

## Experimental Study on Waste Shredder

**Omkumar C S<sup>1</sup>, MuthuKumar K<sup>2</sup>**

<sup>1</sup>PG Student, <sup>2</sup>Professor,

Department of Mechanical Engineering,

Bannari Amman Institute of Technology, Coimbatore, Tamil Nadu

Email: [omkumar.is18@bitsathy.ac.in](mailto:omkumar.is18@bitsathy.ac.in)

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### Abstract

*Mechanical systems are used in non-biological systems and heat to remove water and to reduce the volume and weight of the waste food. The water content from the food is removed by means of grinding food waste through shredders producing a semi solid product with the presence of coffee ground. This can also be sent to further processing or used as a feedstock. In order to breakdown food waste into small range of particles to make it a useful biomass product we use dehydrators. Thus, after testing its proven that it can be used directly on soil to increase the fertility rate as well as it is used as a compost feedstock.*

**Keywords:** Food shredder, 6 blade, 3 blade

### INTRODUCTION

In-vessel dry composters are a high-tech form of conventional composting, making use of carefully managed mixing, aeration, temperature and moisture to boost up the herbal decomposition process. A few systems require the addition of a patented combo of micro-organisms or nutrients to characteristic. Processing time varies from 14 days at the high give up to simply 24 hours on the decrease end. At the same time as producers claim those structures produce soil-equipped compost, in a few cases the output of these machines has been located to want in addition remedy earlier than its miles soil-gear up. Testing is suggested prior to soil application.

Wet systems grind waste from food and mix it with water and patented micro-organism or nutrient mixes. This accelerates the decomposition system, causing most of the meals waste to turn into a liquid effluent this is discharged into the municipal wastewater device. While producers declare that this effluent is

secure as discharge, some sewer districts are reluctant to permit their use. Independent exams have indicated ranges of biochemical oxygen demand that exceed most municipal wastewater standards. Establishments must talk over with their local wastewater district before thinking about use of this sort of system. This report identifies considerations for institutions exploring on-site systems:

Calculate return on funding primarily based on contemporary waste hauling fees and the electricity, water and sewer use of the specific gadget.

Calculate bodily area and utility necessities of the gadget.

Conduct a waste audit to assist institutions understand their waste profile and develop structures to ensure that “natural” Food waste is to be had for the on-site system.

Take into account in all likelihood factors of failure of an on-site machine and increase contingency plans.

Decide how the cease fabricated from on-site page systems might be controlled with a watch to preparing it for useful reuse.

## AIM OF THE STUDY

### WASTE MANAGEMENT 1:NON BIOLOGICAL VOLUME/WEIGHT REDUCTION

A non-organic volume/weight reduction technique to managing food waste is based on mechanical procedures and warmth to lessen the quantity of meals and other meals-provider waste (such as some non-organics) by way of doing away with water, which makes up the bulk of natural waste by way of extent.

These systems can be broken down into two broad types:

**Pulpers and Shredders:** Waste pulping systems first lessen the waste to slurry, which includes often water, and then do away with the water to create a semi-dry waste pulp of a consistency just like coarse espresso grounds. Shredders grind the waste and then press out the water content material, without lowering to slurry. volume and weight discounts range but are normally between 80 and ninety percentage. in addition to food waste, those structures can generally be given different organic and inorganic wastes such as cardboard, paper, Styrofoam and plastic flatware. however, the inclusion of inorganic waste might render the output of the device contaminated and improper for composting at most centers. those types of systems are typically set up in a food processing area or dish room, even though some structures permit the water extraction unit to be placed remotely. The output of these structures is not solid for lengthy-time period storage and should be refrigerated or amassed frequently to prevent odors and pests.

Dehydration structures use heat to process organic wastes right into a sterile, odorless organic fabric with the consistency of sawdust. This form of machine can be combined with a pulping machine to create more general waste extent reduction and

maximize dehydrator ability. those systems are commonly no longer designed to process inorganic waste. The dehydrated output of those machines isn't always compost and requires similarly remedy before it may be used as a fertilizer.

### Technical Overview of Shredder Systems

The shredder manufactures an extensive line food-waste quantity reduction systems which might be widely used in Massachusetts. This product line consists of pulpers, shredders, and dehydrators. This section presents an in-depth examine those structures, observed through an outline of a few other systems available on the market.

Shredder systems reduce meals waste to slurry of 95 percent water and 5 percentage solids. This aggregate is fed thru a separate unit called a Bio fuel, in which maximum of the water is spun out and fed again into the pulper for re-use. Semi-dewatered, pulped meals waste is discharged from the machine, generating a roughly eight-to-1 discount in volume. in addition to food waste, those structures are capable of processing a spread of compostable and non-compostable materials such as plastic flatware, paper and cardboard, Styrofoam, and aluminum foil. Pulped food waste can both be hauled off-web page or used as a feedstock for a dehydrator, composter or different on-website device for similarly weight and volume reductions.

Shredders are available in a ramification of sizes and configurations and may fit many one of a kind stop-consumer space and capacity requirements. near-coupled devices combine the pulper and the Biogas right into a unmarried unit, saving area, money and strength. far flung pulping systems offer more flexibility by way of permitting the pulping unit and the Biogas

to be separated by way of as much as several hundred yards, allowing multiple pulping unit to be linked to a single Biogas, and allowing the devices to be placed on specific flooring of a building. Pulping units are available sizes: one capable of handling 1,000 Kgs of waste according to hour and a bigger unit able to handling 1,250 Kgs of waste consistent with hour. due to its large tank quantity and slicing mechanism, the bigger-sized pulper is often endorsed for non-meals waste including plastic or Styrofoam. The agency also gives smaller table-installed pulping devices with capacities of approximately four hundred Kgs per hour. Standalone Biogas units have capacities of one thousand Kilograms according to hour and 3,000 Kgs in step with hour and may be attached to a couple of pulpers. due to the huge number of viable configurations, the enterprise prefers to have its engineers evaluation the layout drawings for a undertaking and endorse the ideal size of device to the give up person.

The shredder is similar to a pulping device but does now not reduce the waste to slurry. The system is able to processing a throughput of as much as 5 Kilograms of waste, both meals waste and other disposables, and is usually recommended for small- to medium-sized facilities. This waste is shredded after which pressed to put off water, main to a quantity discount of up to 8-to-1, and discharged into a rubbish can. The shredder has the advantage of decreased water and strength consumption compared to a traditional pulper, but is best to be had in a uncoupled configuration and can not be decoupled as the pulping structures can.

The biogas unit can take delivery of either pulped or un-pulped waste, and uses temperatures of up to 180° F to break it down right into a dry, sterile, odorless biomass with the consistency of sawdust. The manufacturer claims that this machine

produces a roughly 90 percent discount in weight and 70 to 90 percent reduction in quantity. If coupled with a Shredder pulping device, the company claims a total extent and weight loss of ninety five percentage is viable. The device is has a rated capacity of eleven to fifteen Kgs according to cycle, which the business enterprise claims can be elevated by means of up to 8 instances by way of strolling the waste via a pulping machine first. Cycle times range with the composition of the enter and are expected to be among 1 and 2 hours. The output of this device is classed as “sterile biomass” in place of compost. It calls for overtime to break down earlier than it is able to be used as fertilizer. whilst the company claims the end product is appropriate for use as a soil amendment, extra testing have to be completed earlier than soil utility.

#### **Factor: Water and Drainage**

Storage and disposal of pulped meals waste in contrast to the output of different structures, this product is still recognizably meals waste. If not stored nicely—underneath refrigeration and in nicely-sealed boxes—it is able to create odors and entice pests. Pulped food waste isn't compost and needs to be further processed before it is ready for any form of useful application. because it has not been broken down biologically, pulped meals waste will generate methane emissions if despatched to landfill. institutions interested by using waste pulping have to cautiously bear in mind their garage and disposal options for pulped meals waste. institutions interested by enhancing their environmental profile have to take into account the use of other on-website online systems or off-website composting to put together pulped meals waste for beneficial re-use.

Residences of dehydrated food waste producers claim that dehydrated food waste can be used as a soil amendment.

however, evaluation of the rehydrated output of a Shredder dehydrator suggests that this could not be the case. when rehydrated, the gadget's output initially had a low pH and experienced an initial spike in temperature. Of extra subject, the material experienced rapid fungal increase, soon protecting the whole sample. those results led the Loyola Marymount crew to conclude that the dehydrated product was not suitable to be used as a soil modification without additional processing. whilst similarly studies into the properties and uses of dehydrated food waste is needed, it's miles critical to restate that this fabric isn't biologically decomposed sufficient to be considered compost. institutions considering use of this product as a soil modification must have their output very well examined to make certain that it's miles in truth suitable for this application.

### **Waste Management System 2: Composting and In-Vessel Dry Composters**

Composting is a biological method the use of heat and oxygen to break down and remodel organic material into a nutrient-wealthy product. Compost, the stop product, is commonly used as mulch or conditioner to enrich the soil's standard structure. when properly used and applied, compost enables lessen erosion, enhance and stabilize the pH balance of soil, supply beneficial microorganisms and enhance ordinary moisture retention. There are a number of composting practices ranging from low to excessive era. some of the typically recognized methods on the low-tech give up of the spectrum are: Windrow composting, static piles and separated containers of compost with guide blending and aeration. For the purpose of this record, this segment makes a speciality of in-vessel, dry composting structures and technology for on-web page, industrial use.

For the institutions impacted by means of DEP's waste ban, onsite processing is a feasible fee-effective opportunity to modern-day waste control practices which include landfill and incineration. In-vessel, dry composters are enclosed packing containers that variety from small packing containers to bath grinders to massive vertical structures. The huge in-vessel composters are ideal for high-quantity, high-capability use and require advanced or excessive technology. regardless of the man or woman design, those systems commonly employ the identical concepts and practices. easy, separated organic waste including vegetables, egg shells and espresso grounds, is loaded into the vessel. Air is then eliminated although a air flow gadget, which inspires oxygenation of the waste. If the waste is specifically wet, a bulking agent additionally called 'brown count', might be wanted; not unusual sorts of brown remember are woodchips, compostable papers and sawdust. those herbal, porous substances take in extra moisture in the vessel and assist provide basic shape to the waste at some stage in the decomposition section. For the commercial composters available on the market, warmth and microorganisms are normally delivered to kill bacteria and pathogens. This level is accompanied by a cooling and curing duration. In maximum commercial composters, automated structures aerate and rotate the waste at some stage in the decomposition method. The quit product is pasteurized compost or mulch that need to be tested and in a few instances treated to make sure it's far secure for use and application.

Processing waste into usable compost extends has numerous advantages. On the bigger, environmental degree, it extends landfill life, minimizes greenhouse gasoline emissions, conserves natural assets and outcomes in an environmentally beneficial cease product. As such, composting is one of the 'complete circle'

or ‘zero waste’ waste discount practices that measurably minimizes environmental effect. greater than the environmental advantages, however, processing waste into compost will reduce the general quantity and allow establishments to comply with the waste ban.

### **Possible Points of Failure**

It's miles important to pick out feasible points of failure; each in individual portions of equipment and in an organization's food waste control device as an entire, and develop contingency plans for the way to deal with anticipated troubles. possible points of failure encompass the unintended creation of improper items inflicting gadget downtime, electrical or plumbing disasters, odors or vermin associated both to the gadget itself or the garage of meals waste, and the opportunity of the unique manufacturer going out of business. The latter can be a concern especially for systems that rely on patented, proprietary mixes of micro-organisms or enzymes, for which there won't be equipped substitutes if the manufacturer goes out of business. establishments need to carefully examine their exposure and tolerance to these sorts of dangers before committing to a given system.

### **Institutional Waste Profile**

It's miles essential to remember how your group generates food waste in thinking about the suitability of on-web site food waste control alternatives. most on-web site systems (as well as composting centers) require a “clean” flow of compostable natural waste. The presence of even small amounts of contaminants inclusive of plastic flatware or cups can reason device to fail or render a batch infected and mistaken for beneficial use. Controlling the purity of the organic waste flow can be easier for “returned-of-house” waste (which requires body of workers education) than for “the front-of-

residence” waste (which is predicated on consumers understanding the system and doing the proper thing). preserving a “smooth” flow of organic waste from “the front-of-residence” settings may additionally require massive client schooling, signage, and measures which include switching to compostable plates, cups and flatware. know-how your group's waste profile by way of engaging in a waste audit (both internally or externally) can be a useful step in considering the feasibility of those systems.

### **Disposition of cease Product**

A prime consideration is what will be accomplished with the cease product. If it's far to be hauled off-web page for processing, preparations will need to be made for storage and pickup. If pulping/shredding systems are used by myself, pickups will need to be frequent and potential problems with odors and vermin will need to be taken into consideration when putting in place garage. structures that create a solid cease product can also require much less frequent pickups, however the cease product will want to be stored in a dry area. If the give up product is for use for landscaping or gardening purposes on-site, it is critical to conduct trying out to determine the most suitable use of the product and to assess the level of demand for this product on-web site. If the product is to be bought or given away as a fertilizer, assessing the marketplace and constructing relationships with capacity buyers or takers will also be critical.

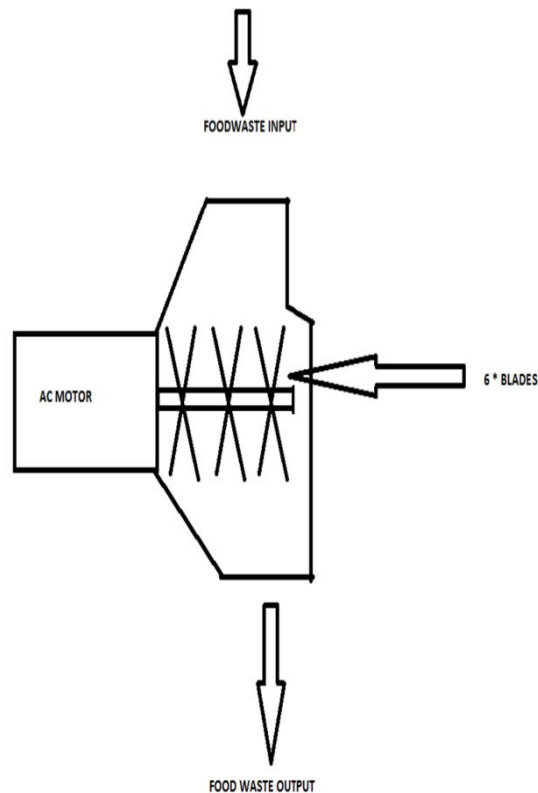
For structures that discharge effluent into the wastewater gadget, it's miles crucial to discuss with the nearby wastewater district to make sure that the effluent meets standards for BOD and other pollutants. a few cities, consisting of Boston, are reluctant to permit the release of organic effluent into their sewer systems. at the same time as manufacturers and vendors



normally claim that their products do now not pose issues for municipal wastewater structures, our studies suggests that in some instances these claims are inaccurate.

institutions thinking about those structures ought to searching for independent evaluation to assist claims made with the aid of manufacturers and providers.

## DESIGN LAYOUT



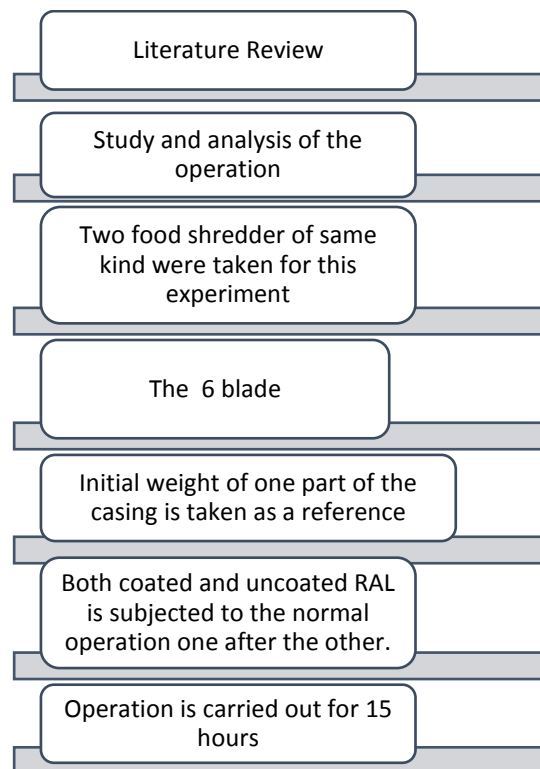
**Figure 1:** Design layout.

**Table 1:** Material selection.

S. NO	NAME	MATERIALS
1.	Ac Motor	Cast Iron
2.	Blade	Stainless Steel
3.	Nut & Bolt	Mild Steel
4.	Connecting Rod	Mild Steel
5.	Motor Support	Cast Iron
6.	Housing	Stainless Steel
7.	Exhaust	Plastic

**Table 2:** Specifications.

S. NO	NAME	DETAILS
1.	Ac Motor	1.5 HP
2.	Exhaust	R7cm
3.	Nut & Bolt	M8
4.	Connecting Rod	27cm
5.	Motor Support	450 X 150 X 6mm
6.	Horiz.&Vertical Arm	50 X 25 X 0.5cm
7.	Blade	6 x 10cm



**Figure 2: Methodology.**

### Construction and Working

The development and/or demolition of clearly each construction project generates waste material that requires recycling or disposal. Shredders procedure scrap and salvage material together with food waste like boiled ingredients, bones, egg shells, and many others. Green waste and other bulky, heavy material to a consistency this is greater efficient for disposal and / or recycling. Production and demolition waste require extremely durable shredders with the potential to shred a spread of materials with a wide range of densities and bulk. Big volumes of scrap wood and different recyclables require a shredder designed specially to handle production and demolition particles. Rotary Waste Shredder is designed to deal with heavy masses of construction and demolition waste material, processing the debris quick and efficiently manufactured with inexpensive replaceable slicing inserts, the waste shredder reduces waste building

materials that stem from construction and demolition projects price-correctly.

### Design Calculation

#### Motor selection calculation

$$\text{Power} = 2\pi NT / 60$$

Where,

N = Speed in rpm,

T = Torque in N-m,

P = Power in watts.

#### Torque calculation

$$\text{Torque} = \text{Load} \times \text{perpendicular distance}$$

#### Load calculation

$$\text{Input} = 2\text{kg}$$

$$\text{Supporting Arm} = 0.3\text{kg}$$

$$\text{Connecting rod} = 0.5\text{kg}$$

$$\text{Support} = 0.7\text{kg}$$

$$\text{Total} = 3.5\text{kg}$$

#### Distance

$$\text{Motor Speed} = 1,500 \text{ rpm}$$

$$\text{Therefore, Power} = 2\pi \times 1500 \times 2 / 60$$

$$P = 314\text{W}.$$

Therefore, 314 W power and 2 N-m is required to the motor at load condition.

### **Fabrication Techniques**

#### ***Welding***

Welding is a fabrication or sculptural technique that joins materials, commonly metals or thermoplastics, via inflicting coalescence. This is regularly completed by melting the work portions and adding a filler fabric to form a pool of molten cloth (the weld pool) that cools to end up a robust joint, with pressure from time to time used at the side of warmth, or via itself, to produce the weld. That is in contrast with soldering and brazing, which contain melting a decrease-melting-factor material between the paintings pieces to shape a bond among them, without melting the paintings pieces.

#### ***Drilling***

Drilling is a cutting procedure that uses a drill bit to cut or make bigger a hollow of circular cross-phase in solid fabric. The drill bit is a rotary reducing device, frequently multipoint. The bit is pressed in opposition to the paintings piece and circled at prices from hundreds to heaps of revolution per minute. This forces the slicing edge against the work piece, cutting off chips from the hollow as it is drilled.

#### ***Bending***

When sheet metallic is bent, it stretches in length. The bend deduction is the amount the sheet steel will stretch whilst bent as measured from the outside edges of the bend. The bend radius refers back to the inside radius. The fashioned bend radius depends upon the dies used, the material homes, and the fabric thickness.

### ***Advantages***

- Less expensive and powerful
- Green initiative.
- No pollutants
- Initial price is low
- Quite simple in construction

- Power intake is low
- Unskilled worker can operate without problems

### **RESULT**

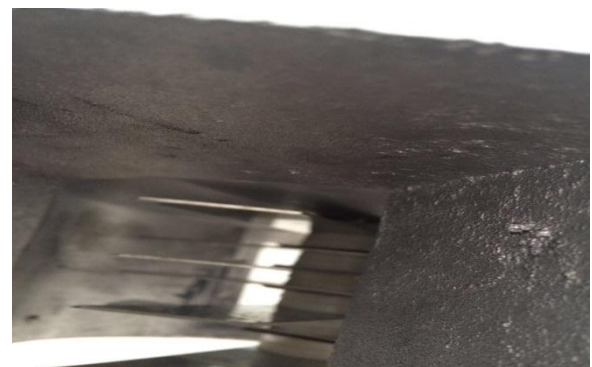
Thus, the food waste shredder machine is designed and fabricated under successful manner and performed with a real time application.



***Figure 3: Real time working mode.1***



***Figure 4: Blade front view.***



***Figure 5: Food waste input***





**Figure 6:** side of the waste shredder.

## CONCLUSION

On-site food waste systems are alternatives to landfill disposal and can facilitate compliance with the proposed waste ban. These systems can be used as an alternative or a complement to off-site composting of food waste. While interviews with staff at facilities using these technologies indicate general success at reducing the volume and weight of food waste generated, a number of potential concerns also came to light. Many of these systems are relatively new to the market and have not been thoroughly tested. While our findings suggest that they can be a valuable component of an institutional food waste management program, they also point to the need for careful planning and due diligence prior to purchase.

## REFERENCES

1. Prof. S.Nithyananth, (2014), "Design of Waste Shredder Machine", *Mechanism and Machine Theory* 80, pp. 1–16.
2. Kurmi.R.S., J.K.Gupta (2012), "Theory of machines", *S. Chand & Company Ltd.*
3. Prof. A.A. Deshpande (2014), "Design and Fabrication of Portable Organic Waste Chopping Machine to Obtain Compost", A review.
4. P.B.Khope and J.P.Modak (2013), "Design of experimental set-up for establishing empirical relationship for chaff cutter.
5. Energized by human powered flywheel motor", *Journal of Agricultural Technology* Volume 9, Issue 4, pp. 779–791.
6. Ajinkya S.Hande et al. (December 2014), "Methodology For Design & Fabrication of Portable Organic Waste Chopping Machine To Obtain Compost -A Review", *IJIRST – International Journal for Innovative Research in Science & Technology* Volume 1, Issue 7, ISSN (online): 2349-6010.
7. Krishna Naik et al. (July 2014), "Design and fabrication of Areca fiber extraction Machine", *International Journal of Emerging Technology and Advanced Engineering* ISSN 2250-2459, ISO 9001:2008 Certified Journal, Volume 4, Issue 7.
8. Y. Prashanth et al. (April 2014), "Design and Development of Coconut Fiber Extraction Machine "Department of Design, M. S. Ramaiah School of Advanced Studies, Bangalore- 560 058Volume 13, Issue 1.
9. S.Nithyananth, Libin Samuel et al (March 2014), "Design of Waste Shredder Machine", *Int. Journal of Engineering Research and Applications* ISSN : 2248-9622, Volume 4, Issue 3 (Version 1), pp. 487–491
10. Doctoral Thesis Machining Properties of Wood: Tool Wear, Cutting Force and Tensioning of Blades Luis Cristovao.
11. P B Khope, J P Modak, "Design of experimental set-up for establishing empirical relationship for chop cutter energized by human power".

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