DISPOSAL OF THE WET WASTE THROUGH MICRO COMPOSTING CENTRES

Commissionerate of Municipal Administration
Government of Tamil Nadu

Contents

1 Preamble

The Solid Waste Management is essential for building a sustainable and liveable habitat but remains a challenge for any urban local body. Rapid urbanisation and changing lifestyles have led to the generation of huge quantity of garbage and waste in the urban areas.

As per CPHEEO characterisation of MSW,the waste contains approximately 40% bio degradable, 45% non degradableand15% inert.Recognising this, the Ministry of Environment & Forests (MoEF), Govt. of India notified the Solid Waste Management Rules 2016. The Solid Waste Management includes the scientific and safe disposal of the waste collected from the Generators. The Municipal Solid Wastes are categorized as below:

- **Biodegradable Waste (Wet waste)**: Food and kitchen waste, green waste (vegetables, flowers, leaves, fruits) and paper.
- **Non - Biodegradable(Dry waste)**:
    - **Recyclable dry waste**: Paper, glass, bottles, cans, metals, certain plastics, etc.
    - **Non – recyclable dry waste**: waste clothes, tetra packs, toys, soiled plastic, thermocol, mattress, bags, chappals
- **Domestic Hazardous Waste**: expired medicines, thermometers, used needles & syringes, diapers, napkins, paint drums, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer and pesticide containers, batteries, and shoe polish.
- **E-waste** : Worn out electrical equipments, TV Sets, old refrigerators, mobile phones, computers and washing machines
- **C & D Waste**: building/construction waste

The bio degradable waste needs to be disposed within 24 hours of its generation in order to protect the citizens and to have a good liveable and healthy environment. The wet waste should be scientifically disposed

by converting them as bio manure, bio gas or electricity on daily basis. The SWM Rule 2016 also emphasises the same.

2 SWM Rules 2016

The Solid Waste Management Rules 2016 has provided guidelines for composting in ***Schedule II – standards for composting*** and it includes:

The incoming organic waste should be stored and properly processed only in covered areas with necessary precautions to control odour and leachate and maintaining the quality of compost.

As per the SWM Rules 2016, section 4 (duties of waste generators) describes that "*The bio-degradable waste shall be processed, treated and disposed off through composting or bio-methanation within the premises as far as possible".*

Section 15 ofSWM Rules 2016 (Duties and responsibilities of local authorities and village Panchayats of census towns and urban agglomerations) directs to

> *(m) collect waste from vegetable, fruit, flower, meat, poultry and fish market on day to day basis and promote setting up of* ***decentralised compost plant*** *or bio-methanation plant at suitable locations in the markets or in the vicinity of markets ensuring hygienic conditions;*
>
> *(v) Preference shall be given to* ***decentralised processing*** *to minimize transportation cost and environmental impacts such as bio-methanation, microbial composting, vermi-composting, anaerobic digestion or any other appropriate processing for bio-stabilisation of biodegradable wastes;*

3 Need for Micro Compost Centres (MCC)

With the ever expanding ULBs and rapid growth of urban population, existingdump yards are now filled with Legacy Waste. There is also the issue of lack of lands to accommodate the Solid Waste generated. Withthe spurt of urbanization in the last 20 years, it has become difficult to chart out the area required for accommodating the generated solid waste due to the NIMBY (Not In My Back Yard) attitude of public. There is also continuous pressure exerted on the ULBs by the public over closure of the existing dumpyards.

In this context, the ULBs were pushed towards treating their waste locally in de centralized manner instead of centralized approach which also reduces the secondary transportation costs.

4 Justification of De Centralized approach - Micro Composting Centres

Earlier, the waste was taken to compost yards to process in windrows and/or vermin composting. This method encompassed certain challenges such as higher transportation cost, larger lands, uncontrollable odour and difficulty in maintaining the system.

One of the most practical, easyand acceptable solution to tackle the garbage menaceis the decentralized treatment of waste in Micro Composting Centres.

In SWM Rules 2016, it has been specifically pointed out that the ULBs *"should **phase out the use of chemical fertilizer in two years and use compost** in all parks, gardens maintained by the local body and wherever possible in other places under its jurisdiction"*.

The Decentralized Solid Waste Management helps in collecting segregated organic waste at the source and managesmunicipal solid waste locally. It provides job opportunities for informal workers and self

help groups. The Decentralised method can be customized for the local waste stream, climate, social, and economic conditions.

5 Advantages of MCCs

- Handles small quantum of waste efficiently
- Construction period for setting up infrastructure is very short
- It starts with primary collection and ends in processing
- Reduces the transportation cost
- Elimination of roadside bins, secondary transportation etc.
- Production of quality manure in a cost effective manner and proper usage of the same
- Promotes organic farming and reduces the dependence on chemical fertilizers

6 Concept of MCC

The MCCs were established to treat smaller quantities of waste in separate tubs which helps in generation of compost in 28 days.An MCC should have 14 tubs i.e. 2 rows with 7 tubs in each row.The sequence followed is given below:

Table 1 Sequence to be followed in MCC

ROW 1	1st day – 1sttub 2nd day – 2nd tub 3rd day – 3rd tub 4th day – 4th tub 5th day – 5th tub 6th day – 6th tub 7th day – 7th tub	8th day – 1sttub 9th day – 2nd tub 10th day – 3rd tub 11th day – 4th tub 12th day – 5th tub 13th day – 6th tub 14th day – 7th tub	15th day – 1st tub 16th day – 2nd tub 17th day – 3rd tub 18th day – 4th tub 19th day – 5th tub 20th day – 6th tub 21th day – 7th tub
ROW 2	22nd day – 1sttub 23rd day – 2nd tub 24th day – 3rd tub 25th day – 4th tub 26th day – 5th tub 27th day – 6th tub 28th day – 7th tub	29th day – 1sttub 30th day – 2nd tub 31st day – 3rd tub 32nd day – 4th tub 33rd day – 5th tub 34th day – 6th tub 35th day – 7th tub	36th day – 1sttub 37th day – 2nd tub 38th day – 3rd tub 39th day – 4th tub 40th day – 5th tub 41st day – 6th tub 42nd day – 7th tub

The waste has to be turned once in two days for the purpose of aeration. Compost will be formed in the 1st tub at the end of 43rd day and similarly the on the subsequent days, compost can be removed from the 2nd tub, 3rd tub and so on.The removed compost isdried for 2-3 days, sieved and packed to be sold to farmers at a marginal/no cost.

The remains of the sieved compost can be placed back again in the tubs since it accelerates the degradation process of wet waste.

7 Infrastructure required

An MCC requires infrastructure facilities like waste receiving platforms,compost tubs, and stabilization/storage area. Other equipments such as shredding machines, conveyor belts, trolleys, weighing machine will also be provided. Also, all the MCCs should be provided with napkin/ diaper incinerator for handling the same.

8 Technical specifications for MCC

Based on the current waste generation and accounting for future increase in waste, the handling capacity of MCCs has been customized to 2, 3, 4 & 5 TPD.

Table 2 Details of tubs for each capacity of MCC

S. No	Capacity of the plant (TPD)	Size of each tub (m^3)	No. of tubs required	Area Reqd. for processing centre (sq.m.)
1.	2	4x2x1	10	335
2.	3	4x2x1	14	417
3.	4	4.5x2.5x1	14	515
4.	5	5x2.8x1	14	600

Table 3Requirement of area for MCCs

Component	Unit			
	2 TPD	**3 TPD**	**4 TPD**	**5 TPD**
No. of cubical tub required	10	14	14	14
Wall thickness of the cubical tub	0.23m	0.23m	0.23m	0.23m
Size of tub	4m x 2m x 1m	4m x 2m x 1m	4.5m x 2.5m x 1m	5m x 2.8m x 1m
Total area for tubs	80 sq.m.for 10 tubs	112 sq.m.for 14 tubs	157.5 sq.m.for 14 tubs	150 sq.mfor 14 tubs
Moving space required around the tub	100sq.m	100sq.m	100sq.m	100sq.m
Stabilization area	50 Sq.m	50 Sq.m	50 Sq.m	50 Sq.m
Area required for receiving the waste and segregation, shredding	100 sq.m@50 sq.m/MT	150 sq.m@50 sq.m/MT	200 sq.m@50 sq.m/MT	250 sq.m@50 sqm/MT
MCC shed Area	330 sq.m.	412 sq.m.	508 sq.m.	600 sq.m.
Workers rest room facility	1.5 sq.m per seat	1.5 sq.m per seat	1.5 sq.m per seat	1.5 sq.m per seat
Store facility	3 sq. m	3 sq. m	3 sq. m	3 sq. m

Table 4 Requirement of Manpower

S. No	Activity	No. of workers reqd.			
		2 TPD	**3 TPD**	**4 TPD**	**5 TPD**
1	Receiving & segregation of waste	1	1	1	1
2	Operating shredder	1	1	1	2
3	General Operation		1	2	2
4	Maintenance & Cleaning	1	1	1	1
Total		**3**	**4**	**5**	**6**

9 Methodology of MCC

9.1 Role of Micro organism (Inoculum)

In order to convert the wet waste into compost within a stipulated time through aerobic digestion process the inoculums i.e microorganisms need to be added to the wet waste. It is a process characterized by a series of biochemical transformation carried out by different consortia of microorganisms (i.e.inoculum) that convert complex organic macromolecules into low molecular compoundsand finally as compost.

9.2 Details of Effective Microorganisms

Inocula/ Effective Microorganisms(bacterial activators), contains several strains of micro-organisms essential to decompose organic matter. One of the simplest and oldest Effective Microorganism being used in India is mixing curd and jaggery. The mix is prepared as follows:

Water = 90 litres (untreated, chlorine free water)

Jaggery = 5 kg

Sour Curd = 2 – 3 litre

These ingredients should be fermented in a 10 litre barrel for 7 days and stirred occasionally.

9.3 Steps for using EM

Sufficient quantity of EM solution has to be prepared and stored for usage as per the following steps:

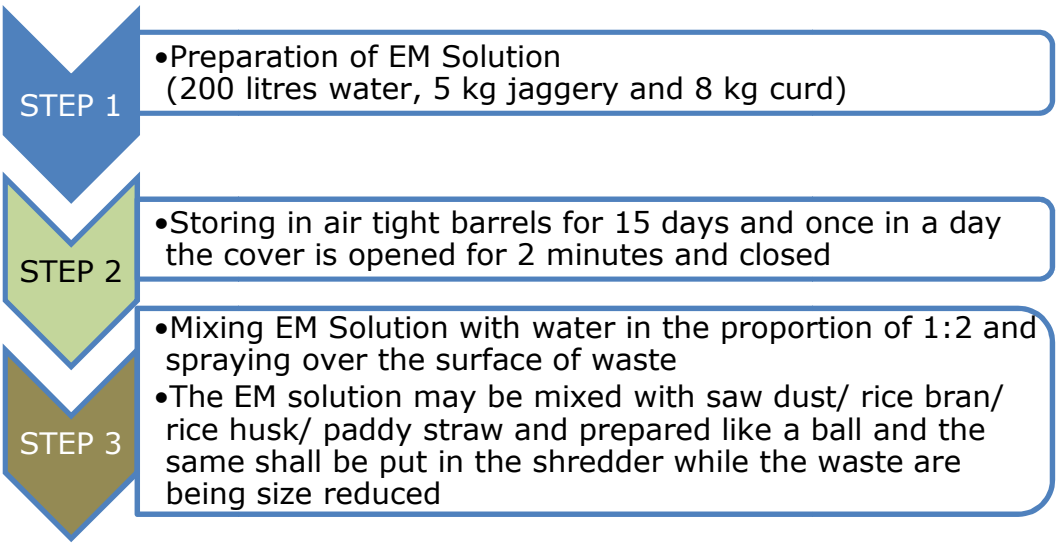

Figure 1 Steps for using EM

9.4 Proper segregation of incoming waste

In order to maintainthe quality of end product, it is necessary to control the quality of incoming waste. In order to accomplish this, awareness should be provided to residentson proper source segregation and what wastes will be taken up at the MCC centres.

As a first step, screening should be done bythe workers in MCC to remove any non degradable materials mixed along with the waste. If the non-degradable waste misses this screening step and infiltrates into the next process, as a thumb of rule, inorganic material tends to come up on top of the pile as the volume of organic material decreases due to the process ofdecomposition. These non-degradables can also be removed during turning of the waste.

10 Operation Methodology

10.1 Collection of waste

In order to collect the solid wastes generated from households, route charts should be preparedbased on the number of households. Primary collection vehicles such as Battery Operated Vehicles (BOV) and Light Commercial Vehicles (LCV) are used. A BOV can cater to 400 households per day in three shifts each comprising of nearly 130-140

households. An LCV covers a total of 1200 households per day with each shift comprising of 400 households.

In order to closely monitor the collection and transportation of primary vehicles, it is necessary to install GPS system in all the vehicles involved in collection process. GPS tracking also helps to keep in check the route taken by vehicles, time taken to cover one shift, number of shifts taken to collect waste from the designated households etc.

As per the Solid Waste Management Rules, 2016, segregation of waste at source and managing the organic fraction of solid waste by bulk waste generators (where average waste generation rate is more than 100 kg/day) has to be handled by themselves.

10.2 Pre-processing of waste

The segregated wet waste from households is collected and taken for processing to the MCCs. The incoming waste has to be weighed in weighing scale before shredding. This waste is then shredded to 20 – 40 mm size using shredders. The EM solution mixed with the media i.e. rice bran/ rice husk/paddy straw/ saw dust maybe added along with the wet waste while shredding. This helps in even mixing of EM in the waste. This shredded waste is filled in the tubs everyday as described in section6.

Such size-reduction will also facilitate oxygenation of the material within, as well as enhance the operator's ability to maintain optimum moisture conditions.

10.3 Transporting the size reduced inoculums added wet waste to pits

The shredded waste is then transferred to the pits. The EM mix is spread along the surface of the waste to accelerate the decomposition process.

10.4 Turning of waste in the pits

The temperature plays a major role in the growth of micro organisms. Hence, it is necessary to maintain the temperature of the pits at 40 – 50° C. If the pile is too large, anaerobic zones occur near the center, slowing decomposition in these zones. If the pile is too small, it loses heat quickly, which would also slow down the process.

In order to overcome this, the waste should be filled in such a way that there is about 0.1 m freeboard to help in turning of waste and the process is illustrated below:

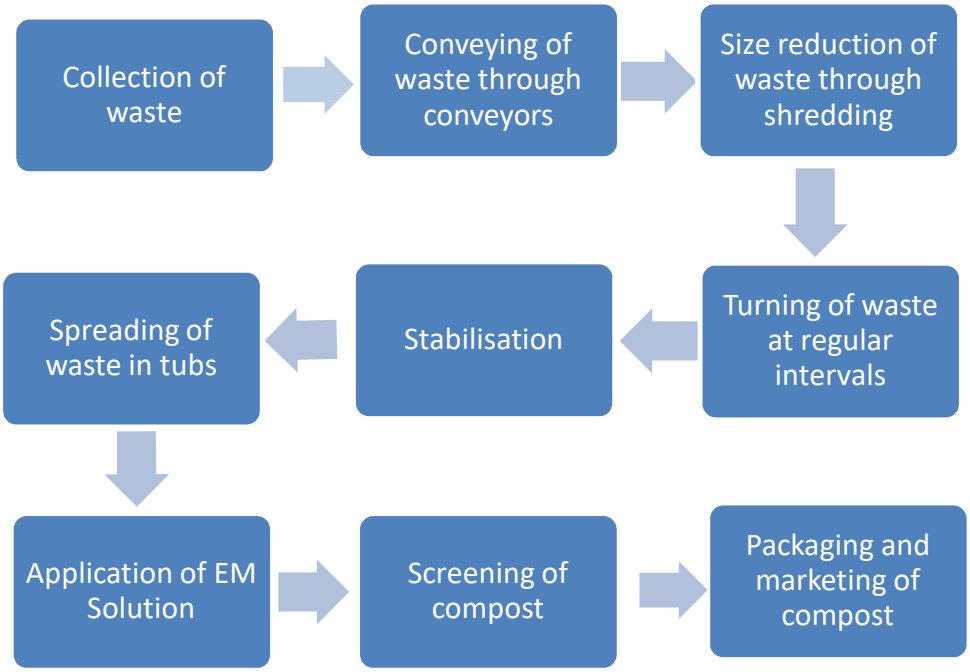

Figure 2 Schematic of operations in MCC

10.5 Methods to control odour/insect menace

The reasons for foul smelling odour of waste are piles of waste that are too large/tightly packed and waste with very high moisture content. Various improvisations can be done to this method to increase the efficiency of composting and also to reduce the odour/fly menace.

To keep the odour generation in check, it is very much necessary to maintain the moisture content between 40-60% since lesser moisture content limits the population growth of aerobic

microorganisms and higher moisture content leads to anaerobic conditions.

One other improvisation is the **use of rice husk which helps to absorb the leachate generated**and also acts as a media for the EM solution.

10.6 Maintaining C:N Ratio

It is very much important to maintain the Carbon: Nitrogen Ratio to effectively produce compost. The waste should have 25 – 30 parts Carbon for every 1 part of Nitrogen. This can be done by the addition of leaves, tree trimmings etc.

10.7 Stabilisation of compost

Compost quality is enhanced by aging the finished compost to stabilize the product. Stabilisation is the final stage of the composting process that occurs after most of the food supply for the microbes has been consumed. Compost will need to be kept in the stabilisation area for a minimum of one month. Once stabilised, the compost will not generate foul odours.

10.8 Screening of compost

Screening, besides producing a more uniform end product, also removes non-compostable. It is the ultimate quality control step. In addition, if wood waste has been included in the MCC tub, it may not be as completely decomposed. Hence sieving is necessary to maintain the quality of compost.

10.9 Quality of Compost

Compost quality should be monitored by the operator of the facility or every batch of compost being sold to the market. If the facility does not have sufficient laboratory capacity to perform all the tests, National Accreditation Board for Testing and Calibration Laboratories (NABL) accredited laboratories should be contracted to perform these tests ona regular basis. Compost that does not meet

specified standards should be put to uses other than for application to food crops.

The stabilized compost should be analyzed for nutrient value and contaminants. The N:P:K should be tested to determine the quality of the nutrients present in the final compost. The details of components to be tested are given below in table 5:

Table 5 Parameters to be tested

S. No	Parameters	Organic Compost (FCO 2009)
1	C/N Ratio	<20
2	Conductivity (as dsm-1) not more than	4.0
3	pH	6.5-7.5
4	Moisture, percent by weight, maximum	15.0 – 25.0
5	Total Nitrogen, percent by weight, maximum	0.8
6	Total Phosphate, percent by weight, maximum	0.4
7	Total Potassium, percent by weight, maximum	0.4
8	Colour	Dark brown - black

Records of these analyses should be maintained and made available to prospective consumers of the product.

11 Packing and Marketing

The screened, final product of bio manure should be packed for marketing with various quantum of packages.

11.1 End use of compost

Compost users can be grouped into three categories:

- Commercial
- Residential
- Public agencies

Commercial	Private Park Maintenance
	Nurseries
	Golf Courses
Residential	Garden, Lawn and Flower Re-vegetation
Public agencies	Community Gardens
	Maintenance of parks under ULBs
	Decorative planting in arterial roads

Horticultural operations require large, continual supplies of high quality organic material. MoU should be signed with other departments such as Department of Agriculture, Department of Horticulture etc. so that the compost can be sold. Apart from the Government departments, other private players who sell organic compost (eg. SPIC, MFL) should be taken into account.

Production and distribution of a bagged product, is recommended when selling for private players. The private operators can be charged for each ton of compost sold.

Local residents can be encouraged to pick up compost at no charge or at a minimal fee. This option provides an excellent way not only to publicize the advantages of composting and resource recycling in general, but it also increases and instills a greater sense of communityidentity and pride.

Another option is wholesale. Compost can be sold at low cost to local farmers. Although thisoption does not provide maximum revenue or publicity, it requires the least effort on thecommunity's part to assure that all the compost is distributed for productive use.

12 Leachate management

Leachate is theliquid that has moved through the compostpile and exits the bottom of the pile. Theleachate contains dissolved and suspendedpollutants.If leachate is formed,it results in significant odour and pollution risk.

Rice husk can be added to the waste mix since it absorbs the leachate developed. Separate pipes are laid at the bottom of the tubs to collect the leachate generated. This is again used in the compost process since it accelerates the decomposition.

13 Implementation of De Centralized MCCs

The works shall be executed by adopting the Tamil Nadu Transparency in Tenders Act 1998 and Rules 2000 and also as per the provisions of the Tamil Nadu Panchayats (Preparation of Plans and Estimate of works and mode and conditions of contracts) Rules, 2007 vide G. O. (Ms) No. 203 RD & PR (PR. 1) Department, dated: 20.12.2007 and amendments issued in this regard shall be scrupulously followed.

14 Educating the public

While the MCC units are still in the planning stages, considerations should be given to holding public meeting and distributing materials to the public to explain its economic and environmental benefits and to alleviate any concerns about its effects on the neighbouring community.

Consideration may be given to establishing a citizen's advisory committee which could contribute ideas during planning and monitor on-going operations. Other successful MCC units can also be exhibited as models to the public.

15 Site security

The MCC site must have sufficient barriers to control access so that illegal dumping is not possible and potential for vandalism (arson) is discouraged. CCTV should be placed in all the units to monitor the activities in all the centres.

16 Safety procedures to be followed

Safety concerns with composting are more related to handling incoming waste than with equipment operation. Care has to be taken by the workers especially involved in shredding process where blades rotate at high RPMs resulting in material being thrown out.

In order to protect the health of workers handling wet waste the following precautions should be taken:

- Washing hands before handling food
- Using personal protective gears

Operators of shredders should be fully trained in the operation of this equipment and should be required to wear the appropriate safety protection such as:

- Safety shoes
- Hard hats
- Eyeglasses or other gear as appropriate.

Other personal protection equipment to be used by all the workers includes uniform, fluorescent jacket, hand gloves& raincoats. Compulsory health camps should be conducted every month by the Health Department for all the workers involved in MCC activities.

17 Maintenance of records

The importance of good recordkeeping is very important since it may be required bylocal and/or state environmental regulatory agencies.

Simple operations such as recording the temperature of waste in tubs, determining moisture content are important diagnostic tools which form a lasting record of the daily successes and failures of site management.

Daily monitoring should be compulsorily done by the concerned Sanitary Officers/ Sanitary Inspectors/ City/ Municipal Health Officers.

Operators should keep a log to track the volume of weight of incoming waste and its origin. This data will be useful for:

- Developing estimates on the amount of compost that will be produced;
- Determining the adequacy of the site for handling projected levels of waste;

Other registers to be maintained include:

- Collection quantity (Input register)
- Quantity ofManure produced
- Details Manure sold & Manure stock available

18 Regulatory Approval

All the MCC units with handling capacity more than 5 TPD should get proper consent to operate from TNPCB and renew the same regularly. The MCCs should also comply with regular directions issued from NGT.

19 Training for workers in MCC units

The operation and maintenance of MCC should be carried out through Self Help Groups/ NGOs.

It is necessary to ensure that all site workers understand the need for hard work and attention to detail. Operational costs depend on a number of staff on-site and the effectiveness with which they work.

Staff will be required to operate and maintain equipment, monitor and sample compost piles, administration and gate management.

Initial training should include the following:

- Basics of composting operations
- Data collection,
- Record keeping