© 2017 IJSRST | Volume 3 | Issue 6 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

A Novel Approach to Food Waste Management

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ABSTRACT

The present study evaluates the problems associated with the solid waste management. For better processing of garbage the waste disposal machine was fabricated. The garbage processing unit developed intends to reduce the size and dry the final product there by reducing problems of disposing the garbage. A prototype model was designed and fabricated which consists of dewatering unit, size reduction unit and heating unit. The benefit of model is ease of handling of garbage due to reduction in mass, resulting in reduced handling costs. Moreover drying prevents microbial growth and disintegrates the food waste. The present study identified the parameter necessary to shorten the time to reach the thermophilic temperatures and this technology was evaluated under batch flow operating conditions. The food waste was collected and was operated mechanically using the food waste processing machine. The laboratory analysis was carried out and the process was optimized the temperature at 100°C with the retention time of 90 minutes. The dewatering process helped in the reducing the time and temperature required for the drying of garbage. The results showed reduction in moisture content of food waste after treatment. The food waste processing machine achieved volume reduction efficiency of 85-90%. From this study, it appears that the use of this fabricated machine may be viable alternative for food waste disposal.

Keywords: Fabrication, Processing, Disposal, Disintegration, Thermophilic

I. INTRODUCTION

Introduction of harmful substances into the environment is pollution. The waste which is left unused and not used as source anymore called as solid waste (SW), garbage, refuse or trash. Municipal solid waste management in India is serious problem because of generation of enormous quantities of waste every day. Improper disposal of municipal solid waste create unhygienic conditions which leads to environment pollution problems and spread of diseases by rodents and insects. Rapid growth in urbanization, industrialization creates enormous amount of wastes. Quantity of solid waste increases with increase in population. Solid waste management tasks presents complex technical challenges and poses social, economical and administrative problems that must be solved and managed. [1]

Municipal solid waste (MSW) is type of waste which includes substances discarded by public. MSW consists of household waste, construction and demolition waste, sanitary residue and waste from streets. Major types are food wastes, paper, plastic, clothes, wood, rubber and leather, glass, metal, stone, and others such as sand, dust, and ash. [2]

1.1 Composition of MSW

Those elements that impacts measure of waste generation are also impacts MSW composition. The most essential step in MSW source management is quantifying and qualifying the types of waste generated. The necessary information about MSW includes waste composition, characterization, sources and seasonal variations. Organic waste is main constituents of waste with wet and dry seasonal variations [5]

1.2 Statement of the Problem

Food waste generated in households, institutional centers and hotels which is not managed well. So, people dispose of garbage in drainages, river banks or nearby water bodies, streets wherever possible. People throw away food waste into open surrounding areas create ecological imbalance and which affects health. Food waste is primary material dump into landfill. Rapid growth in urbanization, industrialization, population and

mechanized agricultural activities increases the organic waste accumulation in environment as solid organic waste (SOWs). Because of shortage of dumping sites the problem has aggravated more. [10]

1.3 objectives and Scope of the Study

The project aims for building up solution for effectively oversee, arrange and reuse the organic waste generated daily at households units and further proposes to fabricate household waste processing machine which converts wet waste into safe dry solid.

1. This study is initiated to study the possibility of converting the wet food waste into dry waste and to use it as compost material.
2. To design and fabricate food waste processing machine.

To study different physical and chemical properties for waste before and after treatment.

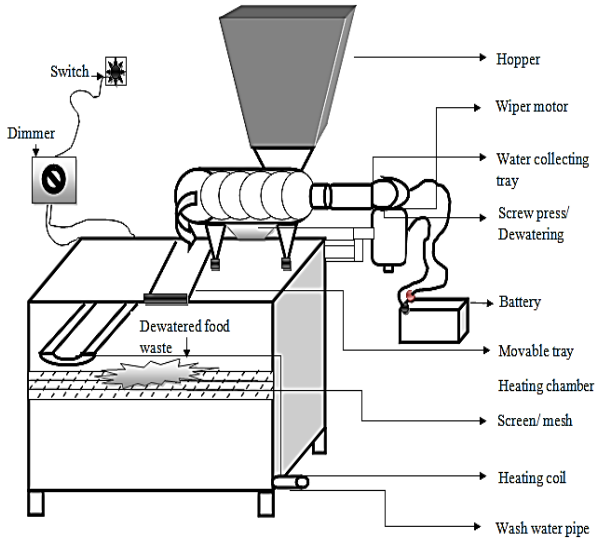
II. METHODS AND MATERIAL

2.1 Source of food waste selected

The food waste used in present study was collected from KLE Dr. M. S. Sheshgiri College of Engineering and Technology, ladies hostel mess Belagavi. The amount of food wasted per day is around 20-25 kg. The waste composition consists of rice, vegetable peelings, cooked food and uncooked food. Assuming that the mess works nine months per year, the amount of food waste generated per year is 9125 kg i.e. around 9.125 tonnes of food waste every year and this value of food waste is likely to go up because of increasing number of students.

2.1 Schematic line diagram of food waste processing machine

Clean polythene bags were used to collect the garbage for physical and chemical analysis. Most important physical characteristics of waste include its composition, moisture content, waste density, temperature and pH as these affect the extent and rate of degradation of waste. Chemical characteristics of waste include volatile matter, ash and fixed carbon and total organic carbon. Analysis of garbage was carried out as per the following procedures.



2.2 Working of food waste processing machine

In present study for better processing phenomenon of food waste, processing machine was designed and fabricated. This machine processes garbage generated every day into a dry biomass. This process reduces the waste volume by 85-90% after that waste is changed over into compostable humus-rich, rich carbon natural particles. The whole process takes place within 1-2 hour and need no water, chemicals. Collected food waste was operated mechanically in which heating temperature above 60°C, retention time of 90 min was provided. Dewatering, homogenizing and drying are the sequences followed in process. Removal of moisture from organic materials, prevalently called drying, has various advantages, including reduction in mass, bringing about less expense. All organic materials actually have high water content (80% moisture or more). This altogether builds the mass volume and additionally mass of the biomaterial. Also, this abundance moisture content builds the water action in the biomaterial, empowering microbiological waste and decomposition of the material. Thus the machine helps in managing the garbage in most efficient manner.

2.3 Working of machine

1. To begin with the process first step was to gather kitchen waste content in bin, additionally kitchen

waste was inspected to see and separate any inorganic material.

2. The waste used in the present study was free from materials like coconut shells, bones, metal and stones. Because the hard and sharp materials damage the cutting edges and the machine.
3. The machine is capable of handling the load of 1-2 kg of food waste. Allow continuous addition of food waste in the container and turn on the machine. Larger quantities of waste overload the machine and damage the heater.
4. Input waste goes into screw squeeze chamber, aides in dewatering process, which isolates fluid from solid substances. Blades present at the end point of screw press helps in reduction of larger sized materials into smaller ones. The liquid is collected in separate unit whereas dewatered solid part enters into heating unit through outlet.
5. The optimum temperature of 100°C was maintained and food waste gets heated where it achieved 85-90% volume reduction.

III. RESULTS AND DISCUSSION

3.1 Characterization of food waste

The different batch operations were conducted on small and medium scale processing machine where food residues, kitchen deposits, cooked and uncooked residues from household residential, restaurants and educational institutions were processed. Food waste was collected from ladies hostel mess of KLE Dr. M.S Sheshgiri college of Engineering and Technology, Belagavi. The daily waste generation rate ranged from 20-25 kg. The sample usually composed of rice, onion, uncooked vegetables etc.

Waste composition, moisture content, bulk density, temperature and pH are important as these affect the extent and rate of reduction of waste. The various physical and chemical parameters were considered here for the analysis. The initial step in waste characterization was to obtain specific data about each part in waste stream.

Table -1 : Effect of pH on percentage removal of lead using different adsorbents

Sl. No.	Component	Food waste sample
1	pH	4.71 ± 0.01
2	Moisture content (%)	65-75
3	Bulk density (kg/m^3)	600-700
4	Total organic carbon (%)	47.6 ± 0.5
5	Volatile matter (%)	91.44 ± 0.39
6	Ash and fixed carbon	15-18

3.2 Laboratory analysis of dewatered food waste

Food waste from screw press/ dewatering unit removed water content from solid material. The size reduction of food waste took place in the dewatering process. Reduced, dewatered waste was collected in petri dish and analyzed for pH and moisture content. It was seen that the moisture content and pH in the collected waste varied daily depending upon daily waste composition.

Table 3.2 Laboratory analysis of dewatered food waste

Sl. No.	Moisture content (%)	pH	Bulk density (kg/m^3)
1	83.50	5.92	385.94
2	82.90	5.93	377.85
3	77.47	5.55	394.00
4	76.48	5.42	373.75
5	72.41	5.12	355.74
6	75.81	5.78	320.15
7	78.075	5.62	367.91

IV. CONCLUSION

1. In this study time and temperature are two important factors considered for obtaining end dry product. Temperature of 100°C and 90 minutes time was considered for the whole process to complete.
2. The daily analysis values of moisture content of the food waste collected over one weak sampling period was 75-85%. Maximum moisture reduction efficiency of 90.4% was achieved in the present study.

3. Also, the results shown that there was no significant change in pH of the food waste before and after the treatment process.
4. The parameters like total organic carbon, ash and fixed carbon and volatile organic matter were analyzed in the laboratory. The results obtained for the final product were satisfactory.
5. Further, the dewatering of food waste played an important role in reducing the retention time and temperature required for heating. Thus food waste processing machine achieved total volume reduction of 85-90%.
6. Information from the present study suggests that food waste processing machine is an alternative for disposal of garbage.

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