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Composition and Characterization Study of Solid Waste from Aurangabad City

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Abstract:

With the progress of civilization and rapid industrial development the problem of increase in waste generation becomes more complex in urban areas. The composition and characteristics of solid waste vary from place to place; factors that influence the quantity and composition are the average income level, the sources, the population, social behavior, climate, industrial production and the market for waste materials. The present paper is an attempt to study the composition of municipal solid waste generated from representative residential area and characterization study of the waste collected from disposal site of Aurangabad city. The study was carried out during three year study period from January 2007 to December 2009. The results reveals that, the average degradable material present in solid waste collected from representative houses were.83.50 %. Whereas the average non - degradable material present in cumulative solid waste collected from selected houses were 16.50 %. However the physic-chemical parameters of the solid waste collected from disposal sites were found in moderate range.

Keywords: Aurangabad, characterization, civilization, composition, solid waste.

1.0 Introduction:

Solid waste are generated from various sources viz. residential and commercial areas, institutions, industries, construction and demolition activities, municipal services, agricultural activities, treatment plants and special category sources. Solid waste of each municipal corporation is diversified in nature and highly dependent on the type of area from where it has collected (Yadav and Linthoingambi, 2009). The characterization studies of solid waste and found out that, MSW contains large organic fraction (30 - 40 %), ash and fine earth (30-40 %), paper (3–6 %) along with plastic, glass and metal (each less than 1%), calorific value of refuse ranges between 800-1000 kcal/kg and C/N ratio ranges between 20 and 30 (Kumar and Gaikwad,2004).

In order to select and plant the most suitable system for storage, transportation and disposal of waste the composition and characteristization study is play a significant role in waste management system. Characterization is also important to determine its possible environmental impacts on nature as well as on society (Alamgir and Ahsan, 2007).

The nitrogen, phosphorus and potassium of the MSW ranges between 0.5-0.7, 0.5-0.8 and 0.5 - 0.8% respectively. The calorific value ranges between 200 -3000 Btu / lb. (Bhide and Sundaresan, 2001). NEERI (1996), Nagpur carried out a study on the characterization of Indian MSW, demonstrating that it contains large organic fraction (30–40%), ash and fine earth (30–40 %), paper (3–6 %) along with plastic, glass and metal (each less than 1 %). During the present investigation Aurangabad city from Marathwada region of Maharashtra state was selected as a study area to study the composition and characterization of municipal solid waste. Aurangabad is one of the important, rapidly growing city from Maharashtra state of India. It is a headquarter of Marathwada region of Maharashtra state having historic background of about 400 years. It is located in central part of Maharashtra. Aurangabad city has been divided into 6 zones and 98 electoral wards. The solid waste generation in Aurangabad city is approximately 350 Metric Tones (MT) per day. The area of Aurangabad city is about 138 Sq. Km. The population of Aurangabad city was 8, 72,663 as per the census of 2001. Whereas, as per

the census of 2011 the population of Aurangabad city is about 1171330.

The waste collected from Aurangabad city were transported to Naregaon waste dumping site. The village Naregaon is situated 6 kilometers outskirts of Aurangabad city. The total area of Naregaon waste dumping site was about 46 acres. It is situated at latitude 19^0 54' 15" north and longitude 75^0, 23' 45" east (AMC, 2006).

The present investigation aims to asses the composition and characterization of waste genrated from Aurangabd city for selection of more specific and effective waste disposal method.

2.0 Materials and Methods:

To study the percent composition of waste generated from residential area 25 representative houses were selected from Begumpura ward of Aurangabad city (Image.1). For easy access in collection and transportation of waste to the laboratory for percent composition study, the 100 houses were surveyed from Begumpura area of Aurangabad city in vicinity of University campus. From which about 25 houses were selected randomly as representative houses for the waste composition study. The polythene bags of 5 Kg waste carrying capacity were provided to the residents of selected houses for the collection of daily generated waste. These bags were brought to the laboratory and weighed for the quantity. From the household collected solid waste 1 Kg of thoroughly mixed waste samples were selected for study. The components such as remains of vegetables and food waste, paper, plastic, glass/ceramics, metal, fine earth and ash and miscellaneous were segregated manually by handpicking. The each component was weighed by using weighing balance and the percent weight of each portion of the waste was calculated.The study was carried for one month, to consider it as a representative percent composition of waste from residential area of city.

To study the physico-chemical characteristics of solid waste, the samples were collected from Naregaon waste dumping site. The sampling was carried out by using quartering method. The study was carried out during the study period from January 2007 to December 2009. The samples were analyzed in laboratory to study the characteristics viz. moisture content, pH, Organic matter, Carbon, Total Nitrogen, Phosphorus as P_2O_5 and Potassium as K_2O. The methods used as described by APHA, 1998; Trivedy and Goel, 1986; Maiti, 2004, Kaul and Gautam, 2002 and CPHERI, 1974.

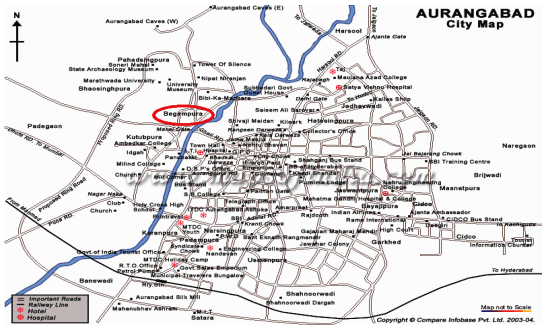

Image.1: Map of Study area (Aurangabad city) showing Begumpura area in ciricle

Image2.: Satellite imageries of Naregaon waste dumping area

3.0 Results and Discussion:

The percent composition study of solid waste collected from selected were carried out and the results were summarized in Table 1 and Fig. a. The average values of the segregated components viz. vegetable and food waste, paper, plastic, glass/ceramics, metal, fine earth and ash and miscellaneous of the municipal solid waste generated from selected representative houses of Begumpura were 28.31 %, 8.11 %, 4.61 %, 3.72 %, 4.08 %, 47.05 % and 4.06 % respectively. Whereas, the average degradable material present in cumulative solid waste collected from representative houses were 83.50 % and the average non - degradable material were 16.50 %. The study of the waste composition of MSW revels that; paper and paperboard 37.6 %, yard waste 15.9 %, plastic 9.3 %, metals 8.3 %, wood 6.6 %, glass 6.6 %, food waste 6.7 % and miscellaneous inorganic (including textile, rubber, leather and other) 9.1%. Drop boxes, both loose filled and compacted (Jim Kundell, 1996) .

The physical composition of the waste is obtained as a percentage of the different constituents. The paper content generally varies between 1.0 and 6.0% and increases with the increase in population (Bhoyar *et al.*, 1996).

The quantity of waste paper in India, is much less, as even the quantity thrown away is picked up by people for its use as a fuel and also for packaging of materials / food sold by road side hawkers. The plastics, rubber and leather contents are lower than the paper content, and do not exceed 1% except in metropolitan cities. The metal content is also low, (less than 1%). These low values are essentially due to the large scale recycling of these constituents .Paper is recycled on a priority basis while plastics and glass are recycled to a lesser extent (Joseph, 2002).

The biodegradable fraction is quite high in Indian MSW, essentially due to the habit of using fresh vegetables. The ash and fine earth content of Indian MSW is high due to the practice of inclusion street sweepings, drain silt, and construction and demolition debris in MSW. During the present investigation similar trend were observed from Aurangabad city.

The physico-chemical characteristics of solid waste were studied seasonally and the results were summarized in Table 2 and Fig. b, c, d, e, f and g. The maximum value of moisture content in collected solid waste sample from waste dumping site (Naregaon) of Aurangabad city were 42.6 %, 40.25 % and 42.9 % during the monsoon season and minimum were 14.89 %, 15.80 % and 16.30 % during summer of the study period January to December 2007, January to December 2008 and January to December 2009 respectively.

The values of organic matter ranged between 19.11% to 24.6 % during January 2007 to December 2009. The pH values of the solid waste sample were ranged between 7.5 to 8.9 during the study period January 2007 to December 2009. The maximum value of carbon content were found 16.43 % during winter season of year 2009 and minimum were 11.13 % during winter of 2007. The maximum values of the nitrogen content were 0.77 % and minimum were 0.56% during year 2009 and 2008 respectively. The maximum values of phosphorus were 0.78 during winter season of 2007 and minimum were 0.41 % in summer season of year 2008.The maximum values of the potassium (K_2O) content were 0.94 % during winter season of 2008 and minimum were 0.39 % in summer of 2007.

Table 1: Percent (%) composition of MSW generated from representative houses of Begumpura area from Aurangabad city.

House No.	Waste generation quantity in grams						
	Vegetable and food waste	Paper	Plastic	Glass/ ceramics	Metal	Fine earth ash	Miscellaneous
1	26.4	9.2	5.1	3.4	4.8	48.7	1.4
2	27.2	8.4	4.9	3.8	4.5	48.4	2.8
3	28.1	8.1	4.2	3.7	4.7	47.9	3.3
4	27.9	7.5	4.9	4.1	4.6	48.5	2.5
5	28.5	8.7	4.6	3.8	4.8	47.9	1.7
6	28.7	8.2	4.1	3.7	2.7	45.9	6.7
7	28.4	7.9	4.2	3.1	3.5	47.6	5.3
8	29.3	8.4	4.1	3	3.1	45.6	6.5
9	29.8	8.4	4.4	3.9	3.7	47.4	2.4
10	28.5	7.8	5.4	3.9	4.3	46.4	3.7
11	28.4	8.3	5.1	3.2	5.4	46.9	2.7
12	29.5	7.8	4.1	3.9	4.2	46.7	3.8
13	28.9	8.5	4.4	3.4	4.8	48.7	1.3
14	27.8	8.2	4.1	3.8	4.3	46.4	5.4
15	28.2	7.9	3.3	4.1	4.2	47.9	4.4
16	28.6	7.5	3.7	4.3	3.9	45.4	6.6
17	28.2	7.9	4.1	4.5	3.7	46.9	4.7

18	27.9	8.1	5.3	3.7	2.1	46.2	6.7
19	28.1	7.8	4.4	2.9	3.5	47.2	6.1
20	27.6	7.5	5.4	3.5	3.5	46.1	6.4
21	28.8	7.8	5.2	4.1	3.8	47.8	2.5
22	28.5	7.8	5.4	3.9	4.3	46.4	3.7
23	27.6	9.1	4.9	3.3	5.1	47.1	2.9
24	28.5	8.2	4.6	4.1	4.2	45.9	4.5
25	28.5	7.8	5.4	3.9	4.3	46.4	3.7
Average	**28.31**	**8.11**	**4.61**	**3.72**	**4.08**	**47.05**	**4.06**
± S.D	**1.08**	**0.44**	**0.59**	**0.40**	**0.75**	**0.98**	**1.75**

(*All values were expressed in %)

Table 2: Seasonal characteristics of the municipal solid waste collected from Aurangabad city during January 2007 to December 2009.

Sr. No	Study period	Sampling seasons	Moisture Content (%)	pH	Organic matter (%)	Carbon (%)	Nitrogen (%)	Phosphorus (P_2O_5) (%)	Potassium as K_2O (%)
1	January – December 2007	Winter	21.57	7.6	21.85	11.13	0.60	0.78	0.64
		Summer	14.89	7.9	19.11	12.67	0.56	0.73	0.39
		Monsoon	42.6	8.8	23.51	12.61	0.67	0.60	0.67
2.	January – December 2008	Winter	24.35	7.5	22.7	15.38	0.58	0.57	0.94
		Summer	15.80	8.3	20.91	14.54	0.56	0.41	0.74
		Monsoon	40.25	8.7	21.82	13.06	0.63	0.46	0.64
3.	January – December 2009	Winter	26.21	7.4	23.4	16.43	0.72	0.63	0.97
		Summer	16.30	7.6	22.3	15.01	0.60	0.44	0.79
		Monsoon	42.9	8.9	24.6	12.86	0.77	0.52	0.68

All parameters were expressed in % except pH

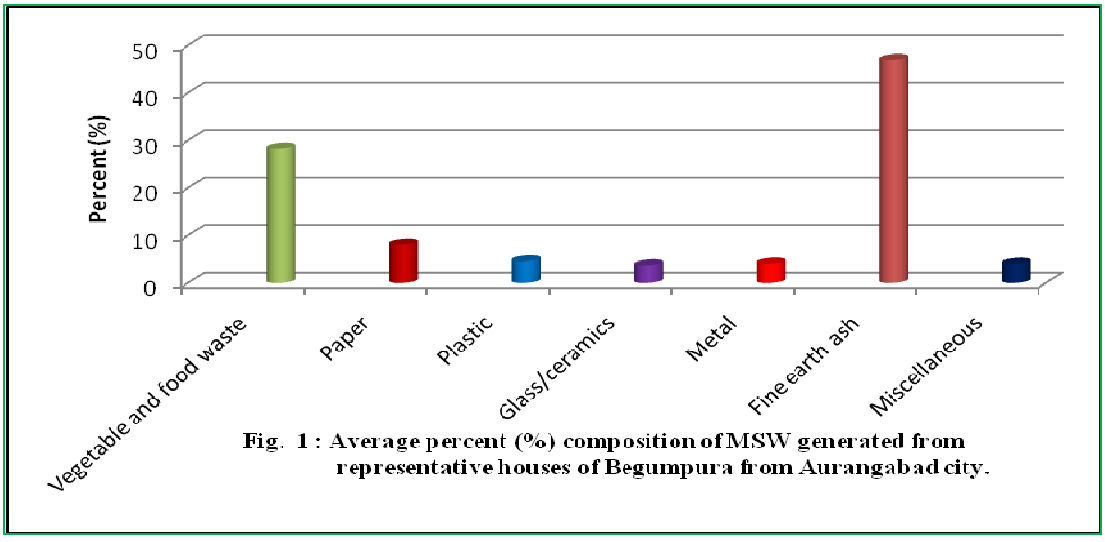

Fig. 1 : Average percent (%) composition of MSW generated from representative houses of Begumpura from Aurangabad city.

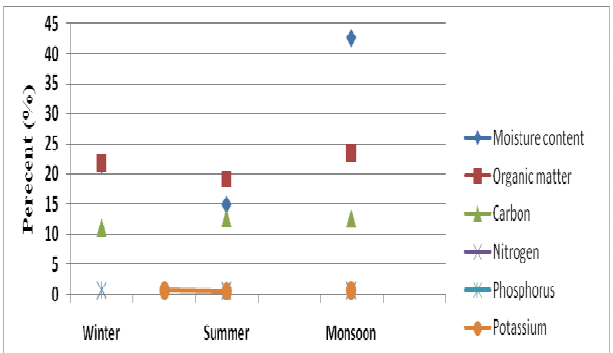

Fig.b : Seasonal variation in characteristics of the MSW collected from Aurangabad city during January 2007 to December 2007.

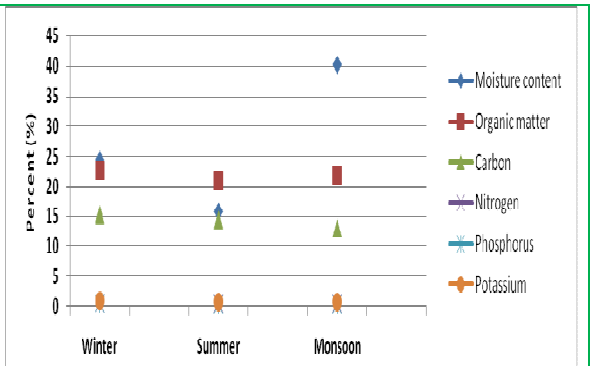

Fig. c : .Seasonal variation in characteristics of the MSW collected from Aurangabad city during January 2008 to December 2008.

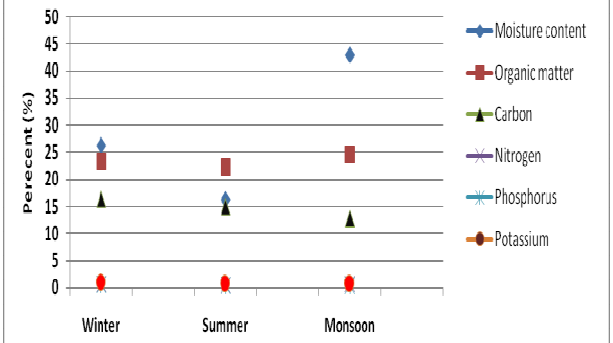

Fig. d: Seasonal variation in characteristics of the MSW collected from Aurangabad city during January 2009 to December 2009....

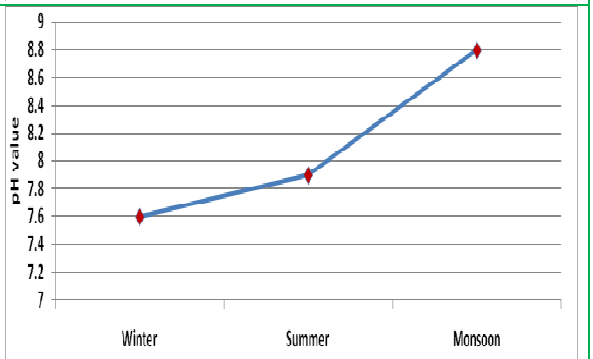

Fig. e: Seasonal variation in pH value of the MSW collected from Aurangabad city during January 2007 to December 2007.

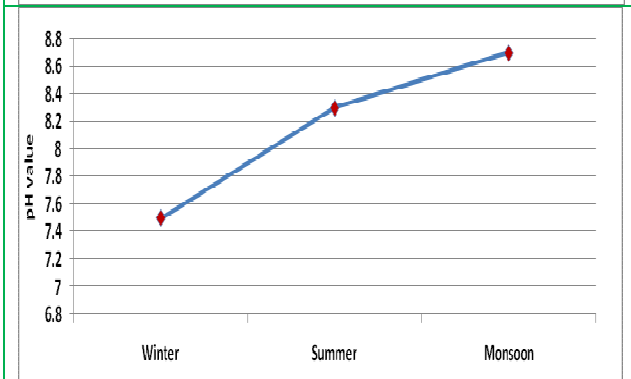

Fig. f : Seasonal variation in pH value of the MSW collected from Aurangabad city during January 2008 to December 2008.

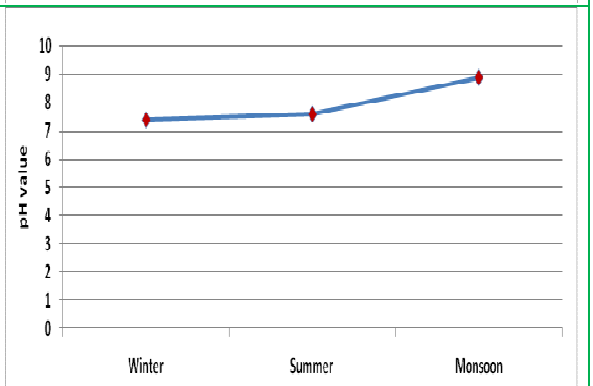

Fig. g : Seasonal variation in pH value of the MSW collected from Aurangabad city during January 2009 to December 2009.

The moisture content in city waste is significantly higher and the calorific value is much lower, which determines the viability of composting or anaerobic digestions rather than waste combustion (Yousuf and Rahman,2007).

The higher moisture content in the MSW was observed at Shillong, Kohima (65%), Simla, and Agartala due to heavy rains. For cities having a population of 1–2 million (11 cities), the ranges for various constituents varied, with a compostable fraction of 39 – 54 %, recyclables of 9–25 % and

moisture content of 25–65 %. In the case of cities with populations greater than 2 million (13 cities), the constituents varied such that the compostable fraction was 40–62 %, recyclables were 11–22 % and moisture content was 21–63 % (Kumar *et al*.,2009).

Physical and chemical characteristics of solid waste are important to implement the waste disposal and management plan for the selection of resource and energy recovery potentials. A number of studies have been conducted to determine the composition of wastes including moisture content and calorific value (Tyagi, 2008).

4.0 Conclusions

The results obtained during the present investigation reveals that;

i) The waste generates from residential areas of city areas comprises the maximum portion of degradable material as compare to non-degradable portion of waste.

ii) The characterization study of waste collected from waste disposal sites reveals that, parameters of waste viz. pH, moisture content, organic matter, organic carbon and NPK were found in the moderate range.

iii) It reflects that waste generated from Aurangabad city area are suitable for the application of composting techniques.

5.0 Acknowledgement

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