

## Compact Wet Waste Decomposer Machine

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**Abstract**— Composting is the biological degradation of organic waste by microorganisms, present in our environment, under suitable conditions. Population living in urban areas is expected to increase from 4 billion to 5.5 billion, from 2006 to 2026, representing 54% and 65% of total world population, respectively. Household wet biodegradable waste (HWBW) forms a major portion of municipal solid waste (MSW) in developing nations that will add more pressure on already overburdened municipal solid waste (MSW) management systems of such cities. It is estimated that around 60 percent of the MSW is biodegradable, even then it is openly dumped, land filled and burnt which causes environmental degradation and harmful disease. Composting is the most appropriate economical solution to overcome this problem of municipal waste management. Its recycling at the source of generation can not only reduce waste transportation costs but also prevent harmful air emissions. This study aims at design of compact compost machine for Indian household kitchen or medium size farming, which is hassle free, with no odours issues and ergonomic in nature. Designed compost machine consists of composting chamber with a grinding blade, attached to shaft propelled by DC motors, air filter setup and a compost collection chamber. Simple mechanism allows the user to maintain cleanliness, operate the machine easily.

**Keywords:** Municipal solid waste (MSW), Household wet biodegradable waste (HWBW), Carbon: Nitrogen (C:N)

### I. INTRODUCTION

Decomposition of organic waste to obtain soil that is rich in humus is known as compost, as food waste produced in India is around 67 million tons per year so by composting, we can manage waste in an efficient way which is hygienic and improve soil quality by adding compost as soil intervention.

These days management of MSW and HWBW is a hard task and issue that the urban settlements are facing. Besides that, handling of waste is a hectic process to carry out. It requires large area, equipments and labor to process. The existing processes to make compost requires long time and the process itself produces harmful gases and awful odours. There is a need to easy these processes to handle organic waste and minimizing the time required and removing the odours. The statistics of MSW generation, land required and population, composition of waste in south Asia and Indian cities' annual waste generation.

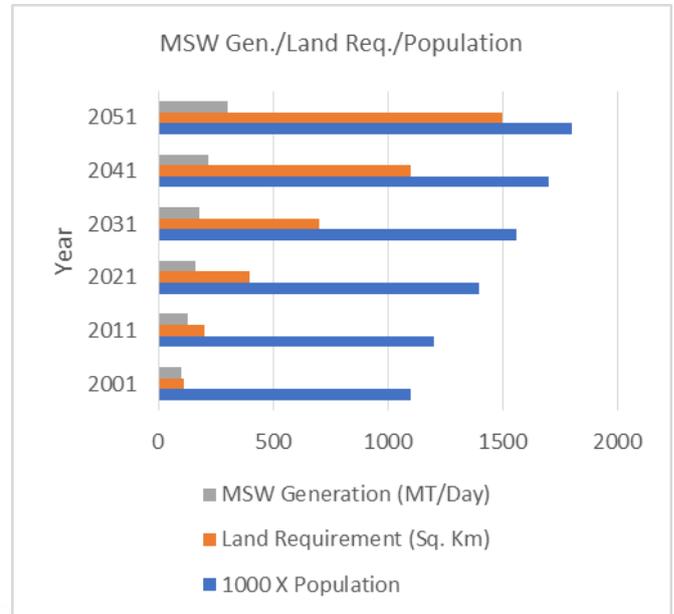


Fig. 1: Graph of MSW Generation /Land Required/ 1000X Population.

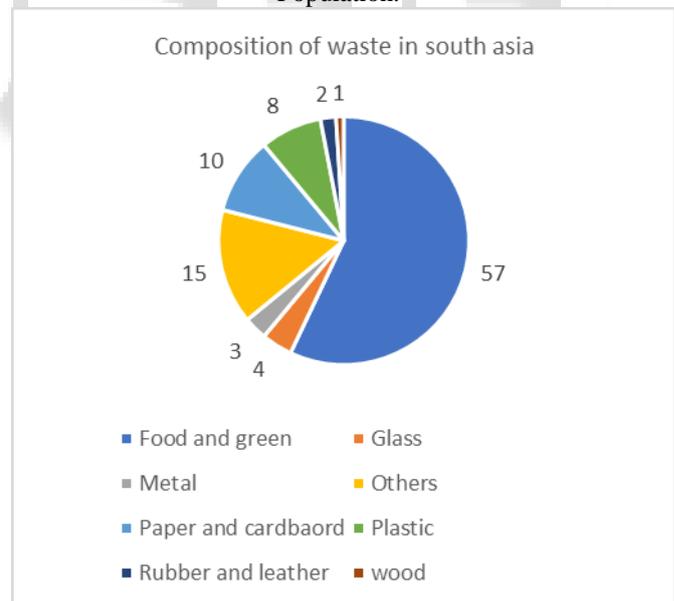


Fig. 2: Pie chart of Composition of waste in south Asia.

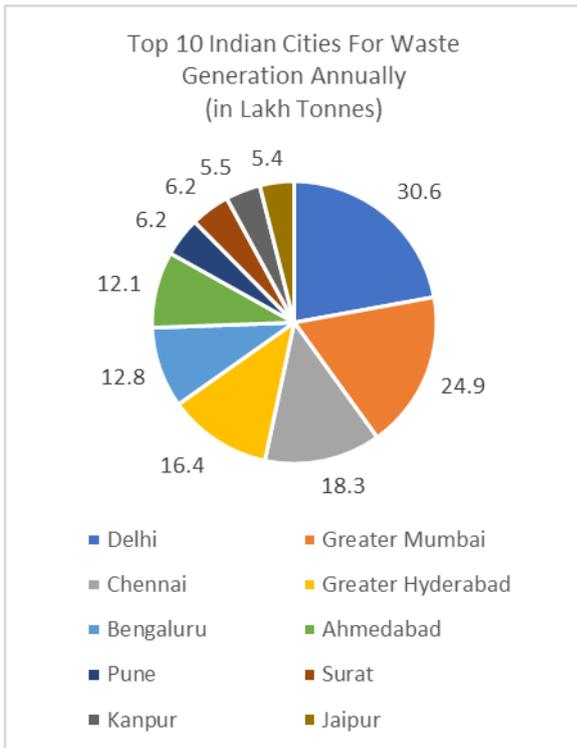


Fig. 3: Pie chart of top 10 Indian cities for waste generation annually

In this study we have wet waste management and composting process. To develop and study the organic waste treatment m/c which can convert to compost or manageable form. Minimising the time required to make the compost, various factors affecting the composting process and selection the materials and components properly.

## II. METHODOLOGY

For this the moisture in the food waste should be around 60-65% and ph. near neutral and temperature an important factor which helps in good growth of microorganisms and evaporates water should range from 35°- 60°celcius, also the waste should be biodegradable, this basically increases organic carbon content in the soil, which reduces issues of landfills. High quality of compost can be obtained through composting, daily household waste such as fruits/ vegetables and its leftover, paper, tissues etc. can be composted.

Sr. No.	Factors	Ranges	References
1	pH	5.5 to 8	[3] [8]
2	Temperature	20-45 degree Celsius	[3] [8]
3	Moisture	40%-60%	[3] [12]
4	Nitrogen	At least 5%	[3] [12]
5	CN ratio	20:1 to 30:1	[3]

			[8]
			[12]

Table 1: Factors and Ranges

Other important aspect is the carbon to nitrogen ratio i.e. (C/N) it should be between 20:1 and 30:1 respectively. The advantage of having a compact vessel for composting is that the speed of composting increases and helps overcoming obstacles such as land requirement which is a scarce resource in some countries such as (Singapore), Odor problem is also solved. Several organic Stabilizing agents such as bacteria, fungi, worms can be used. machine and makes it portable too. A study done by laboratory-scale system shows the effects of using bulk forming agents such as cornstalks and pretreated chemicals such as FeCl<sub>3</sub> leads to reduction of bad odor producing gases (NH<sub>3</sub> and H<sub>2</sub>S).

The results also shows that proper arrangements of aeration and periodically turning the wet waste are necessary to produce a good quality of compost. Also, during this process of composting, increasing the ambient temperature of wet waste for first 48 hours reduces the time for decomposition upto 30 days. Vermicomposting, in which earthworms' breakdown and digest the organic waste. Small scale compost may be used for personal requirement farmers/gardeners can harvest 5-10 tons of vermicomposting annually. Large scale vermicomposting can do at commercial scale by recycling large quantities of organic waste in modern facilities. There are around 3500 types of earthworms classified under burrowing and non- burrowing which is used according to need. Organic waste inserted into Drum , silo, concrete- lined trench this allows good control over environment conditions such as temperature, moisture and airflow, the material is mechanically turned / churned to make sure material is aerated it is done by full hydraulic crawler type turner machine it can handle grease and animal by product , for composting temperature should be at least 40 °C for at least 4 days and a temperature above 55 °C required for at least four hours, Process takes 22 weeks for completion in an open narrow heap in which organic waste is recirculated thoroughly and distributed evenly, composting through this type of natural aeration is highly successful, while the introduction of an air blower found to be successful in supplying oxygen to the compost for better metabolism. This process adds heat and carbon dioxide is released.

Mostly used in village, it uses anaerobic method in which organic waste along with cow dung /animal waste are composed. The biogas contains methane 50- 70%, carbon dioxide 30-40% and other gases. it generates heat and electricity usable for engines, micro turbines, and fuel cells. Biogas limits the amount of methane released into the atmosphere and reduces dependence on fossil fuels. It is used for heat boilers or generates electricity.

We, also studied and created a 2D sketch of the machine using AUTO-CAD software.

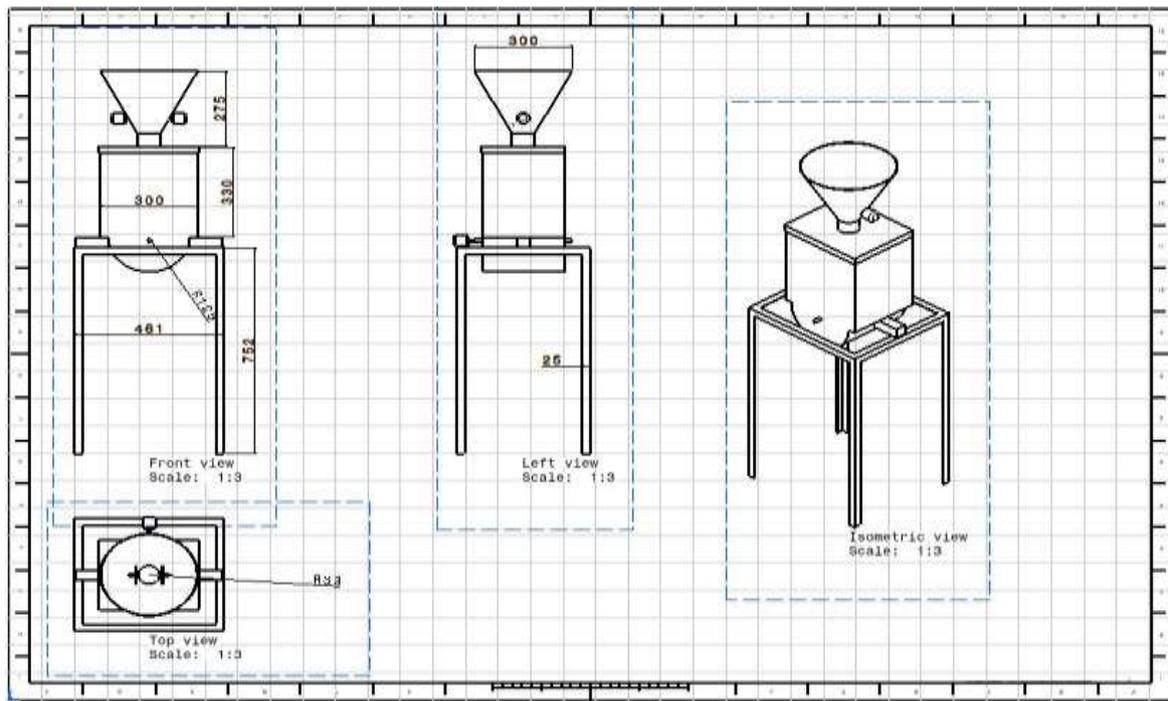


Fig. 4: 2D sketch of the machine

### III. ADDITIVES AND ITS EFFECTS

FeCl<sub>3</sub>: use of this chemical as a pretreatment to the waste is found to be successful in capturing the H<sub>2</sub>S and NH<sub>3</sub> gases which are the main constituents for bad odor in a compost. Neem leaves or Cow dung: a natural and hassle-free method to reduce odor. Disodium phosphate (Na<sub>2</sub>HPO<sub>4</sub>): is a type of soil used in the compost to enhance the phosphorus content

which in turn is beneficial for plant growth. Calcium Carbonate (CaCO<sub>3</sub>): the initial phases of composting decrease the overall pH which can have bad effects for microbes and overall stability. Its use buffers the pH to normal value. Horticulture waste: corn stalks and other livestock stems are used as bulking agents which protects the compost from any phototoxic effects and also enhances the quality of compost.

Sr. No.	Additives	Effects	References
1	Ferric Chloride (FeCl <sub>3</sub> )	Decreases Ammonia (NH <sub>3</sub> ) and hydrogen sulfide (H <sub>2</sub> S)	[6] [3]
2	Disodium phosphate (Na <sub>2</sub> HPO <sub>4</sub> ) Type of salt	Addition of phosphorus is required to increase the positive effect on plant growth of organic fertilizer from food waste	[3]
3	Calcium Carbonate (CaCO <sub>3</sub> )	Controls pH buffering	[3]
4	Neem leaves, Cow dung	Helps reduce odour	[7]
4	Horticulture waste	Improves the bioconversion process and increases the stability of the final product.	[3]
5	Controlled aeration	Helps treating horticultural waste and quick drying of the wet waste	[3]

### IV. CONCLUSION

Based on the study, the compost made is a useful in overcoming the increasing HSBW and MSW. It offers a range of benefits, such as: - Using the compost produced by the machine, organic matter in the soil increases along with humus increases the porosity of the soil which intern increases the water holding capacity of the soil. This helps plants/crops/trees to get better nutrients. Maintains the pH level of soil. Using the FeCl<sub>3</sub>, odor is reduced. This minimizes landfill space and less load on municipal cooperation and hence being economical. The additives are very useful to minimize the time requirement to make compost. Some of

them are also useful for controlling pH, organic growth, increasing stability, helping improving efficiency of overall compost. Additives used and factors which enhances the composting process. This helped us to understand, select proper materials and additives which will economically and effectively help make the compost machine. We were also able to design a 2D CAD sketch of the machine in AUTO-CAD

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