and use.
4. Water Retention: Compost improves soil structure, helping it retain moisture better, which can reduce water usage in gardens and landscapes.
5. Carbon Sequestration: Composting helps sequester carbon from organic materials, mitigating climate change by reducing carbon dioxide emissions.

Conclusion:

A composter can significantly reduce food waste by turning scraps into nutrient-rich compost for plants. It promotes sustainability, reduces landfill waste, and supports a healthier environment. Additionally, it can save money on fertilizers and contribute to an eco-friendlier lifestyle.