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MUNICIPAL SOLID WASTE MANAGEMENT EVALUATING CHEMICAL CHARACTERISTICS IN BAHRAICH CITY, (U.P.) INDIA

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ABSTRACT

This paper presents an assessment of the existing situation of municipal solid waste management (MSWM) in Bahraich City. The quantity and composition of MSW vary from place to place, and bear a rather consistant correlation with the average standard of living. Field investigations were carried out for quantification, analysis of physico-chemical composition and characterization in disposal site. Studies carried out in these places have revealed that there were many shortcomings in the existing practices used in managing the MSW. These shortcomings pertain mainly to indequate manpower, financial resources, implements and machinery required for effectively carrying out various activities for MSWM. Various adopted treatment technologies for MSW were critically reviewed, alongwith their advantage and limitations. The study was concluded with a few fruitful suggestions, which may be beneficial to encourage the competent authorities/researchers to work towards further improvement in the present system.

Figure : 00 References : 13 Tables : 03

KEY WORDS : Municipal solid waste, Organic matter, Waste characterization.

Introduction

Municipal solid waste management (MSWM) is one of the major environmetal problems of Indian cities. Improper management of municipal solid waste (MSW) causes hazards to inhabitants. Various studies reveal that about 90% of MSW is disposed off unscientifically in open dumps and landfills, create problems to public health and environment.

Urban areas expand. Individuals are not willing to accept the implemetation of a new landfill site near them because of concern about smell, litter, pollution, pests and the reduction in the value of their homes. There are large costs involved in providing conveniently located and environmentally responsible landfill facilities.

Waste is the most visible environmental problem among many in urban areas. Increasing population, changing consumption patterns, economic development, changing income, urbanization and industrialization result in increased generation of solid waste and also a diversification of the types of the solid waste generated. Solid waste is often called the third pollution after air and water pollution. Solid waste consists of highly heterogeneous mass of discarded materials from residential, commercial and industrial activities[1,9]. The impact of disposed waste is composed of (i) the contamination of surface and ground water through leachate; (ii) soil contamination through direct waste contact or leachate; (iii) air pollution through burning of wastes; (iv) spreading of diseases by different vectors like birds, insects and rodents; (v) odour in landfills and (vi) uncontrolled release of methane by anaerobic decomposition of organic matter in waste. Although some governments have formulated policies for environmental protection, these policies have been implemented only in the national capital cities. In rural areas, open dumping is still the most commonly used method of solid waste disposal.

Waste cannot be dumped without due concern and preparation, because not only it is unpleasant, unhygienic and potentially disastrous to our environment, it also

TABLE-1 : Sample location and period of selection.

S. No.	Sample	Period of study	Climate
1.	Sample I	June 2017	Rainy season
2.	Sample II	November 2017	
3.	Sample III		
4.	Sample IV		
5.	Sample V		
6.	Sample VI	December 2017	Winter season
7.	Sample VII		
8.	Sample VIII	Februry 2018	
9.	Sample IX		
10.	Sample X		

requires the allocation of space and incurs costs related to the consequences of the waste disposal. Moreover, suitable landfill sites are becoming more difficult to find. In recent years, the nation of integrated waste management, applied to reduce waste at its source before it even enters the waste stream, has spread. It means that waste materials generated must be recovered for reuse and recycling and the rest should be disposed at landfill sites. Unfortunately, disposal is not a sustainable solid waste management solution. The zero emission concept has arisen since the late 1990s. The amount of solid waste generated varies for different cities and towns. The concept is reflected by the phrase 'no time for waste' because the concept envisages all industrial outputs from processing being used as input process materials or converted into value added inputs for other processes, maximizing resource consumption and increasing eco-efficiency. In this way, the production process is reorganized into a closed loop system which emulates as an industrial metabolism of the sustainable cycles found in nature 'grown - use - waste - reuse'. Also, waste can be fully matched with the requirements of any other processes. A perfectly integrated process management produces 'no waste' and it can be an innovative system of sustainable industry development, where reduction, minimization and utilization of waste are simultaneously realized.

Solid Waste Management in Bahraich.

Bahraich City : General information:

The City lies 27°34' 15.02" N latitude and 81°3552.89°E longitude in the state of U.P., India. It is one of the 75 district of U.P. and part of Devipatan division as well as the historic Awadh region. Bahraich coordinates are near the Nepal Border, 53.8 km S of Nepalgunj and mid western region Nepal. Bahraich is a city and a municipal board in Bahraich District in the State of U.P. (India) located on the Saryu river, a tributary of river Ghaghra. Bahraich is 125 km North East of Lucknow, the state capital. Gonda, Balrampur, Lakhimpur and Seetapur share local bounadries with Bahraich. A factor which makes this town important is the international border shared with the neighbouring country, Nepal. On the basis of the 2001 census data on population, socio-economic indicators and basic amenities indicators covers an area 4.696.8 km^2. Bahraich had population as of 2011 census 3,478257 (Fig.-1). The average rainfall is only 807.5mm.

Soil and Vegetation : The geological formation in the area mostly belongs to great gneissic series with abundance of limestone found in extensive beds of grey, pink and white colours hinter banded with gneissic matter. The soil belongs to Irugur series, is moderately well drained with rapid surface run off and is mainly used for the cultivation of millet, paddy, cotton, tea, oil seeds and tobacco, where the water supply facilities are available. The flora mainly consists of palmyra, tamarind and xerophytes. Ground water in these areas occur in limited quantities in the pores available in the weathered material overlying in the crystalline-rocks and also in the joints, fissures and other opening in the rocks[12].

Materials and Methods

The solid waste of Bahraich city was collected from the Balrampur Road dumping yard. The sampling procedure adopted for collection was Quartering Technique[10]. In this method representative samples of 10kg were obtained from several parts of the heaps of the wastes and well mixed and during this it was ensured that equal amounts were taken from all parts so that a true representative sample could be obtained. Steps involved were :

Step 1: A part from other operations, a truck load waste was unloaded.

Step 2 : Quartering the waste load was done.

Step 3 : One of the quarters was selected and quartered that quarter.

Step 4 : The individual component of the waste were taken into preselected components from the

TABLE-2 : Physico-chemical characteristics of solid waste (July to November- 2017)

Parameters	Sample I	Sample II	Sample III	Sample IV	Sample V
Physical parameters (in %)					
Colour	Pale grey	Pale grey	Pale grey	Pale grey	Pale grey
Texture	Mixed	Mixed	Mixed	Mixed	Mixed
Leaves	0.06	11.90	5.01	6.01	9.84
Food wastes	18.14	13.90	40.01	43.20	13.63
Fruit residue	9.22	9.01	24.02	19.30	0.10
Ash & fine earth	61.80	40.28	13.03	9.01	27.01
Paper	1.04	8.98	6.60	3.41	8.70
Plastics	1.61	14.11	0.65	7.89	18.70
Wood Scraps	30.45	0.02	5.01	3.02	9.36
Textile	1.84	0.006	2.33	7.02	6.21
Metal	1.80	0.02	0.68	1.50	5.78
Rubber	0.25	0.003	3.35	0.04	3.25
Moisture Content	62.00	62.12	60.12	65.62	65.00
Chemical parameters					
pH	7.5	7.2	7.4	7.1	7.3
EC	3.45 mho/cm	3.79 mho/cm	3.52 mho/cm	3.52 mho/cm	3.12 mho/cm
Total Carbon	24.75%	30.20	35.70%	42.70%	43.25%
Total Nitrogen	0.81%	0.90	0.82%	0.98%	1.24%
Phosphourus	0.58%	0.68	1.24%	0.62%	1.22%
Potassium	0.90%	8.86	0.95%	0.44%	0.97%
C/N Ratio	30.32	37.60	43.02	46.00	37.01

selected quarter.

Step 5 : Separated components were placed in a container of known volume. The volume and mass of each component was measured. The separated components were compacted tightly to simulate the conditions in the storage containers from which they were collected.

Step 7 : The percentage distribution of each component by mass was obtained.

In this study, the daily waste quantity was computed and waste generation in kg/capita/day was calculated based on the urban population. The waste from identified trucks was thoroughly mixed and grab samples were collected from various trucks located in Balrampur Road Site, Bahraich Corporation. About 100 kg of sample was collected, throughly mixed and reduced to 10 kg by

TABLE-3 : Physico-chemical charateristics of solid waste (November, December 2017 and January 2018)

Parameters	Sample VI	Sample VII	Sample VIII	Sample IX	Sample X
Physical parameters (in %)					
Colour	Pale grey	Pale grey	Pale grey	Pale grey	Pale grey
Texture	Mixed	Mixed	Mixed	Mixed	Mixed
Leaves	8.85	8.90	7.92	8.50	11.01
Food wastes	19.12	24.98	26.0	27.00	27.02
Fruit residue	2.15	3.01	2.00	3.60	1.60
Ash & fine earth	25.16	22.01	36.00	43.25	35.00
Paper	34.00	34.02	21.00	14.01	20.95
Plastics	3.15	3.02	1.10	1.80	1.87
Wood Scraps	2.10	2.98	4.67	4.60	1.84
Textile	0.98	0.06	1.20	1.50	1.60
Metal	0.01	0.98	0.45	0.01	0.95
Rubber	0.01	0.26	0.52	1.75	0.22
Moisture Content	65.28	67.8	69.2	69.01	70.01
Chemical parameters					
pH	7.3	7.1	7.4	7.2	7.0
EC	3.43 mho/cm	3.98 mho/cm	4.42 mho/cm	3.55 mho/cm	3.54 mho/cm
Total Carbon	27.1%	23.01%	26.50%	40.01%	33.50%
Total Nitrogen	0.76%	0.78%	0.75%	1.20%	0.94%
Phosphourus	0.60%	0.76%	0.430%	0.47%	0.45%
Potassium	0.80%	0.55%	0.58%	0.43%	0.40%
C/N Ratio	33.85	32.81	36.13	33.02	36.01
Calorific Value	852 kcal/kg	852 kcal/kg	893 kcal/kg	895 kcal/kg	830 kcal/kg

*EC - Electrical Conductivity.

quartering technique. Using the quartering technique, the total waste mass was divided into four parts and waste from two diagonally opposite portions was taken and mixed. The other two portions were discarded. This procedure was repeated until a waste sample of approximately 10 kg weight was obtained. Characterization studies were conducted to assess the recycling and pollution potential of MSW[3,7,8,11].

Various components from the 10 kg sample, such as plastics, paper, metal, organic fractions *etc.* were

segregated and weighed and these were expressed as a percentage of the total weight. To determine the moisture content, the entire sample was weighed to obtain the wet weight (Ww). It was then dried in an oven at 105^{0C} till its mass became constant. After drying, the dry weight (Wd) was measured. Moisture content[2] is an important parameter affecting various processing operations *e.g.,* composting, incineration *etc.* of municipal solid wastes. It is expressed by the equation given below :

Moisture Content = $(W^W - Wd)/W^W$

The organic fraction was taken to the laboratory for chemical analysis. Chemical analysis was performed as per standard methods[3]. The parameters studied were pH, electrical conductivity (EC), carbon (C), total nitrogen (N), phosphorus (P), potassium (K) and C/N ratio.

Results and Discussion

The physical and chemical characteristics of the MSW were analysed and presented in Tables 2 and 3. The characteristics of MSW were analysed for two seasons during the period of July to November 2017 (Season I) and December to February 2018 (Season II).

Table.1 shows the sample location and period of collection of all the samples I to X. Table- 2 gives the physical and chemical characteristics of five samples of MSW of Bahraich city to season1. Table 3 shows the physical and chemical characteristics of five samples of MSW of Bahraich city for season 2.

Organic and inorganic contents : Analysis of the results revealed that organic contents were 12.52% in the first season and 15.14% in the second season. In organic were 8.31% in first season and 6.55% in second season on an average weekly disposal of five samples in two different seasons. From the results it can be concluded that the organic waste can be converted into organic manure by composting method. For the inorganic contents it can be concluded that after recovery and reuse they can be used instead of disposing into environment.

pH and electrical conductivity : pH was found to vary between 7.0 and 7.5 in both the seasons. Electrical conductivity varied from 3.98 to 4.12 mho/cm and it was maximum in the second season. This indicates the greater degree of mineralization[8].

Total carbon, phosphorus and potassium : Higher percentage of carbon of 8.865 in the first season and 36.01 in the second season concluded that waste could be controlled by composting successfully.

Phosphorus and potassium were found to be approximately 1% in both the seasons. In both the seasons C/N ratio was above 30% indicating that the organic manure of solid waste is rich in nutrients.

Calorific value : MSW samples from Season I have a maximum calorific value of 845 kcal/kg and 895 kcal/kg in season 2. This may be due to addition of waste materials from other sources[4].

Based on the studies, it is observed that solid waste is not being segregated and hence the energy that can be recovered from the waste by using suitable technology is not presently possible. Recently compost yard and land fill site has been developed and it will commence its operation very soon. The organic fractions can be either composted or used as organic manure or it should be biomethanated for generation of energy and the less organic fractions can be used for sanitary landfilling. The study is concluded with few fruitful suggestions, which may be beneficial to encourage the competent authorities/ researchers to work towards further improvement of the present system[13].

Conclusion

From the results the following conclusions can be drawn:

- ❖ All the samples were grey in colour.
- ❖ All the samples cotained food wastes, wood scraps,plastic, ash and fine earth, paper, textile, metal, rubber *etc.*
- ❖ Moisture content was found to be above 60% which is required for the process of composting.
- ❖ The amount of organic waste was high. Proper awareness regarding segregation of waste must be created among the people with the help of NGOs to reduce the cost of transportation and to reduce the volume of waste. Masks and gloves should be provided by the government to the labourers working at disposal sites. As given in the report, proper management of waste will include collection, segregation, storage, transporation, processing and disposal. This will lead to integrated solid waste management, will provide salubrious environment to the town making it green and clean town, environmental friendly, garbage and dust free and also to implement vision plan with full commitment.

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