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SEGREGATION AND TREATMENT OF BIODEGRADABLE AND NON BIODEGRADABLE WASTE OF CHALAKUDY MARKET

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Abstract: Solid waste management includes collection, transfer, resource recovery, recycling and treatment of waste. The main target is to protect population health, promote environmental quality, develop sustainability and provide support to economic productivity. The problem of solid waste is having an impact on the urban environment of the Chalakudy market as well. The primary purpose of the study was to conduct an inquiry of the current situation regarding the segregation and treatment of garbage in the Chalked market. This investigation covered the collection, separation, treatment, and disposal of waste. The necessary data was gathered from the Chalakudy Municipal Corporation as well as through individual field visits. The methodology of this project consists of data collection and proposing a convenient method for efficient solid waste management in chalakudy market. The Chalakudy municipality consist of a total of 41 number of wards, stretching over an area of 33.57 sq Km. The total population of Chalakudy Municipality as per 2011 census is 65,031, with 16433 houses, 3 markets and 2200 shops. The amount of solid waste generated making a total of 16,350 kg waste per day in chalakudy market. Non-Biodegradable waste generated is about 1 tonne waste per day. The physical composition of waste consist of 2% of inert materials, 2% of ash and fine earth, 2% of plastic waste, 4% of domestic hazardous, 80% of compostable organics, 1% of metals and 1% of glass.

The present procedure is as follows solid waste is collected from market . The waste is then stored segregation is done. The segregation is done manually by the workers of chalakudy municipality. The disposal and treatment consist of Thumboormuzhy Aerobic Model. The plastic is sold to green Kerala mission and no other treatment is adopted. From the studies it was understood that the Chalakudy lacks a efficient segregation unit. The segregation of is done manually which is not efficient method for segregation. Hence proposed a convenient method i.e MRF, material recovery facility, which is semiautomatic in nature and provided a solar panel as a renewable source of energy and providing a system for treating the blood of slaughtered animals.

Index Terms –: Slaughter wastewater, material recovery facility, biodegradation, Anaerobic pond, Facultative pond, Maturation pond

I. INTRODUCTION

Incresing in the population lead to increase in the generation of municipal solid waste by 20% over the past 10 years. It is anticipated that this rise will reach forty percent by the year 2040. SWM had always been a part of every human community, although the practises that are followed vary both between and within growing nations. The greatest environmental challenge that faces the entire planet is how to treat the SWM in systematic way.

The phrase "municipal solid waste" (MSW) refers to undesired items or garbage that is often created from households, places of employment, hotels, schools, and hospitals in addition to other municipal services such as markets. The most common types of municipal solid waste are discarded food, paper, plastic, metal, and glass products; debris from construction; components from automobiles; electrical appliances; pharmaceuticals; and electronic gadgets. Dumping garbage results in serious health risks, as well as a number of communicable diseases, unpleasant odours, and annoyances, as well as negative environmental effects such as water, soil, and air pollution. Because there is no adequate waste management programme, legislation, or policy, dumping garbage results in these issues.

It has been proposed that urban development should be given adequate attention in order to take an integrated approach and take into account the ways in which social, cultural, economic, interact with one another. The disposal of solid waste and the manner in which it is managed are two of the primary contributors to greenhouse gas emissions (GHG). The recovery and recycling of resources from municipal solid waste can result in considerable reductions in the emissions of greenhouse gases.

II. NEED OF STUDY

The problem of solid waste is having an impact on the urban environment of the Chalakudy market as well. The primary purpose of the study was to conduct an inquiry of the current situation regarding the segregation and treatment of garbage in the Chalakudy market. This investigation covered the collection, separation, treatment, and disposal of waste. The necessary data was gathered from the Chalakudy Municipal Corporation as well as through individual field visits . And Proposing and designing "Material recovery facility" which is semiautomatic for segregation of Non-biodegradable waste such paper plastic and providing a system for treating the blood of slaughtered animals.

III. METHODOLOGY

Data is collected from the chalakudy municipality → Proposing convenient methods for efficient SWM → Design of MRF for Non-Biodegradable waste → Design of waste stabilization pond for abattoir waste water .

3.1 Description of the study area

Chalakudy is a municipal town in Thrissur district, Kerala, India. The municipality was formed on 8 February 1936. Now, the Municipality has 41 wards. The area of Chalakudy municipality is 33.57 Sq Km with a population of 65,031 as per 2011 census.

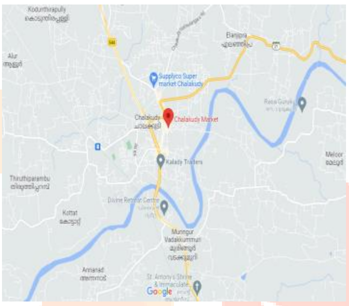

Figure 1 Chalakudy Map

3.2 Quantity of waste generated

The amount of Solid Waste generated is ranges from a total of 16,350kg waste per day. Non bio degradable waste generated is about 1 ton per day. The physical composition includes 8% of paper, 2% of inert materials, 2% ash and fine earth, 2% of plastic waste, 4% domestic hazardous waste, 80% of compostable organics, 1% of metals, 1% of glass.

3.3 MRF

Materials recovery facility (MRF), also known as materials reclamation facility or materials recycling facility, Solid waste management plant process the recyclable materials to sell to manufacturers as raw materials for new products and MRFs also play an important role in reducing the waste stream, the demand fo r raw materials, and pollution associated with the manufacturing of new products. The machines to be used in MRF includes conveyor system, shredding machine and baling machine.

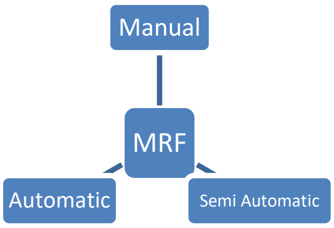

Figure 2 Types of MRF

3.4 Waste stabilization pond for abattoir wastewater treatment

Waste stabilization ponds are biological treatment system. Process and operations dependent on the environmental conditions wind speed , light intensity and Temperature. WSP is the cheapest & simplest method. The discharge of untreated abattoir wastewater result in deterioration of water bodies. The wastewater is treated by the removal of particulate matter & biological degradation of settled solids.The renewable solar energy is used for the treatment. A field scale prototype pond is designed for waste water treatment.

3.5 Design of MRF

In Chalakudy market waste of about 3.2 tons per day is collected by members. A semi automated MRF is designed for segregating these collected dry wastes. Equipment like conveyor system, shredder and baler is provided for the effective sorting and process ing of waste materials. The MRF is sited within a ware house type building with concrete flooring and enclosed by a perimeter fence for security. It have the following components: (i) Receiving or Tipping area, (ii) Sorting or Processing area with conveyor system, (iii) Storage areas for recyclables, (iv) Equipment area and (v) Space for an office.

It is provided with the basic connections for water and electricity and adequate space for the entry and exit of waste trucks. The warehouse design minimize the placement of columns that could interfere with the efficient movement of materials and equipment, and facilitate the installation of higher ceilings. Tipping floor have the capacity to receive at least 2 days worth of the MRF‟s processing capacity in anticipation of equipment breakdown and to provide materials for the second-shift operation where required. Semi automated MRF is designed with a floor area of 2191.1016 square feet.

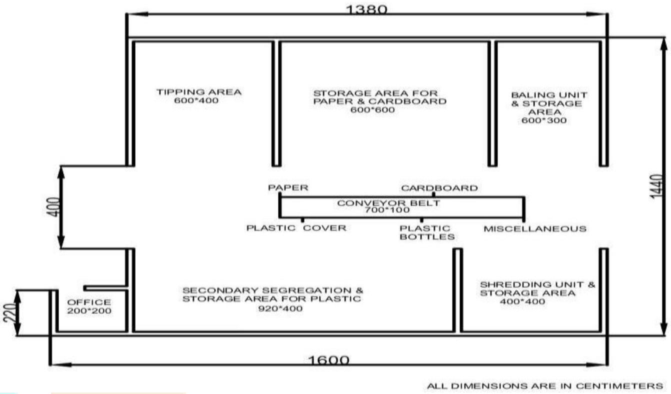

Figure 3 MRF Floor Plan

3.6 Calculation of Area Required for Storing Waste

Total waste - 16350kg, Plastic-5%, Paper-5%
V= 16350 x 0.5 =817.5 Kg = 0.8175 m^3
H = 1 m, Area = 0.8175 m^2
For one month storage :
Area = 0.8175 x 31 = 25.3425 m^2 L = 5.034 m , B = 5.034 m
Storage Area Provided :
Paper - 6x6 m , Plastic – 9.2x4 m , Tipping Floor – 6x4, Conveyor Belt – 7x1

At the MRF, the collected waste is unloaded from collection vehicles onto the tipping floor. The tipping floor is designed to store 2 days of material, which has a size of 6m by 4m. At the tipping floor the waste shall be visually inspected and any bulky or non- suitable material is removed. Conveyor belt of size 7m length and 1m width is provided for the manual sorting of waste materials. Workers on each side of conveyor belt manually sort the waste to different categories like paper, cardboard, plastic covers, bottles and other miscellaneous materials. Plastic is also segregated to different types like Polyethylene Terephthalate (PETE or PET), High-Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Low Density Polyethylene (LDPE), Polypropylene (PP) and Polystyrene (PS).

For the storage of different types of plastic materials a space of 9.2m by 4m is divided into different compartments of size 6m by 6m. A storage area for paper and cardboard is also provided near to the tipping area of size 4m by 4m. A shredder machine is used in the MRF for reducing the size of the waste material, resulting in a uniform mass of material. Storage area of size 6m by 3m is provided to store the shredder machine and shredded materials. A baler machine is also used to increase the density of the recovered material. So that the materials can be sorted and transported with the highest cost efficiency through maximisation of volume in each load. storage area of size 4m by 4m is provided for keeping the baling machine and baled materials

3.7 Solar Panel for Material Recovery Facility

For the Material Recovery Facility to be economical MRF is designed to run with solar power. The total units required for working of MRF is 75 units and the MRF is designed for 125 units, where 50 units is provided as additional. A single solar module produces an approximate of 1.3 units of electricity (300 watts).

Hence number of modules required = 125/ 1.3= 97 modules

Total watts = 97× 125 = <u>29.1 KWs</u>

3.8 DESIGN OF WASTE STABILIZATION POND

Total BOD influent concentration

$Li = B/\, Q \; = \frac{40}{120}$

= 333.33 mg/l (values B and Q assumed from IS 9234 (1979) (for 1000 persons)

Design of Anaerobic Pond

$\lambda V = LiQ/V$

$= \frac{333.33 \text{ X } 120}{295 \text{ X } 4} = 34\text{m2}$

V volume of anaerobic pond, , Li Influent BOD , Q wastewater flow rate , λV Volumetric loading

Area of the pond = $3B^2$

$34=3B^2$, B = 3.36 m, L = 3B = 10.08 m, H=4m

Design of Facultative Pond

$\lambda s = 20T - 60$

λs = 20(20) – 60 = 340 kg/ha/day

$Area$ of facultative pond A_f = (10 X LiQ) /λs

$= \frac{10 \, x 120 \, x \, 333.33}{340}$

$= 1176.45m^2$

Assuming that the mid-depth d_f = 1.5, then the volume of facultative pond.

v_f = 1176.45 X 1.5 = 1764.68 m^3

Area of the pond = 1176.45 m^2

$3B^2$ = 1176.45

B = 19.80 m , L = 3B =59.4 m, d_f = 1.5m

Design of maturation pond

The number of faecal coliform bacteria per 100ml of the effluent can be calculated using below equation, (I.H Nwanko *et.al*)

$Be = Bi/ (1 + (T) *)$

Where Bi = Bacterial Concentration in no of FC 100ml of effluent.

t = Detention time.

KB(T) = First order FC removal rate constant in T °C/day and was computed in below Equation,

$(T) = 2.6(1.19)\ T{-}20$

Putting the value of T, in above equation,

the first order FC removal rate constant KB(T) is given as

$(T) = 2.6(1.19)^{30-20} = 14.81d^{-1}$

$Be = Bi /[(1 + KB(T)t_a)(1 + KB(T)t_f)(1 + KB(T)t_m)]$

t_a, t_f, and t_m are the detention times of the anaerobic, facultative and maturation ponds respectively and n is the number of maturation units in the series.

Assuming a minimum of 5 days' retention time t_m = 5 days.

then the bacterial concentration in number of FC/100 ml of effluent can be calculated using below Equation, (I.H Nwanko *et.al*)

$Be = 1x10^8 /[(1 + 14.81x5)(1 + 14.81x5)(1 + 14.81x5)\ 1]$

$= 236.56FC/100ml$

The value of Be = 236.56FC/100ml signifies that the wastewater generated can be treated with one anaerobic pond, one facultative pond and one maturation and the effluent can be safely discharge into the environment (based on FEPA standard at 400fc/100ml).

Volume of the pond $V_m = Q \text{ x } t_m$

120 x 5 = 600 m^3

Assuming depth of pond = 1.3 m

Area of maturation pond =$Vm\ d$ = 600/ 1.3 = 461.53m^3

Length to width ratio =3:1

Area of the pond = $3B^2$ =15,548 m^3.

B = 12.4 m

3B = 37.21 m

The dimension of a pond is length (L) = 37.21 m, Width (B) = 12.4 m and depth (d)=1.3 m

Probable cumulative BOD removal at higher temperature is 96% after maturation ponds, therefore effluent BOD

Le = 4% of 333.33mg/l

Le = 13.3mg/l which is lower than the required limit of 30mg/l

The full scale pond prototype that the anaerobic pond represents is 10.08 m length, 3.36m width and 4m depth with an estimated volume of 135.47m^3 .The full scale prototype dimension of facultative pond is 59.4 m length, 19.80 m width, 1.5m depth with an estimated volume of 1764.68 m^3 while the full prototype dimensions of maturation pond is 37.21 m length 12.4 m width and 1.3 m depth with an estimated volume of 600 m^3.

IV. RESULTS AND DISCUSSIONS

Area Required	Length in metres	Breadth in metres
Tipping area	6m	4m
Storage area for plastic	9.2m	4m
Storage area for paper	6m	6m
Storage area for shredding unit	4m	4m
Storage area for baling unit	6m	3m

Table 1 Design of semiautomatic MRF

particulars	Quanity
Units of Electricity required	125 units
No of modules required	97 NO.S
Total watts	29.1 kw_s
Total cost estimation System price	13,82000/-
KSEB (Feasibility study)	1500/-
KSEB Fees (Application fees, registration Fees)	35,500/-
Total payable	14,19,000/-

Table 2 solar panel for MRF

Description	Anaerobic pond	Facultative pond	Maturation pond
Volume	$136m^3$	$1765m^3$	$600m^3$
Area	$34m^2$	$1176.12m^2$	$461.53m^2$
Length	10.08m	59.4m	37.21m
width	3.36m	19.80m	12.4m
Depth	4m	1.5m	1.3m

Table 3 Dimensions of waste stabilization pond (prototype)

V. CONCLUSION

Improper waste management practices have a significant impact on the natural environment and sustainable development in the study area. Thus, awareness about SWM impact on sound environmental development and sustainable development is low. Therefore, it is important that the SWM should be developed from the primary level. Waste segregation and primary disposal are the dominant ways of managing waste. Thus, it has caused significant challenges in the study area. Therefore, waste segregation is identified as the required process in the study area.

For this MRF was designed which is semiautomatic in nature which has a total area of 2191.106 square feet. To be economical, a renewable source of energy i.e, solar energy is converted to the electricity which is used to run the electrical appliances . By Material Recovery Facility the waste management system functions efficiently. The discharge of untreated abattoir wastewater into the water bodies result in water quality deterioration so treatment of the waste water using waste stabilization pond was adopted which is the simplest and cheapest method of waste water treatment. A field scale prototype pond which comprises of anaerobic, facultative and maturation ponds were designed for the abattoir waste water treatment.

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