

Development of Solar Kitchen Waste Shredder with Segregation Process

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ABSTRACT: A trend of significant increase in municipal solid waste generation has been recorded worldwide. This has been found due to over population growth rate, industrialization, urbanization and economic growth which have ultimately resulted in increased solid waste generation. Final destination of solid waste in India is disposal. Most urban solid waste in Indian cities and towns is land filled and dumped. Our Project deals with the most blistering topic i.e. waste segregation. An efficacious management needs to be materialized for better planet to live in. Hence, with our cost effective project proposal, we try to bring in the change. It deals with the minimization of blue-collar method utilization for exclusion of waste into an automated panache. An automation of this style not only saves the manual segregators of the numerous health issues, but also proves to be economical to the nation. Besides, this system utilizes low cost components for the successful segregation of most types of waste. When installed in apartments or small colonies, it proves to be beneficial in sorting the waste at the site of disposal itself.

KEYWORDS: segregation, solid waste, waste segregation

I. INTRODUCTION

The urban population has grown at the rate of 19.90% to 34.61% during last two decades. The urban population is increasing at a rate of 3-4% and the rural at the rate of 1-1.5%. One of the main reasons for increase in the urbanization is the migration of rural population into the towns/cities/metropolitan cities for the employment. Urban population (26%) generates 40% of the National Domestic Product (NDP) due to better educational, medical and other infrastructural facilities. We have observed in our daily lives that decomposition of organic materials such as vegetables, fruits, leaves, plants etc. is very natural. Composting is a technique to control and accelerate this natural process. There are many composting methods and techniques available now. We mentioned earlier that through composting we control and accelerate the natural process of decomposition. How do we do this? What happens during composting is, microbes (e.g. microscopic living organisms such as bacteria, fungi – millions of them) feed on and breakdown organic materials. It is best to keep their population high so as to accelerate the composting process because they help faster decomposition. The Philosophy of “Waste management Hierarchy” has been adopted by most industrialized nations as the menu for developing Municipal Solid Waste management strategies. Every city is grappling with the menace of escalating amounts of waste. The situation calls for an efficient system that can sort waste at the primary stage thus making waste management more efficacious and fruitful. Mechanizing such a system is of paramount importance as is clearly indicated in Aidan’s work. We have thus come up with an Automatic waste segregator that categorizes the waste as wet, dry or metal.

II. LITERATURE REVIEW

[1] Fuchigami et al., (1999) described the methane fermentation from night soil sludge and kitchen waste mixture. They developed a new treatment process called the RENAISSA system that treated a mixture of night soil sludge and kitchen waste under anaerobic conditions. The system produced energy and compost for agricultural use. A considerable volume of methane gas was generated for the amount of introduced VTS - a minimum of 0.5 Nm³/kg-

VTS. The two-stage fermentation system designed in-house exhibited satisfactory processing performance. Compost produced from the residue of the methane fermentation process exhibited a superior fertilizer effect compared to the dried somatic cell fertilizer employed as the control.

[2] Chang and Hsu (2008) explained the effects of compositions on food waste composting. The objective of this work was to provide a method of predicting important parameters (composting time, highest temperature, final and lowest pH values, cumulative CO₂ evolution, and percentages of material losses) that characterized the composting process of synthetic food waste in terms of weight fractions of protein and fat. Experimental results showed that the final products of all 12 experimental runs passed multiple maturity tests. Quadratic equations by the multiregression analysis were also developed for quick estimation. The models were tested for real kitchen waste and the agreements between experimental and predicted results were fair. Quantitative models developed in this work are limited within the composition ranges and properties of synthetic food waste.

[3] Vipin Upadhyay, Jethoo A. S, Poona M. P, (March 2012) studied solid waste collection and segregation: to implement proper waste management, various aspects have to be considered such as: source reduction, onsite storage, collection and transfer, Processing, and Disposal. Solid waste may be defined as generation of undesirable substances which is left after they are used once. They cannot be reused directly by the society for its welfare because some of them may be hazardous for human health. Covering of various vegetables, fruits and cooked material facilitate proliferation of various group of microbial flora, which may be pathogens. The solid Waste management appears to be inadequate and needs upgradation. The solid waste has to be disposed of scientifically through sanitary landfill and recyclable portion of the waste should be salvaged. Segregation of recyclable material would also leads to reduction in quantity of solid waste for final disposal.

[4] Murlidhar gangwani, (2019) - "a comprehensive study on waste segregation techniques": In this research paper author studied that various ideas proposed for proper waste segregation. Since a stabilized system is needed for preventing harm caused to the environment due to improper disposal. The study shows that mainly IoT based techniques are mostly used for waste segregation but the cost of implementing IoT based system is very high. To make a cost-effective solution, Artificial Intelligence and Machine Learning based system can be developed for automating the process of waste segregation with maximum efficiency and low cost.

[5] Ashish a. Mishra, (Jan 2014) - "solid waste management": In this research paper author studied the waste disposal system of yavatmal where waste disposal is done by two methods which are composting and landfilling. Composting:- It is done by vermin composting of any type of biodegradable wastes such as hotel refuse, biodegradable portion from residence and commercial market, vegetable waste, leaf litter, etc. Size of each vermin composting rack is 6.12 m X 1.52 m X 0.6 m made up of steel. It requires two month. Land filling:-Waste is stored on the top of the hill in 5 acres area. All inorganic material is used for the land filling and dumping. This research shows that the maximum proportion of refuse caused by food and garden wastes, proportion of the reuse caused by food and garden wastes, second highest was paper and the third highest was inert material. Percentage of Plastic carry bags was higher, where glass, ceramic and metals were nearly equal with each other.

Findings from literature review and scope:

The various study on waste shredders was done. Here in some papers they have developed the waste shredders which can separated the dry and wet waste. Also in some paper the authors had written about the waste composting. After studying the above papers it is found that very less work is done on waste shredders which separates the waste as wet dry and metal at lower costs. In our paper we are doing the same.

Problem Definition:

The food wasted took resources to make. It used up huge amounts of water, land, and fertilizer only to be tossed in a landfill. The food in landfills decomposes and emits methane, a poisonous greenhouse gas. Food waste is a huge problem, but it is possible to cut it down for the economy and the environment.

The workers get frustrated while separating the food waste as it makes more Adour smell.

The food waste also consumes more space if it is not managed properly.

Managing waste requires more workers at different stages which increases the labour cost.

III. OBJECTIVES

To study the waste generation in various sources like hotels, household etc.

To design and develop portable operated shredder

To design and develop segregation system

To separate solid waste for shredding process



IV. METHODOLOGY ADOPTED FOR THE STUDY

- a) To identify types of kitchen waste to shred
- b) To determine the physical characteristics of kitchen waste
- c) To design and develop portable operated shredder
- d) To design and develop segregation system
- e) Actual fabrication of prototype and installation of prototype.
- f) Validation, Trials and Performance Testing of prototype. Required necessary changes in prototype. Final testing of prototype.

V. MARKET SURVEY

Thus to achieve our goals we have studied various waste generating sources. The data is tabulated below:

Sr No.	PLACE	DATE	PEOPLE	WASTE PER DAY (Kg)
1	Kisan Hotel Kolhapur	25/7/2019	270	40.5
2	House	26/7/2019	6	3.6
3	Haripriya Complex	30/7/2019	64	28.8
4	Govind Mess Kolhapur	3/12/2019	60	24

This wastage increases as per persons.

We also studied the following issues in each of waste generating sources and concluded to shredder this waste so we can use this for various applications according to the waste, the wet waste can be used in biogas plants while the plastics and other recyclable materials can be reused.

Segregation of waste:

The waste dumped in community bins is a mixed type of waste, i.e. all types of waste biodegradable, recyclable, inert & non- biodegradable waste is found in one bin, which become very hard to manage. Following table shows Variety of waste material generally found in a dustbin.

Frequency & efficiency in waste collection:

In most of the cities, waste collection occurs as often as once per day. But areas with a high density of small retail shops, slaughter houses, meat, fish and vegetable markets, hotels, restaurants & urban areas where storage space is limited, Community bins regularly overflows due to heavy dumping of the waste. The frequency of collection and transportation of wastes is not satisfactory in those areas. There is lack of adequate number of containers on each street corner, at several places of densely populated street. The slum and pavement dwellers do not have access to proper services and hence dispose their waste in the public spaces like roads, drains or railway tracks. Hawkers contribute to littering of roads. Community bins are not properly placed or not at a point on the edge of a region which is easy to use & accessible to both generators and collection vehicles.

Man force:

Solid waste management involves number of labourers in different stages, right from collection to disposal of waste. Those labourers are generally not fully trained about the proper procedure, information regarding equipment's, use & maintenance of equipment. They are also unaware about the health hazards caused by unhygienic handling of waste. Lack of education and training severely limits collection and transfer services in the cities. The lack of coordination and overlapping of responsibility among agencies and different levels of local governing bodies involved in waste management also contribute to the problem.

Equipment's:

In most of the cities, the design, location and capacity of community bins is not appropriate both in terms of population they serve and quantity of waste generated in the area of their location. Further the provided bins are not in proper working condition. Damaged Community bins or open Community bins attract the stray animals in search of food, which result in the messy place around the bin & cause severe health hazards.



Impacts:

Direct handling of solid waste can result in various types of infectious and chronic diseases, with the waste workers and the rag pickers, being the most vulnerable. There are some occupational hazards associated with waste handling like Skin and blood infections resulting from direct contact with waste, and from infected wounds. Eye and respiratory infections resulting from exposure to infected dust. Cause infectious diseases that are transmitted by flies feeding on the waste & some chronic diseases like cancers resulting from exposure to dust and hazardous compounds. Some accidents like chemical burns also occur. The unhygienic use and disposal of plastics and its effects on human health has also become a matter of concern. Colour plastics are harmful as their pigment contains heavy metals that are highly toxic. Some of the harmful metals found in plastics are copper, lead, chromium, cobalt, selenium, and cadmium. Stray animals eat vegetable, food material along with plastic carry bags, which are used for dumping. Through this heavy metals enters in food chain. Improper waste dumping also leads to Soil Pollution, Water Pollution, and contamination of foods. It also increases the Propagation of flies.

VI. DESIGN OF SHREDDER

The components of the project are listed below

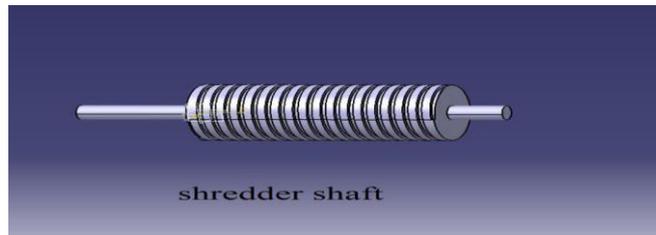
- └ Hopper
- └ Rack & Pinion
- └ Permanent Magnet
- └ Blower (DC Fan)
- └ Arduino
- └ Arduino expansion Shield
- └ Motor Driver
- └ IR Sensor
- └ Conveyor Belt
- └ PVC pipe roller
- └ DC Motor (12 Volt)
- └ Relay

The materials used for the fabrication of kitchen waste shredder, the quantity and cost of materials used are presented in Appendix I. The materials used were M.S. sheet, M.S. angle (L), M.S. shaft (EN-8), bearings, cylinder, pulley, motor and other miscellaneous materials.

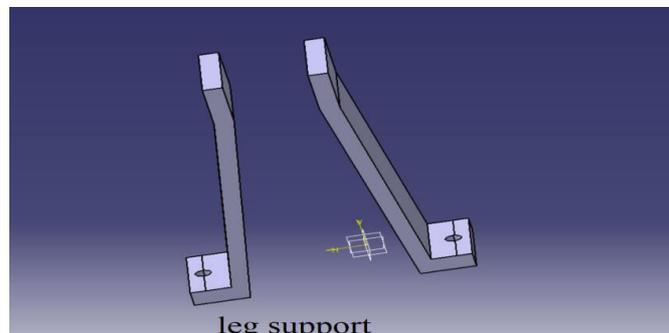
COMPONENTS	MATERIAL
Inner Cylinder	M.S Sheet
Hopper	Mild Steel
Outer Shell	Mild Steel
Dc Motor	Low Rpm
Solar Panel	36 Cell
Power Supply	12 V And 7 Amps.
Inner Cylinder	M.S Sheet
Charge Controller	12 V
Shaft	M.S.
Bearing	6004

Shaft:

- Diameter of shaft: 19mm
- Diameter of outer cylinder=65mm
- Diameter of inner cylinder=85mm
- Height of weld=5mm
- Clearance between weld & inner cylinder=5mm
- Threads are made by,
- Electric arc welding with pitch=10mm
- Depth of threads=5mm
- No. of strip fitted on shaft=7strips
- Distance between two strip=150mm

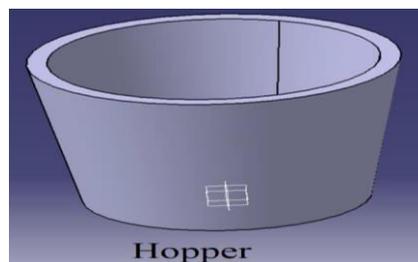


Dimensions of leg:
Height of legs=200mm
Width of leg=50mm
Length of leg=600mm
Thickness=6mm



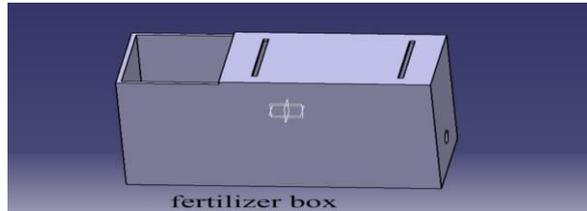
Bearing dimensions:
Outer diameter of shaft=19mm
 $P = 60 \times 60 \times 10106$
 $P = 60 \times 60 \times 30000106$
 $L10 = 108 \text{ mill. rev}$
 $C = P \times (L10)^{1/3}$
 $C = 1800.63 \times (108)^{1/3}$
 $C = 8574.96 \text{ N}$
Bearing no. is 6004 selected.
Quantity = 2no.
Outer diameter of bearing = 42mm
Width = 10mm

Hopper:
170mm length of sheet metal with 6mm thickness.

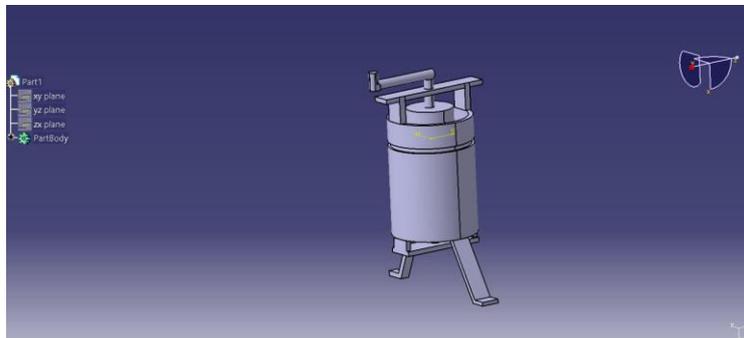


Dimensions of box:
Length of box=600mm
Width of box=300mm
Height of box=450mm
Shaft=20mm
No. of strips fitted on shaft=7strips

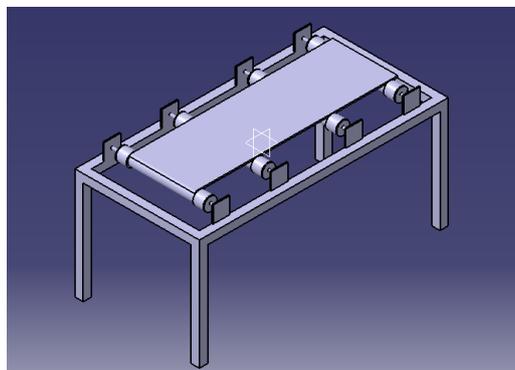
Distance between two strips=150mm
Quantity of soil= 35% of volume of box
Quantity of waste= 30% of volume of box
Space for area= 35% of volume of box



Assembly of Waste shredder



Assembly of Conveyor for passing the waste.



After Fabrication Project:



VII. CONCLUSION

- a) The automatic segregation helps reduce the physical complicated work of separating different types of wastes
- b) Efficiency of work increases due to less need of man force
- c) Only needed waste such as solid waste is used for shredding separating remaining waste.
- d) The kitchen waste shredder is used to reduce methane emission.

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