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Manure from Municipal Solid Waste

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ABSTRACT

The disposal of municipal solid waste (MSW) is a problem, and a number of methods such as open dumping, land filling, sanitary land filling, incineration are used for the disposal for solid waste. Production of manure from waste is one option, by which we can convert waste to valuable that is manure for use in agriculture.

INTRODUCTION

The terms MSW describes the stream of solid waste ('trash' or 'garbage') generated by households, commercial establishments, industries and institutions. MSW consists of everyday items such as product packaging, grass clipping, furniture, clothing, bottles, food, scrap, newspapers, appliances, paint and batteries.

We all generate wastes on daily basis, which we collect in a waste bin at our home, until it is removed to the nearest municipal community garbage bin. The garbage is then transported to the dumping area notified by the municipal authority. However, this method only shifts the menace of garbage from one backyard to another.

TYPE OF WASTE

Solid waste can be classified into different types depending on their source. Household waste is generally classified as municipal waste, while industrial waste is usually hazardous, and biomedical or hospital waste is termed as infectious waste.

IMPACT OF SOLID WASTE

With increase in the global population and the rising demand for food and other essentials, there has been a rise in the amount of waste being generated daily by each household. This waste is ultimately thrown into municipal waste collection centers from where it is collected by the area municipalities to be further thrown into the landfills and dumps. However, either due to resource crunch or inefficient infrastructure, not all of this waste gets collected and transported to the final dumpsites. If at this stage the management and disposal is improperly done, it can have serious impacts on health and create problems in the surrounding environment.

Impacts of solid waste on health

The group at risk from the unscientific disposal of solid waste include the population in areas where there is no proper waste disposal method, especially pre-school children; waste workers; and workers in facilities producing toxic and infectious material. Other high risk groups include population living close to a waste dump and those whose water supply has become contaminated either due to waste dumping or leakage from landfill sites. Uncollected solid waste also increases risk of injury, and infection.

TREATMENT PROCESS

Local corporations have adapted different methods for the disposal of waste — open dumps, landfills, sanitary landfills, and incineration plants are used. One of the important methods of waste treatment is production of manure.

Process for MSW to Manure

All kind of bio-degradable organic wastes of fruits, vegetables, gardens, food residue, agro-process industries, fish, poultry and slaughter houses, etc. can be used for treatment and aerobic fermentation to handle mixed unsegregated waste.

1. The MSW received is stacked on a paved or cemented site so to avoid ground water contamination.
2. This MSW is piled up in heaps having 3-5 meters width and 2-3 m. height.

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3. 1 kg of culture is mixed in 500 liters of water and sprayed on one tone of MSW
4. Moisture content of MSW is maintained up to 50% throughout the decomposition period of 40 days.
5. The heaps are tuned upside down for aeration with the help of "Bobcat".
6. Aeration results in rapid microbial multiplication.
7. The temperature of heaps rises due to mesophillic bacteria, and reaches 40-45 ^{0}C. Within 40 to 48 hrs. thermophillic bacteria take over and the temperature of heap reaches to 70^0 C which kills the pathogens and ensures proper fermentation. With the span of time the bio-mass changes from light green to dark brown in colour.
8. After complete decomposition the moisture content of biomass is maintained up to 20% and sent for separating, grading, searing and air classification machine.
9. The decomposed biomass is first charged to trammel having mesh size 35 mm. Here the unwanted material is removed as oversize which contains stones, glass, plastic, rubber, metal, etc. (which can be recycled if properly managed. The undersize is sent to second trammel of 16 mm mesh size. In the second trammel, having mesh size 16 mm, again the unwanted material is removed as oversize and undersize is sent to third trammel. The third trammel consist of three sizing streams of mesh size 8 mm, 4 mm, and 2 mm. The undersize obtained from third trammel is of 2 mm. mesh size but still contains stones or sand. This material can be used for horticulture.
10. The undersize from third trammel is then sent to the "Destoner" where stones are removed and finally sent to the vibratory screens.
11. From the vibratory screens the final fully matured manure obtained is of 0.2 mm to 0.4 mm mesh size, and is packed in 50 kg. plastic bags.

Product recovery

Indian garbage has organic component from 35 to 45 % on wet garbage basis or to 70 to 90 % on dry matter basis, almost 90 to 95% of this component is utilized for production of stabilized organic fertilizer. After accounting for losses of moisture and CO_2, 20 to 30% organic fertilizer is recovered; i.e. each one MT of wet garbage can yield 200 to 300 kgs. of organic fertilizer. About 5 to 10% remnants comprising metals, plastic, glass and woody materials, are disposed off through appropriate recycling channels. Balance 8 to 10 % rejects are required to be land filled till suitable use is found out.

Culture

A culture is the growth of microorganisms in or on a nutrient medium. A pure culture consists of a nutrient medium containing the growth of a single species of microorganisms. Different species of bacteria growing on the same kind of medium may appear quite different. Thus the knowledge of the appearance or the cultural characteristics of a species may be useful for the identifications of the species. For that purpose bacteria must be obtained in a pure culture.

- ***Psychrophiles*:** Psychrophiles are commonly defined as microorganisms capable of growth at 0^{0}C, though they grow best at higher temperature, between 15^{0}C to 30^{0}C;
- ***Mesophiles*:** These are classified in two subdivisions, a) those whose optimum growth temperatures are from 20^{0}C to 45^{0}C; and b) those whose optimum temperatures are between 35^{0}C to 45^{0}C.
- ***Thermophiles*:** Thermophiles have optimum growth temperature of 45^{0}C or high and generally grow over a range of 40^{0}C to 75^{0}C.

Product composition

Organic fertilizer/soil enricher is highly stabilized and balanced plant food having N, P, K, Ca, Mg, S and other trace elements required for almost all crop plants. In addition, it has several soil health improvement properties such as rich source of essential food for micro-organisms in the soil and or-

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ganic carbon for improving biological properties of soil, water holding capacity, root aeration, soil texture, structure, etc.

PROPERTIES OF ORGANIC MANURE PRODUCED FROM MSW

Physical

Manure is dark brown, rich humus-like coarse material free of foul smell, weed, seeds and extraneous matters. Direct manorial value is much better than farm yard manure. It has high moisture holding capacity, and is a rich stabilized organic nutrition system for improving the health of soil.

Biological	
Total bacterial count	1010
Actinomycetes / gm	104
Fungi / gm.	106
Azotobactor / gm	106
Root nodule bacteria	104
Phosphate solubilisers	106
Nitrobactor / gm	102
Chemical	
pH	6.8 to 7.8
Organic substances	6.8 to 7.8
Organic carbon %	11 to 16.0
Nitrogen	1.20 to 2.20
Available phosphorous %	1 to 1.50
Total phosphorous %	2.5 to 3.2
Potassium %	1.00 to 1.50
Calcium %	2.00 to 4.00
Magnesium %	0.70 to 0.90
Sulphates %	0.50 to 0.80
Fe %	0.50 to 1.00
Zn ppm	300 to 700
Mn ppm	250 to 740
Cu ppm	200 to 300

Co, Mo, B present in sufficient quantities required by crops.

NEED FOR ORGANIC FERTILISERS

1. Two-third of Indian agriculture is dependent upon seasonal rains. The main rainy season is of 90 days duration only (from 15th June to 15th September). Hence need for moisture conservation around root zone is essential. This is not possible without organic fertilizers.

2. Chemical fertilizer usage is 66 kg/ha/yr, with fertilizer use efficiency of 35 to 60%. This can be easily improved with the organic manure application.

3. In India over 150 crops of diverse nature requires integrated plant nutrition system. Increased focus on vegetables/fruits/spices/ herbals and medicinal crops requires organic manure for quality produce.

TABLE 1
COST OF PROJECT

[Rs. Lakhs]

Particulars	**Amount**
Building	**16.0**
Factory building	12.0
Site Development	4.0
Plant & machinery	**28.0**
Process Equipment	20.0
Mobile Machine	6.0
Electrical Substation	2.0
Vehicles & Office Equipment	0.6
Contingencies	2.0
Margin for Working Capital	3.4
Total cost of project	**50.0**
Funded as below:	
Loan from financial institutes	35.0
Govt. subsidy	10.0
Investment from operator	5.0

Note: No cost has been factored for the land as it is presumed to be taken on lease from Municipal Corporation

4. Increasing soil illness due to imbalance chemical fertilizer uses can be corrected with organic manure.

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TABLE 2
COST ESTIMATION FOR PLANT

[Rupees]

	Per day	**Per month**	**Per month**
Labour 10 @ 2000	20,000	240 x 10^3	
Supervisor @ 6000	6,000	240 x 10^3	
Lab	50	1,500	72 x 10^3
Culture water spraying @ 50 Rs. 1 tonne.	1500	45,000	540 x 10^3
Packing unit 80 bags of 10 kg	800	24,000	2,88,000
Manager @ 10000	10,000	1,20,000	
Vehicle	100	3,000	36,000
Miscellaneous	100	3,000	36,000
Working Capital required.	1,12,500	13,50,000	
Product formed =			
4 MT @ 2500 Rs./MT	10,000	300 x 10^3	3.6 x 10^6
Profit		**187.5 x 10^3**	**2.25 x 10^3**

5. The standard NPK ratio is 4:3:1, but now-a-days 9:3:1 is used in synthetic fertilizer which is proving harmful.

CONCLUSION

Waste management by means of composting which gives manure has potential to produce a valuable soil enhancing product. The process of manufacturing manure requires low installation, as well as capital investments. With the government providing subsidies for setting up such plants their economics can be attractive.