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Composting of Municipal Solid Waste of Jabalpur City

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Abstract: A pilot study was conducted to asses the feasibility of composting of source separated organic matter of municipal solid waste (MSW) generated in low, middle and high income areas of Jabalpur city with a population over 5 lack. Results of MSW analysis indicate the presence of high percentage of Biodegradable organic matter, acceptable moisture content and C/N ratio. On windrow composting, not only the volume of the waste was reduced but also produced a crumbly earthy smelling soil-like, compost material. All quality parameters in the compost samples were found to be within the acceptable limits set by international standard. The pH ranged between 7.8-8.1, organic matter 45%, moisture 36% and have acceptable amount of plant nutrients C35%, N (0.05%), P (0.002), Na (4.8%), K (0.35%). The compost quality could further be improved by adding cow manure, poultry manure or yard waste etc. Its use in plant production or land reclamation may be helpful to maintain soil fertility and improve moisture holding capacity. MSW Composting could be adapted country wide to recycle/reuse the organic residue as solid waste management option.

Key words: Municipal solid waste (MSW) · Composting · Recycle

INTRODUCTION

Rapid increase in population and change in life style in India have resulted in a dramatic increase in (MSW). MSW includes both domestic and commercial waste account for a relatively small part of the total solid waste stream in developed countries [1]. Accumulation of a large amount of waste may create several problems to inhabiting populations. It requires application of some effective strategies for proper disposal of (MSW). Composting is a microbial based aerobic process which is now consider as an environmentally sound way to reduce organic waste and produce organic fertilizer or soil conditioner [2]. Modeling composting process is the prerequisite to realize the process control of composting. Over past years, there have been many approaches [3]. which have been used to investigate composting processes [4-6] considered growth rates of microorganisms and used the mooned equation to simulate the composting processes [7-9] made emphasis on the thermodynamic and physicochemical changes taking place during composting processes [10,11] developed a dynamic simulation model to present biodegradation processes in composting based on the knowledge of the physical and chemical change occurring in the processes [12,13] also conducted a number of workers on the modeling for composting process. The MSW composting is being encouraged in many countries of the world and researchers have experienced the benefits of using MSW compost in the field [14-17].

Keeping in view the quantum of MSW generation in Jabalpur city and huge cost for its disposal, the present investigation was carried out to select an appropriate system of solid waste management which is discussed in this paper.

MATERIALS AND METHODS

The investigation was conducted at Madhya Pradesh Pollution control Board Vijay Nagar Jabalpur and Mycological Research laboratory R.D.V.V. Jabalpur Campus in the month of March to May 2009 at ambient temperature ranging from 35 to 45 °C. MSW were collected from nine different localities from Jabalpur city, representing high, middle and low socio economic areas. The organic material mainly vegetable, fruit and kitchen waste etc., were separated manually and subjected to turned windrows composting process. Percentage of organic waste generated at various income groups were determine as per [18].

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The total weight of introduced organic material for composting and the finished compost were calculated by weighing. Required operation conditions of composting were maintained as per [19]. Aeration typically in the heap was provided by manually turning of waste. A heap of manually separated mixed MSW of 4' high, 8'long was placed on paved ground on composting windrow type and was watered regularly to maintain moisture level between 50- 60% and turned manually every 3-5 days for the first six weeks of composting cycle. From the seventh week, the moisture was allowed to drop when optimum biosolids decomposition was achieved. The process was completed in about 8-9 weeks. After this period the compost was allowed to cure for additional three weeks without turning. The finished compost was then screened out and weighed. A representative compost sample was taken from the homogenized compost heap for the sequential physicochemical analyses. Sub-samples (250 g) were taken from 4 different points of the compost heap (bottom, surface, side and centre).the following physical parameters pH, Electrical conductivity, was determined on a sample in water (1:5), the Organic carbon (TOC) was determined by TOC analyzer, Phosphorus was analyzed by spectrophotometer and the Concentration of Sodium and Potassium in the sample were measured using flame photometer. Total Kjeldahl Nitrogen (TKN) was estimated by [20].

RESULTS AND DISCUSSION

Presence of significant amount of biodegradable organic and inorganic materials in comparison of those of standard value [22]. as shown in Table 1 and 2. cleanly indicate that the organic fraction of the refuse was highly suitable for composting process. Similar observations have also made by many earlier workers [23, 24,]. It was observed during the process that the mixture heated up rapidly, reaching a temperature of 48°C after one day of composting. By maintaining the temperature of 48 – 50 °C for initial 3 days of the process, the frequency of turning and mixing of the waste was increased to obtain temperature between 35- 40 °C, (an optimum level for microbial degradation) [25-27]. During the course of present investigation, it was observed that the reduction in weight of waste was more significantly in the first week. It may be done to maximum microbial activity during this period. Composting of MSW during summer season required 4-8 weeks where more than 70% weight loss was recorded, earthy smell of the material after one week cleanly indicated the maturity of compost [19, 28]. It was noted that the weight loss gradually become more pronounced during first week of the test, as microbial activity increased to maximum. It was observed that, the composting process in summer season was completed in about 4-6 weeks. The weight reduction in summer season it was above 70% similar finding observed by [29]. The screened compost samples were drawn and analyzed in the laboratory for the parameters such as pH, Organic matter and moisture. Data recorded in Table 3 and 4. cleanly indicates that the test sample were at part with prescribed international standard of quality of compost. Organic matter was significantly high (39-47%) while carbon, nitrogen ratio and pH values more or less lies at part with standard. Comparatively low nitrogen content was recorded. The amount of other plant nutrients viz. phosphorus (0.42-0.85%),

Table 1: Composting of municipal solid waste in high, middle and low socioeconomic localities

S.No.	*Components*	*High%(by weight)*	*Middle*	*Low*
1.	Paper	9	6	4
2.	Plastic / Polythenes	14	17	21.4
3.	Textile	1.5	3	2
4.	Rubber/ Leather	1	2	1.2
5.	Metal	0.8	0.5	0.3
6.	Glass	3.2	4.2	1.3
7.	Food wastes	30.2	28.5	24.4
8.	Soil	38.5	37.3	42.2
9.	Miscellaneous	1.8	1.5	3.2

Table 2: Average chemical composition of municipal solid waste

S.No.	*Parameters*	*Average values*	**Standard values suitable for composting*
1.	pH	7.80	5.5-8.0
2.	Moisture (%dry basis)	36	<50
3.	Organic matter (%dry basis)	45	>20
4.	Nitrogen (%dry basis)	0.05	>0.6
5.	Carbon (%dry basis)	32	30-40
6.	C/N ratio (total dry basis)	40:1	25-50:1
7.	Phosphorus	0.002	No specs
8.	Sodium	4.8	No specs
9.	Potassium	0.35	No specs

(*Source: Standard Zucconin, F. and deBertolidi, M., 1987) [21]

Table 3: Comparative average values of pH, Organic matter (%dry basis) and moisture content of MSW Compost and Chemical fertilizer samples

S.No.	Sample type	pH	Organic matter (%dry basis)	Moisture
1.	MSW Compost (High income)	7.75±032	39±1.4	34
2.	MSW Compost (Middle income)	7.82±027	47±1.21	41
3.	MSW Compost (Low income)	7.84±052	44±1.5	25
4.	Chemical fertilizer	6.95±0.11	38±0.71	00

Table 4: Comparative average nutritional values and C/N ratio of composts and Chemical fertilizer samples

S.No.	Sample type	C(%dry basis)	N (%dry basis)	C/N ratio(Total dry basis)	P	K	Na
1.	MSW Compost (High income)	35	0.05	35:0.05	0.003	0.36	3.4
2.	MSW Compost (Middle income)	37	0.03	37:0.03	0.005	0.34	4.6
3.	MSW Compost (Low income)	32	0.07	32:0.07	0.002	0.32	4.3
4.	Chemical fertilizer	22.00±0.71	0.86±0.09	25:58	0.75±0.21	0.18±0.02	0.25±0.02
5	MSW Compost Quality Standard	>25	>1	<25	No Specs	NoSpecs	No Specs

Sodium (1.21-1.92%) and Potassium (1.00-1.80%) were also found within the acceptable limits as prescribed for soil conditioning similar observation have also made by several other workers [30-32].

The nitrogen deficiency could be improved by addition of phosphoric acid which also prevents excessive volatilization of ammonia [33].

The standard excellent quality compost, generally contain high concentration of nitrogen but no specific value set for Phosphorus or Potassium while the MSW compost prepared during the present study was found to be as good soil conditioner and ecofriendly cheap and best as compare to Chemical fertilizer. Therefore, its use in Jabalpur soil may add compost and improve the aeration, aggregation and water holding capacity use helps to prevent erosion, supplies slow release of nutrients and can control numerous soil born disease.

CONCLUSION

Based on the study it can be concluded that municipal solid waste is suitable for composting because of the presence of high percentage of biodegradable organic matter, acceptable moisture content and C/N ration in the waste. However, the composting process and compost quality could further be improved by adding inoculating agent like cow manure, poultry manure, yard waste etc. in the municipal solid waste. Since Jabalpur soil is sandy, erodible, low water holding capacity with little organic matter and nutrient content, the application of compost would be an investment in the long term for the health of soils and plants. Finally, it is concluded that a module of this type for the recovery of valuable and economical organic fertilizer- the compost, can be adapted country wide to recycle the organic residues as waste management option.

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