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Research Paper

A Review and Physico-Chemical Analysis of Solid Waste Generated From Radhakrishna Temple Ward, Bangalore-A Case Study

Engineering

KEYWORDS :

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ABSTRACT

The present is to determine the problems and prospects of municipal solid waste and to analyze the various physic-chemical parameters of solid waste which is collect from Radhakrishna temple ward, Bangalore mahanagara palike, Bangalore. Solid waste is management is a worldwide phenomenon. It is one of the biggest challenges in Bangalore city and also all over the world for human begins.Radhakrishna temple wad has a population of 26211 in 2011 including 13862 male and 12349 female persons having latitude 13002'00.90``Nand longitude 77034'32.17``E. As per the land use pattern of Radhakrishna temple ward, nearly 1.95% of the area is in use household and garden land. Radhakrishna temple is a number 18 wardofBangalore city in the state of Karnataka, India and seventh most populous metropolitan area in Karnataka.Bangalore Municipal Corporation, Radhakrishna temple ward is responsible for the management of solid waste generated in the city. The study was carried out during six months study period from January 2015 to June 2015.Solid waste was collected from each house hold which is generated every day from the wad and also waste compost collected. The results showed that the MSW in the study area was very wet with an average value of 41.60 % by weight of fresh waste. The C:N ratios in the dried leaf and garden waste components were in the range of 20.8 to 32.6%. These results indicated that the MSW in the study area might be were found in moderate range. If this municipal solid waste landfill continues, it may create serious environmental problems. The present study will revealed a data of analysis about the amount of toxicity level and analyzed various nutrients of solid waste. This may bring the social awareness amongst the people and also presents the indicator of solid waste awareness about the sustainable solid waste management in Bangalore city.

Introduction

Solid waste is one of the major pollution problem caused by the household, construction, debris and other waste, which are generated as a significance of percolation, surface runoff and entry of ground water percolating through a landfill. In India, directly more than 90% of the municipal solid waste generated and dumping on land in an inadequate manner (Archana and V. Dutta, 2014). Municipal Solid Waste (MSW) Management and the associated technologies comprise a wide range of topics which have been studied in depth by researchers worldwide as well as those in India and an extensive literature exists in this domain. Though traditionally it is found that majority of the studies focused on cases in developed countries, now cases in developing counties in general and particularly in India have become the focus of research efforts (Rajput, et al., 2009).

India is one of the developing countries of the world with quick in increase in population, industrialization is not protected to the harmful effects of solid waste management on its existing environmental conditions which are highly vulnerable to deterioration. Since brisk urbanization is occurring in India, the problem of solid waste management is causing a great concern to our environment (Hazra and Goel, 2009).

Due to developmental activities, increase in population, industrial activities and increase in economic condition a trend of increase in municipal solid waste (MSW) generation has been recorded worldwide in major cities (MoEF. 2000). The annual waste generation has been showing increasing trend in proportion to the rise in population and urbanization (Mor, et al., 2006). Further, municipal solid waste (MSW) generation in terms of kg/capita/day has shown a positive correlation with economic development on a global scale (Ahmad, et al., 2008).

The solid wastes placed in open dumps are subjected to either entering into the groundwater or precipitation through infiltration and any other possibility of infiltration of water. During rainy season, the dumped solid wastes receive water and the by-products of its decomposition move into the water through the waste deposition. The waste dumped at this place includes domestic waste, office waste, institutional waste, commercial waste, restaurant waste, bus stand, railway station e.g. kitchen waste; paper, plastic, poly bags, glass, cardboard and cloths. Construction and demolition waste consisting of sand, bricks and concrete block are also dumped. Further waste from the adjacent slaughterhouse, dairy farm and non-infectious hospital waste is also dumped (Visvananthan, et al., 2003 and Bundela, et al., 2012). The densities of solid waste in Indian cities range from 280 to 1000 Kg/m3 (Hazra and Goel, 2009). Especially in Bangalore city is having big problem related to disposal of solid waste. In the present study under taken to determine the problems and prospects of municipal solid waste and to analyze the various physic-chemical parameters of solid waste which is collect from Radhakrishna temple ward, Bangalore Bruhat Mahanagara Palike (BBMP), Bangalore.

Materials and Methods

Study Area

Bangalore lies at having latitude 13002'00.90``N and longitude 77034'32.17``E. covering an area of 2,196 Sq.km. Bangalore is the planned city in India with a population of 8.5 million in 2011. Bangalore is the fifth most populous city in India and the 18th most populous city in the world. Bangalore was the fastest-growing Indian metropolis after New Delhi between 1991 and 2001, with a growth rate of 38% during the decade. The entire management of solid waste is taken care by Bangalore Bruhat Mahanagara Palike (BBMP). Figure 1 shows the location of Bangalore city. The corporation of the city is making efforts to devise plans and strategies for management of solid waste in an efficient manner.

In the present study one of the ward (Figure 1) was selected (Radhakrishna temple) of Bangalore Bruhat Mahanagara Palike (BBMP), Bangalore. Radhakrishna temple (ward no 18) with an area of 1.95 Sq. km and a population of about 26211 and 426 household. Nearby areas are Lottegollanahalli, Venkatachary Nagar, HIG North By Outer Ring road colony, RMV II stage, Dollar apartment, Krishna Layout, Amarajyothi Layout (P), Raj Mahal Vilas 2nd Stage 3rd Block, Naidu Layout (P), Judicial colony, AECS Layout, Jaladarshini Layout, Geddalahalli.

Field Survey

Total 20 representative houses were selected from Radhakrishna temple ward of Bangalore city (Figure 2). Total 50 houses were surveyed from selected study area of Bangalore city in vicinity of

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Radhakrishna temple (Ward 18). From which about 20 houses were selected indiscriminately as representative households for the solid waste composition analysis. The plastic container of standard 5 kg solid waste carrying capacity were provided to the households of selected residential houses for the collection of daily generated solid waste.

To evaluate the present situation of Solid Waste disposal in Radhakrishna temple ward, Bangalore, Karnataka, India to examine the problems and prospectus the study area. The location where solid waste was dumped was examined. Dried, fresh leaves and all garden waste are composted and practicing. The dried composted waste was and also solid waste collected from individual house hold finally segregated as biodegradable and non biodegradable waste.

Physico-chemical Analysis of Solid waste

The quantity of solid waste weighed to know the total quantity of solid waste. The House-to-house collected solid waste exactly 1 kg of thoroughly mixed solid waste samples were selected for present investigation. The collected solid waste was segregated properly and each component was weighed by using weighing balance.

To study the physico-chemical characteristics of solid waste, the samples were collected from Radhakrishna temple ward. The sampling was carried out by using quartering method. (Sunil Kumar, et al., 2009). The study was carried out during the study period from January 2015 to June 2015. The sample solid waste was analyzed for the following physicochemical parameter which includes pH, temperature, organic carbon, chlorides, Na, K (, flash point, specific gravity and calorific value. The methods used as described by APHA, (1998), Trivedy and Goel, (1986) and Maiti, (2004).

Results and Discussion

The sample solid waste was analyzed and the results were shown in Table 1 and Figure 3. The mean values of the separated materials viz. vegetable waste and food waste, paper, plastic, glass/ceramics, metal, fine earth and ash and miscellaneous of the municipal solid waste generated from selected household of the Radhakrishna temple ward. The each component comprises of plastics and polythene (8.9%), clothes (6.5%), paper (6.8%), wood/organic/vegetables (66.1%), glass (0.9%), Inerts (7.7%), rubber/leather (2.3%) and miscellaneous waste (0.8%). Whereas, the mean biodegradable material present in community solid waste collected from households were 87.90 % and the mean non-biodegradable material were 12.10 %. Bhoyar, et al., (1996) explained in their study, the physical characteristic of the solid waste is obtained as a percentage of the different materials. The biodegradable content generally varies between 1.5 and 5.9% and it in depend upon the population.

Generally, in India the quantity of paper waste is very less, as even the quantity thrown away is picked up by scavenger for its use as a fuel and also people for packaging of materials by road side and circles also a person who travels about selling goods. Except in metropolitan cities, the plastics, rubber and leather contents are lower than the paper content and do not exceed 1.5%. The metal content is also low, (less than 0.9%). These low values are essentially due to the large scale recycling of these constituents. Compare to paper, pastics and glass are recycled to a lesser extent (Joseph, 2002 and Amul Late and M. B. Mule, 2012).

The biodegradable materials are high Indian municipal solid waste is due to the tendency of using fresh vegetables. The ash and fine earth content of Indian MSW is high due to the addition of street sweepings, drain waste and demolished and construction waste in municipal solid waste. Present study also reveals the high biodegradable materials in municipal solid waste from Radhakrishna temple ward of Bangalore city.

The physico-chemical characteristics of solid waste were studied for two seasons (winter and summer) and the statistical analysis results were summarized in Table 2. The moisture content is showing high in collected solid waste sample from house hold waste compare to garden leaf composting yard in the selected area city were 39.6 %, and 41.2 % during the winter season and low were 15.80 % and 16.30 % during summer of the study period January to June 2015 respectively.

In the present investigation, the mean values of organic matter ranged between 18.20% to 22.8 % during winter season and 16.9% to 21.6% during summer season. The pH values of the solid waste sample were ranged between 7.5 to 8.9 during the winter and 7.2 to 8.8 during summer season. The maximum value of carbon content was found 14.24 % during winter season and minimum were 10.21 % during summer. The maximum values of the nitrogen content were 0.68 % and minimum were 0.38% during winter and summer respectively. The maximum values of phosphorus were 0.58 during winter season and minimum were 0.32 % in summer season. The maximum values of the potassium (K) content were 0.69 % during winter season and minimum were 0.29 % in summer season. The average value of present investigation and seasonal average values of municipal solid waste collected in the study are given from Figure 2 to 8.

Yousuf and Rahman, (2007) discussed in their study, the moisture content in city municipal solid waste is significantly higher and the calorific value is much lower, which determines the viability of composting or anaerobic digestions rather than waste combustion. The moisture content in the MSW was observed at different cities and describes that, the ranges of various constituents varied and depends upon the population and rainfall (Kumar et al.,2009).

Table-1 Composition (percentage) of MSW generated from house-house of Radhkrishna temple ward from Bangalore city

Parameter / Months	pH	Moisture	Organic matter	Carbon	Nitrogen	PO_4	K
January,15	8.9	41.2	18.6	12.4	0.52	0.42	0.59
January,15	8.8	39.6	18.2	13.8	0.62	0.58	0.69
February,15	8.2	39.8	19.6	14.3	0.68	0.46	0.62
February,15	7.9	41.6	20.4	13.9	0.59	0.57	0.66
March,15	7.5	41.5	21.8	12.6	0.61	0.42	0.58
March,15	7.8	39.8	22.8	14.2	0.60	0.42	0.62
April,15	8.8	16.9	16.8	10.2	0.38	0.42	0.31
April,15	8.6	16.3	17.2	11.6	0.42	0.34	0.29
June,15	7.2	15.6	21.6	12.5	0.45	0.40	0.32
June,15	7.4	15.8	20.4	12.2	0.42	0.32	0.28
Average	8.11	30.81	19.74	12.77	0.53	0.43	0.49

Note: All parameters expressed in terms of % except pH,

Table 2 Seasonal statistical values of the municipal solid waste collected Radhkrishna temple ward during January 2015 to June 2015.

Parameter	Unit	Winter			Summer			Recommended Standard
		Max	Min	SD	Max	Min	SD	
pH		8.9	7.5	0.56	8.80	7.20	0.82	6.9 to 8.3
Moisture	%	41.6	39.6	0.94	16.9	15.6	0.58	45 to 65%
Organic matter	%	22.8	18.2	1.80	21.6	16.8	2.37	> 30 %
Carbon	%	14.3	12.4	0.82	12.5	10.2	1.02	-
Nitrogen	%	0.68	0.52	0.05	0.45	0.38	0.03	0.05%
PO_4	%	0.58	0.42	0.08	0.42	0.32	0.05	0.4 to 1.1 %
K	%	0.69	0.58	0.04	0.32	0.28	0.02	0.6 to 1.7 %

Source: Recommended range of moisture content by Biotreat, 2003, pH, PO4 and potassium of compost by Bordna Mona, 2003; for organic matter and C:N ratio by EPA; for nitrogen by Barker, (1997).

The results (Table 3) show that at the dried leaf and other garden waste compost an initial, rapid increment was observed, although fermentation caused by the bacteria with the dumped area and gave rise to a drop after the three months. After the three months and turning the dumped leaf, pH increased again, but mixing of dumped garden waste outer and inner (due to lack of oxygen conversion of acidic condition) produced a low value in the final product. At Radhkrishna temple ward, a gradual increase was observed until the values stabilized around 7.03. In this study, the initial drop described by Nogales et al. (1987) was not recorded but present study describes the same trend observed by Rodolfo Canet and Fernando (1995).

Table 3 Evolution of dried, fresh leaves and all garden waste chemical characteristics

Day	Moisture, %	Organic Matter, %	Ammonical Nitrogen, mg/kg	C/N ratio	pH
1	62.8	74.8	436	32.0	6.80
15	61.9	72.6	412	32.4	6.78
30	59.6	75.6	435	31.6	6.92
45	48.5	76.0	421	32.6	7.01
60	44.9	68.2	328	28.9	7.02
75	40.6	67.8	312	26.8	6.72
90	41.4	65.9	282	27.6	9.88
120	48.8	62.5	248	21.6	7.01
150	72.4	64.3	262	26.8	7.03
180	68.6	62.1	240	20.8	7.05

The results (Tables 3) show that at Radhakrishn temple wad a clear reduction in moisture in the composting material was observed until 90 days, when rainfall created a significant final increase. In the present study reduction was gradual from 45 day to 90 days is 48.0 to 41.0% respectively, but with two bumps caused by lack of homogeneity in the moisture distribution in the dumping of garden waste. The decrease was greater at during 60 days (44.9%). than during 75 days (41.4%).

Results are shown in Tables 3. In the present investigation, in nearly all the days, the organic matter was high. Obviously, this may be due to the 1.72 factor as organic matter/organic carbon ratio (Giovanini et al., 1985). Nevertheless, oxidizable and total organic matter behaved in parallel. In garden waste composting processes, diminishing trends were recorded, but the values varied. The organic matter decreases during 120 days (62.5%) when compared to previous days and also especially during the initial stages.

Ammonical nitrogen and carbon/nitrogen ratio was observed are given in Table 3. Vales showed high variability. During the study the ammonical nitrogen was not absence and small amount of ammonical nitrogen showing their deceasing trends finally the composts were suitable for use. The results indicated by Katayama, et al., (1985). Carbon/nitrogen ratio was observed, associated with the initial loss of nitrogen in seepage through ground and the improper management of carbon materials due to lack of oxygen in the dumping of garden waste.

Conclusion

Radhkrishna temple ward from Bangalore produces about 370 tons/day of solid waste. One of the major problems experienced by the Bruhat Banaglore Mahanagara Palike is inadequate collection in solid waste. Delay in waste collection leads to degradation of waste and rag picking activities. It is suggested that daily house-to-house collection of waste should be done. The main drawback for such conditions is the location of the bins. Vehicles owned by the mahanagar palike are inadequate in number with no proper route mapping.

The waste generates from residential areas of Radhakrishna temple wad includes the more biodegradable materials compare to non-biodegradable materials. The analysis of waste collected from solid waste disposal locations reveals that, parameters of solid waste viz. pH, moisture content, organic matter, organic carbon and nitrogen, phosphorous and potassium were found in the fair. Present study reveals that waste generated from Radhakrishna temple wad are suitable for composting technology.

Based on the study, there was a strong loss of materials caused by drainage in the initial stages, rapid decomposition and limiting temperature. A long period of composting time can cause the characteristics and may effect on the compost. Characteristics of garden waste composts were practically standard and similar. However, the product of Radhakrishna temple showed high moisture, slightly low pH and high content of organic matter and carbon/nitrogen ratio.

Acknowledgement

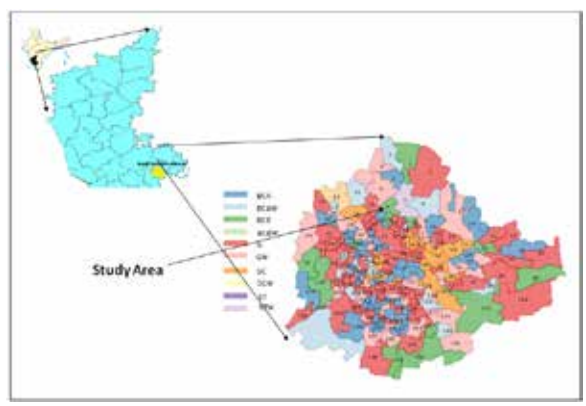

Figure 1 location Map of the Study Area

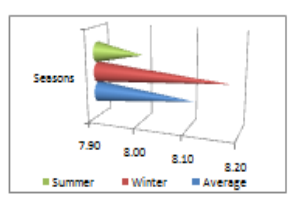

Figure 2 Seasonal variation of pH in MSW

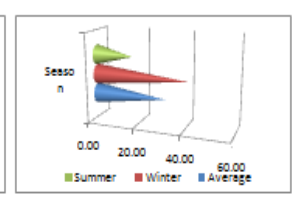

Figure 3 Seasonal variation of Moisture in MSW

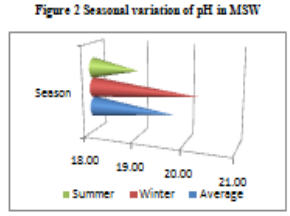

Figure 4 Seasonal variation of Organic matter in MSW

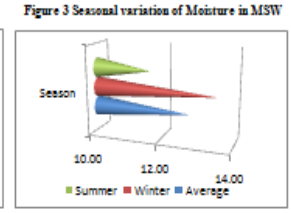

Figure 5 Seasonal variation of Carbon in MSW

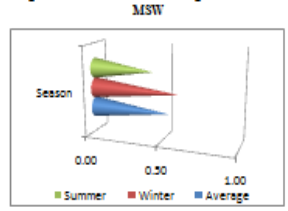

Figure 6 Seasonal variation of Nitrogen in MSW

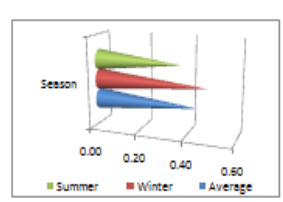

Figure 7 Seasonal variation of PO_4 in MSW

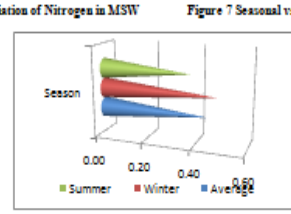

Figure 8 Seasonal variation of K in MSW

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