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MUNICIPAL SOLID WASTE MANAGEMENT THROUGH

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India is facing an ever increasing challenge of providing for the incremental infrastructural needs of a growing urban population. This increasing population, management of Municipal Solid Waste (MSW) in the country has emerged as a severe problem .it is being collected, transported to dumping yard.These practices attract lot of public and academicians objection in view of open dumping of MSW, obnoxious odour and flies menace etc. It also poses great risk of ground water contamination due to percolation. Finding a scientific solution to the MSW disposal problem is prime consideration of the Government as it is connected with public health issues.

The ISWM concept, as described is closely linked to the **3R** approach (Reduce, Reuse, and Recycle), which is also aimed at optimizing the management of municipal solid waste from all the waste-generators (households, commercial and institutional establishments, parks and gardens , construction and demolition activities, urban agriculture, safety and healthcare facilities) and involving all the stakeholders (waste generators, service providers, informal sector, regulators, government, and community/neighbourhoods). The adoption of the 3R concept helps to minimize the amount of waste to be handled by the municipal authority minimizing the public health and environmental risks associated with it. Integrated solid waste management has also to reflect the following aspect

As per the Municipal Solid Waste (Management and Handling) Rules, 2000, waste disposalmethods prescribed includes sanitary land fill disposal andincineration disposal.

Considering land constraints, Population density and waste characteristics, incineration is suitable for disposal of Municipal Solid wastes. Incineration is one of the method of MSW disposal in many countries. In Asian countries likeJapan and Korea, this is prime method of MSW disposal

Merits of Incineration Disposal

(i) It require smaller land area (2.5 to3acres)
(ii) Does not generate any leachate
(iii) Does not generate any obnoxious gas or methane gas

(iv) No chances of ground water contamination
(v) Generation of power, added value
(vi) Instance disposal

2. OBJECTIVES:-

The broad objectives of the Detail Project Report (DPR) are to determine a technically andeconomically viable sold waste management project for the Urban area .

Following are the specific objectives:

(i) To devise a system for effective and efficient method of MSW disposal.
(ii) To assess Project feasibility
(iii) To assess Environment Impact Assessment of the Project
(iv) Cost Estimate
(v) To prepare operational plan
(vi) Organizational and Financial Studies
(vii) Training and Capacity Building

3.Policy Initiative for SWM

In India, in the last few years, there has been lots of pressure due to international eventsconcerning better environment and human settlements. As a result, several initiatives weretaken at the National, State and Local Government level to go deep into the flaws in theexisting situation and suggest remedies. The Central and State Governments initiated effortsto develop policies and programs in this regard. The Strategy Paper on Solid WasteManagement in India by the National Environmental Engineering Research Institute (NEERI)in August 1995 is one of the most exhaustive evaluations of the problem at the national level.

The first impression that the city creates in mind of a visitor is how clean the city is. Theurbanization is done without a remarkable change in the attitude which is still rural, rustic anddown to earth. The habit of throwing garbage on road and waiting for sweeper to sweep oncein 24 hours needs to change.

Solid waste management is a part of health and sanitation, and according to the IndianConstitution, falls within the purview of the State list. Since this activity is non – exclusive,non – rivaled, and essential, the responsibility for providing the

service lies within the publicdomain. The activity being of a local nature is entrusted to the Urban Local Bodies.Department is responsible for the solid waste management.

4. Waste Characterization:

Composite waste sampling was carried out to assess the waste composition and the same ispresented in Table 1. It showed that C&D forms the major composition of 15 % followed byvegetable and fruit wastes and food wastes. Plastic wastes consist of 11 %. Barring metalsand glass wastes and etc, the remaining all other types of wastes are incinerablewastes.

Table.1 Physical Characteristic of MSW

Physical characteristic of Garbage

Sl. No.	Components	Percentage by Weight
1.	Paper	1.3
2.	Plastic	11.2
3.	Metals	0.08
4.	Glass	0.16
5.	C&D	20.13
6.	Rubber / Rexin	0.08
7.	Gunny bags	0.11
8.	Cotton	0.36
9.	Wood	0.34
10	Paddy Straw	1.4
11	Cow Dung	0.90
12	Banana Stem	0.35
13	Coconut Husk	0.70
14	Baggage	0.26
15	Vegetables & Fruit Waste	28.00
16	Leaves Waste	8.23
17	Food Waste	24.3

The chemical composition analysis presented in Table 2

Table 2. Chemical composition of MSW

Sl.No	Element	Percentage
1.	Moisture	50.70%
2.	Net VS	17.31%
3.	Ash	30.70%
4.	Coal	1.29%
5.	Sulphate	3000 mg / kg.
6.	Phosphate	1457 mg / kg.
7.	Chloride	1499 mg / kg.
8.	T.K.N.	1105 mg / kg.
9.	Sodium	1302 mg / kg.
10.	Potassium	3315 mg / kg.
11.	Calcium	5600 mg / kg.

6. Existing Solid Waste Disposal System

The source of solid waste generation is given in Table 3. Among the various sources, solid waste generationis expected to be high in residential areas.

Table3. Sectoral Source of MSW

Sl.No	Waste Source	% of Total
1	Residential	68
2	Commercial	14
3	Restaurants/Hotel/Marriage Hall	11
4	Market	4
5	Hospital	3
	Total	100

The collected mixed waste is transported to dumping area by truck and dumpedon open land without any processing. It causes obnoxious odour and fly formation. The Ragpicker collects usable materials. They also involves in burning of waste to collect thevaluable materials. The ambient air quality analysis carried out in the area showed highervalues of PM, SO2 and NOx . This problem results in public agitation againstdumping of MSW in site. Ground water contamination in the area also has been reporteddue to leaching from the dumping site.(below fig).

The existing practice posesgreater challenges to the public health, environment and aesthetic value of the city.

Present MSW dumping yard

Ground water contamination through percolation

6.1 Merits and Demerits of the Existing MSW disposal system

Open dumping, composting and Sanitary land filling are three methods being adopted forMSW disposal. The merits and demerits are summrised below:

Open Dumping

Merits	Demerits
❖ Inexpensive	❖ Health-hazard, insects, rodents, odour, etc
❖ Instant disposal	❖ Air pollution
	❖ Release of Methane
	❖ Ugly look
	❖ Ground water contamination and run off pollution

Composting

Merits	Demerits
Wealth from waste	Takes longer duration
Concentration of Nutrients	Release greenhouse gases
Easier to transport	Require larger land
Composting kills parasites	Need to control rainfall runoff from the compostingarea
Usable in organic systems	Generate odor

Sanitary Landfilling

Merits	Demerits
Accommodate huge quantity	Larger land area is required
Instant disposal	Cost intensive
Leachate can be collected	Odor
Longer duration	Methane formation
	ETP is required
Caped land can be reused for other communitypurposes	Chances of ground water contamination if leachate is not collected properly

Rehabilitation of Rag pickers:

The rag pickers are involving in segregating valuable articles from thedumping site. The dumping yard is acting as major livelihood for these rag pickers. Once thisproject commence its operation, rag pickers would lose their revenue. In order to protect, their livelihood, it is proposed to get involve all the rag picker in waste segregation conveyorsystem. It would support their life sustainability

7. Recycling & Recovery

Recycling play vital role in reducing waste amount, returning resources back to use and minimizing the financial and environmental burden of MSWM

Recycling is the process by which materials that are otherwise destined for disposalare collected, processed and remanufactured or reused. Recycling diverts a significantfraction of municipal, institutional and business waste away from disposal and, thereby, saves scarce resources as well as reduces environmental impacts and the burden of wastemanagement on public authorities. If appropriate market mechanisms are established,recycling can generate revenues, contributing to the overall cost recovery for municipal solid waste service provision.

7.1 Advantage of Recycling

- **For the ULB**
  - **–** Reduces waste volume
  - **–** Cost savings in collection, transport and disposal
  - **–** Longer life span for landfills
  - **–** Reduced environmental management efforts
- **For the economy:**
  - **–** Reduction of imports of raw materials, fertilizers etc. and hence foreign currencyrequired.
  - **–** Livelihood opportunities for recyclers in the recycling industry
- **For the environment**
  - **–** Sustainable use of resources: less material and energy consumption andconsequently lower pollution.
  - **–** Reduced amount of waste going to storage sites / reduced requirement of land.
  - **–** Reduced environmental impacts including impacts of climate change.

8. Site Suitability

The problem of municipal solid waste management (MSWM) has acquired an alarmingin the developing countries during the last few decades. The quantity of solidwaste generated has increased significantly and its characteristics have changed as a result ofthe change in the peoples‟ lifestyles due to swift industrialization and urbanization. Hence inHence in India, establishing solid waste management facility has become mandatory according toMSW Rules, 2000.

(i) The site should be an undeveloped site comes under agriculturalland.Hence the site can be developed for processing of waste without any major
impact.

(ii) Accessibility to the site for transporting municipal solidwaste to the site for processing.

(iii)Ground water contamination should be less. Surface water should be available near the plant.

The site will be developed suitably for setting up of processing and treatment facility. Boundary wall around the site will beconstructed to prevent the entry of public inside the site. Then the total area will be splitaccording to therequirements. Plant, storage area,Vehicle Parking , Green belt development and Administration Block.

The storm water drains will be provided all along roads, green belt and open space to collectthe rainwater. The water from the open area will be drained into storm water drains, which inturn drain to a common municipal drain. The rainwater from roof of the buildings will becollected through PVC down take pipes and taken to RWH sump.

9.Installation of composting plant out of domestic garbage

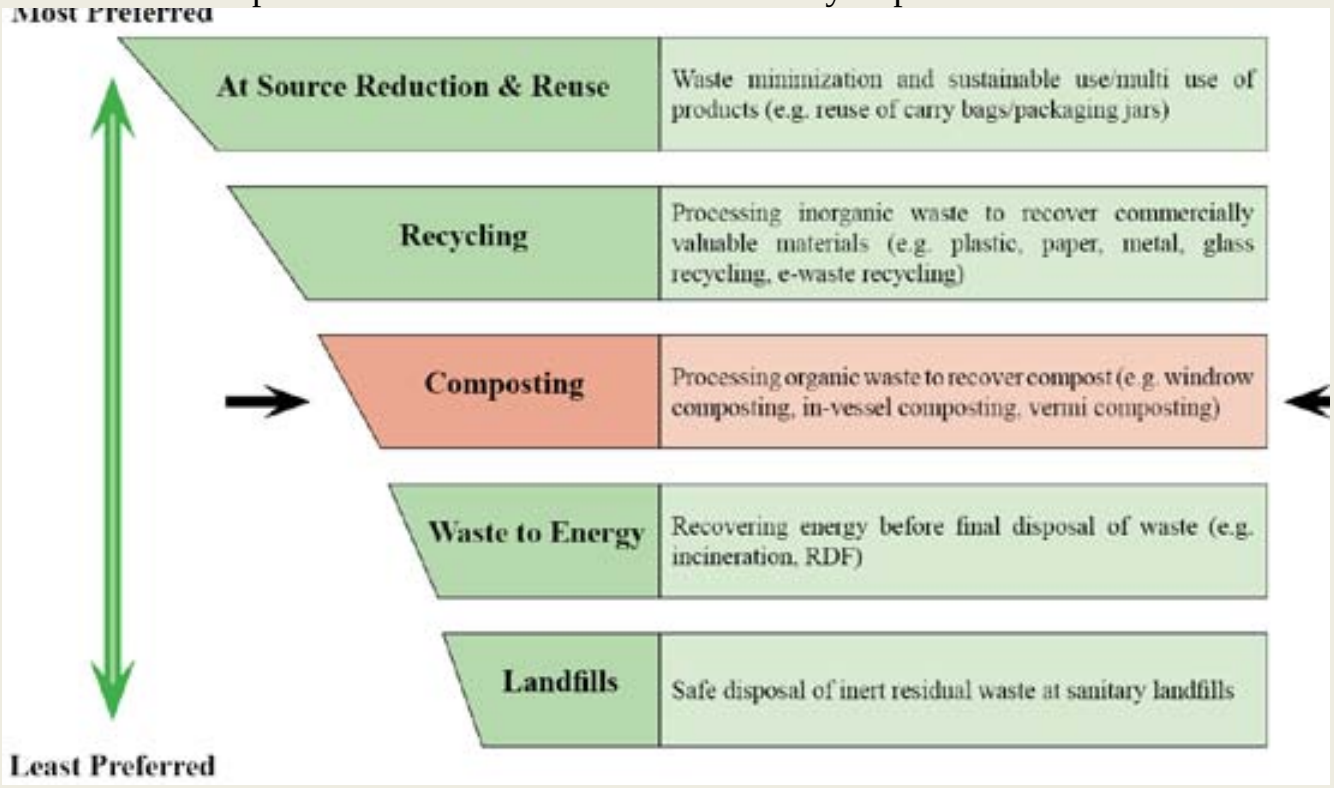
This Chapter describes, in outline, the overall approach that will be adopted to achievecompletion of the engineering, procurement and construction phases of the Project. composed Plant, on schedule and in accordance with the specification, optional, safetyenvironmental and requirements up to and including the design, construction, testing andcommissioning of the Project on the basis of Turn-Key.

The purpose of this project is to install the plant for composed the municipal waste. Thedesigned plant shall provide a pleasant surrounding environment and smooth operation of composed plant by controlling the exhausted air pollutant

materials in compliance withthe prevailing environmental law. The given specification is indicative only, and may bemodified the Specification of plant system or may improve its designcondition.

9.1 Composting in the ISWM frame work

The Integrated Solid Waste Management (ISWM) hierarchy indicates reduction of waste as the most preferred option for managing waste, followed by recycle of waste. The preferred choice in the ISWM strategy, viz., adoption of resource recovery strategies and composting, ensures that waste is processed appropriately to facilitate further use of the material, as indicated in figure 3.9. Composting is a controlled process of biologically "digesting" the municipal solid waste, so it may be recycled for other purposes – plant nutrient, stabilization of soil in remediation process or soil amendment for recovery of poor soils.



Composting in the ISWM

Organic waste contributes to environmental pollution in more ways than one. Compostingand other biological stabilization processes mitigate the impact of uncontrolleddecomposition of organic municipal solid waste and should be adopted by urban areas.Composting is an environmentally beneficial waste recycling mechanism and not a wastedisposal mechanism.

9.2 What is Composting

Municipal Solid Waste primarily consists of organic, inorganic and inert fractions. Under natural conditions, the organic fraction of waste continually decomposes, accompanied by a strong foul odour and production of gases, predominantly methane or carbon dioxide depending upon the aerobicity of the decomposing mass. Vector infestation during the natural decomposition process is a common phenomenon. Composting is a process of controlled decomposition of the organic waste, typically conditions, resulting in the production of stable humus like product, compost. Considering the typical composition of wastes and the climate conditions, composting ishighly relevant in India and should be considered in all MSWM concepts. Composting ofthe segregated wet fraction of waste (see chapter2 of Part II of this manual) is preferred.
Mixed waste composting, with effective and appropriate pre-treatment of feedstock maybe considered an interim solution; in such cases stringent monitoring of the compostquality is essential.

9.3 Benefits of Composting

- The real economic benefits of compost use include improved soil quality, enhanced water retention capacity of soil, increased biological activity, micro-nutrient contentand improved pest resistance in crops.
- Composting minimizes/avoids GHG emissions from anaerobic decomposition oforganic waste (such as in a large unturned heap).
- Composting increases the design life of other waste management facilities
- Stringent design requirements and associated costs for catering to management of leachates from organic waste decomposition may be reduced in those landfills that donot receive organic waste (so far not in MSW Rules).
- Compost is particularly useful as organic manure as it contains macro plant nutrients (Nitrogen, Phosphorous and Potassium) as well as micro nutrients. When used inconjunction with chemical fertilizers optimum results are obtained.
- The use of compost reduces the dependency on chemical fertilizers (availability as well as quantity) for agricultural operations. When used as a soil amendment,compost reduces the need for water, fertilizers, and pesticides. Compost acts as a soilconditioner, therefore supporting the long term fertility of soil.
- Compost may be used to revitalize vegetation habitats and add life to marginal, impoverished soils.

- Compost may also be used as a bio matrix in remediation of chemical contaminants and asremediation soil in contaminated sites as compost helps in binding heavy metals and other contaminants, reducing leachability and bio-absorption.

9.4 Need for Market Identification & Analysis

The financial viability of compost plants is primarily dependent on the marketability ofthe compost. For the low carbon soil (soil organic carbon) prevalent in India, there is hugerequirement of good quality compost for agriculture. Yet the demand for compost is verylow. An analysis of the available markets and potential demand for compost is essential todecide the required size of the compost plant. An assessment of end user requirements ofcompost quality, as defined by the final use, is essential to arrive at the final design of the compost plant, especially the finishing stages.

Successful market for compost depends on three major factors:

• Producing consistent quality and quantity of compost
• Identification of end use of compost
• Identification of potential users

Market development for compost and proper quality monitoring is a crucial issue. Thefollowing strategies can be applied for market development:

- The pricing mechanism for sale of compost should be assessed. Each State Government should fix a minimum retail price for the sale of compost which meets FCO 2009standards, to ensure economic viability of these plants
- All state and local government departments should be encouraged to promote the use of compost in parks, gardens, nurseries and urban forestry projects
- Farmers should be made aware of the befits of compost and should be encouraged tosubstitute inorganic fertilizers with organic compost, as appropriate

9.5 Composting technologies:

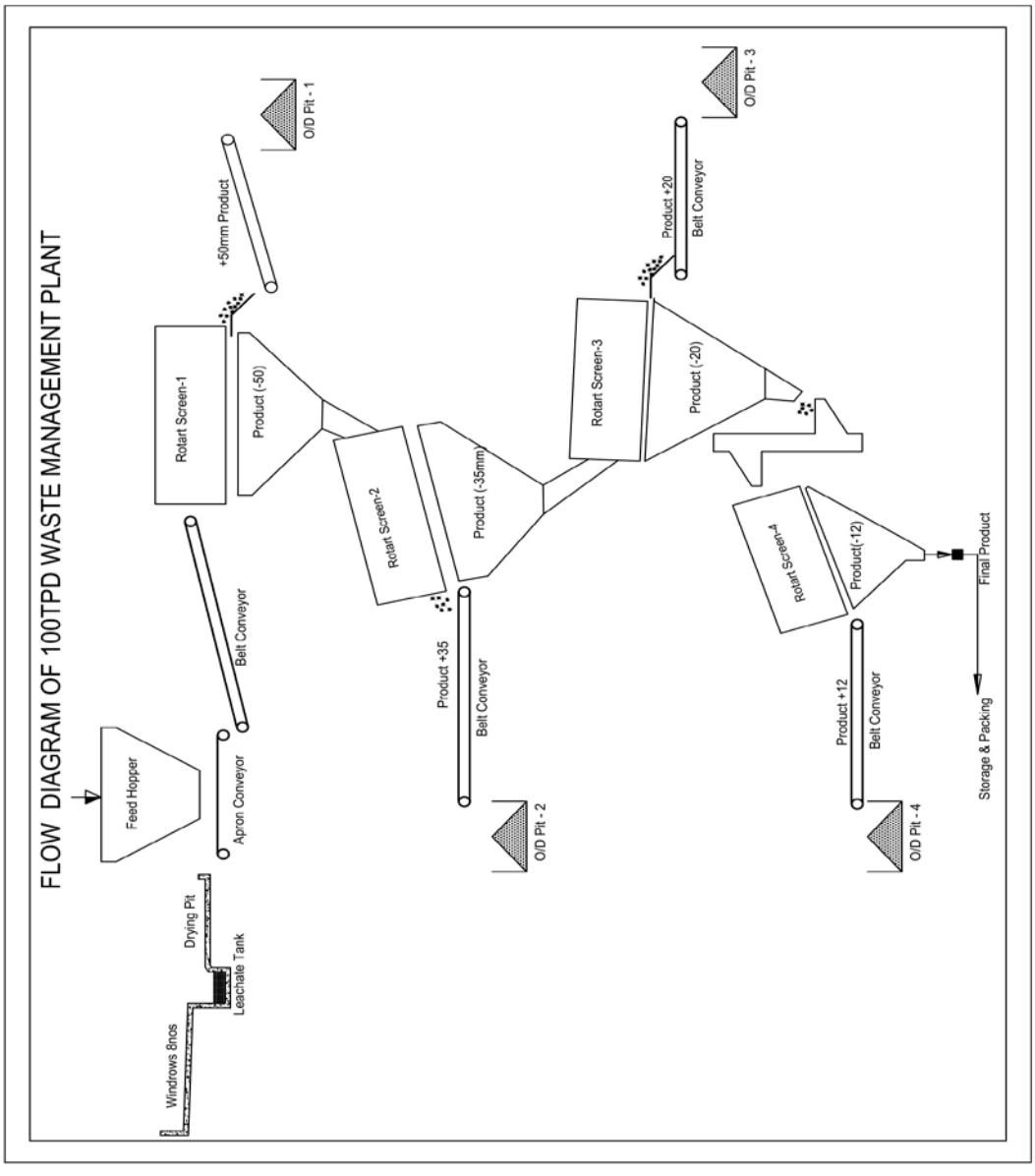
Technologies for composting can be classified into the following general categories:

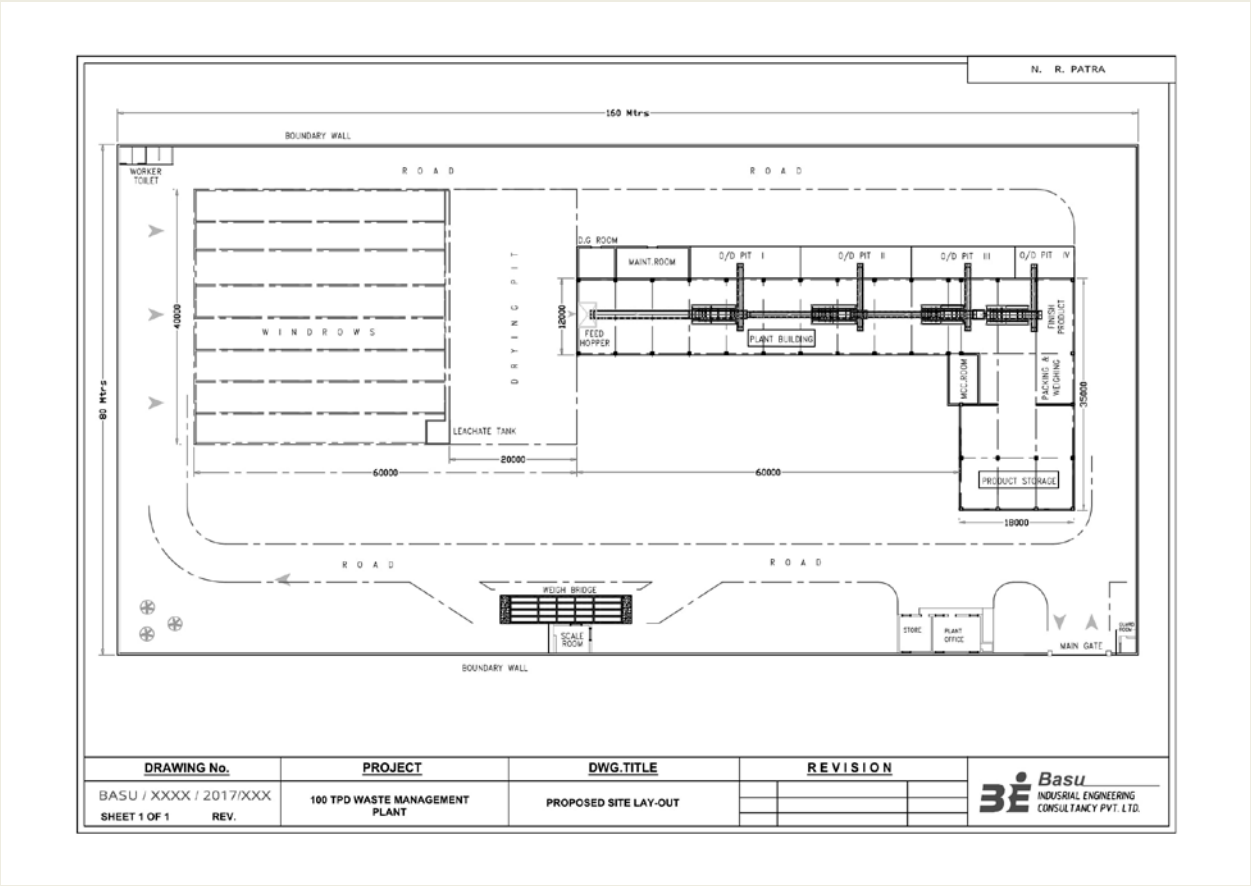
- Windrow Composting
- Aerated Static Pile Composting
- In-Vessel Composting
- Decentralized Composting
- Vermicomposting

We are using the **windrow composting** method.
Windrow composting process consists of placing the pre-sorted feed stock in long narrowpiles called windrows that are turned on a regular basis for boosting passive aeration. Theturning operation mixes the composting materials and enhances passive aeration.

Below Figure gives a brief overview of the windrow composting process

Material Flow chart of Windrow Composting Process





Layout Diagram of the Plant

9.5.1 Unit Operations In Windrow Composting

Compost pad should be impervious, have a drainage system to collect leachate for treatment and an appropriategradient to route the leachate to the collection point.Windrow composting is the most economical and widely accepted compostingprocess.

Compost pad (platform): The pre-processed MSW is transferredonto the compost pad into windrows. The compost pad is an area where the windrows arestacked. The compost pad is stable, durable. it is constructedwith an appropriately designed combination of RCC and PCC. The compost pad have a slope of about 1% to drain the excess water (storm water or leachate) from thewindrows into a leachate collection tank. The leachate tank is placed in the lowest cornerof the compost pad area. This leachate should be reused for recirculation of nutrients andfor maintaining the moisture content of windrows

Following factors hastaken care in design of the compostingpad:
1. The base have a barrier to prevent the percolation of leachate andnutrients to the sub-soil and groundwater.
2. The surface has to facilitate equipment movement even during wet weather conditions.

9.5.2 Windrow Formation:

The size, shape, and spacing of windrowson the equipment used for turning. Manual labors used for windrowsof a smaller scale .

9.5.3 Windrow Turning

Regular turning of the windrows helps oxygenate the pile; breaks up particles to increasesurface area; improves the porosity to prevent settling and compaction; and allowstrapped heat, water vapor, and gases to escape. In general, the more frequently a pileis tuned, the more quickly the composting process is completed.

A turning schedule should be established based on the rate of decomposition, moisturecontent, porosity of the material, and the desired composting time .

In general, each windrow should be allowed to stay on the compost pad for 7 days andat the end of the 7th day the compost is ready for use. Each windrow should have a flagboard depicting the age of the waste. Fresh incoming waste is always depicted by “Age1”. The numbering on the windrow changes from Age 1 to Age 2 on the second day; Age2 should be changed to Age 3 on the third day and so on.

Fresh water or leachate stored in the leachate tank should be sprinkled during the turningprocess to maintain the moisture content of the waste.

Temperature should also be monitored and maintained within 55-60°C.This is importantbecause low/ high moisture and variation in temperature can slow down the compostingprocess.

On the 8th day, the compost is loaded on the feed hopper, the apron conveyor will feed the material to belt convey 1 to transfer the material to rotary screen no1 this will successively sieved through four stage screening systemof -50mm followed by -12mm. Screened material coming out of this section is uniformin texture but contains semi-solid organic compost, which requires further stabilization.There are 4nos of rotary screen for sieved the material and four nos. of belt conveyor to transfer the material for screening. This four rotary screen screening the material in different size i.e.-50, -35,-20 and -12.The reject material from this four sizes will go to the 4 different O/D pit through the belt conveyor i.e.

+50 material will go to O/D pit 1 , +35 material will go to O/D pit 2, +20mm material will go to O/D pit 3 and +12 mm material will go to O/D pit 4.In every O/D Pit the bacteria is available they will eat material and make it to different size. The reject material from the +50 to+12mmmaterial will further loaded on the conveyor to rotary screen after some days for process of screening the material to get the final product i.e. -12mm.

9.5.4 Curing

Screened material coming out of the coarse segregation section requires furthermaturation and moisture control for producing a product that is beneficial for plants andsoil. The degree of maturity is determined through either oxygen uptake or carbon dioxideproduction rate.

Maturity may also be determined through a simple test, wherein the material is placed ina plastic bag and moistened to 60% water content, the mouth of the bag is then closed.The plastic bag containing the moist material is allowed to sit for 24 to 48 hours at room it indicates that the material is not fully matured and needs to undergo further decomposition.

The cured material does not release odors because of carbon stabilization during aerobicdecomposition of bio-degradable materials in the windrow. Microbial activity continuesduring the curing phase also, but at a lower rate compared to the main compostingphase.

During curing also, the supply of adequate oxygen is ensured throughpassive movement of air through the pile and moisture content is maintained within 25 to30%. The curing piles are placed either in a storage area or covered area for a minimumduration of 2 weeks. In general, the area needed for the curing process is one quarterof the size needed for the windrow/composting process. The completely cured wellcomposted material does not release foul odor and is ready for final screening and forthe preparation of the finished product for marketing.

9.5.5 Compost Refinement:

At the end of composting phase, the material usually contains30 to 35% moisture. The composting is normally taken to be complete when the activedecomposition stage is over and the C/N ratio is around 20:1.The refinement section also consists of a feeder conveyer and a trommel with 4mmperforations. The screened product which is less than 4mm is passed through ADS (airdensity separator or de-stoner) to remove sand and grit. Then the compost can be putin bags and stored for sale. The remaining material greater than 4 mm in size should beput on top of the fresh incoming waste heap, to speed up the process of composting andfor absorbing excess leachate. The residue material from the ADS

is inert laced with fineorganic material. This should be kept out of the composting stream. This material can beused for landscaping.The finished product is dark brown with an earthy smell, fragile and rich in organic mattercontent and nutrients.The product is bagged and dispatched for marketing, to be used on farmer's fields.

9.5.6 Leachate Management:

Leachate generation during composting varies with seasons. The compost pad surface be designed with a proper gradient and surface drainagesystem such that the entire leachate from the windrows is directed through drainagepipes to a collection tank. This leachate utilized for moistening the wasteplaced in the windrows, as may be required. In case leachate production is higher thanconsumption, especially during rainy seasons, the leachate tank should be provided withtreatment facilities for treating the leachate before disposal. Normally, the leachate tank isprovided with a surface aerator for reducing the BOD content. Treated leachate could besubsequently used for irrigation and as a fertilizer.

9.5.7
Project Estimation :-

ESTIMATION FOR 100 TPD WASTE MANAGEMENT PLANT			
SL.NO.	**DESCRIPTION**	**PRICE/LAKH**	**REMARKS**
1	**LAND & ITS DEVELOPMENT :**		
1.1	Land Required 160 Mtrs X 80 Mtrs (Min)	20.00	
1.2	Land development such as Levelling, Boundary works, Inplant road, internal drainage, water and electricity supply etc.	12.50	
2	**SHED & BUILDING**	120.00	
2.1	Plant shed-1 (12 Mtrs X60 Mtrs X 6 Mtrs roof ht)		
2.2	Plant shed-2 (18 Mtrs X35 Mtrs X 8 Mtrs roof ht)		
2.3	Parking shed (8 Mtrs X10 Mtrs)		
2.4	D.G Shed (8 Mtrs X6 Mtrs)		
2.5	Maint. shed (8 Mts X10 Mts)		
2.6	Control Room (4 Mtrs X5 Mts)		
2.7	Plant Office(6 Mtrs X8 Mtrs)		
2.8	Security Room(3 Mtrs X3 Mtrs)		
2.9	Lobour Toilet(3 Mtrs X3 Mtrs)		
3	**CIVIL & RCC FOUNDATION WORKS**	110.00	
3.1	RCC Foundation works		
3.2	Wind rows (40 Mtrs X40 Mtrs)		
3.3	Drying Pit (40 Mtrs X40 Mtrs)		
3.4	Industrial flooring		
3.5	Brick wall		
3.6	Misc. constructions		
4	**PLANT & MACHINARY**	135.00	
4.1	Technological structures		
4.2	Equipment & machineries		
4.3	Conveyor & conveyor supports		
4.4	Trommels		
4.5	Electrical &instrumentation		
4.6	Safety devices & safety guards		
5	**ENGINEERING & CONSULTANCY**	20.00	

5.1	Design & detail engineering		
5.2	Erection & commissioning		
6	20ton weigh bridge	8.00	
		425.50	
7	contingencies @ 10%	42.55	
	Total	**468.05**	