Characterization and Management of Solid Waste of Srinagar City

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Abstract

Background: One of the basic environmental problems in Srinagar city is the Transport and Disposal of Municipal Solid Waste (MSW). Management of solid waste eradicates the impacts on environment and human health supporting the economic development as well. Objectives: The objective of the current study is to manage the solid waste produced in Srinagar city, identify zone generating the maximum amount of solid waste and suggest the proper disposal/management technique for the waste. Methods/Analysis: In the present study, the seasonal analysis of the MSW was done and tests were performed to find out the physical and chemical characteristics of waste. Samples were collected from the area generating maximum amount of waste and the composition of waste was determined. Findings: The analysis shows that MSW having a generation rate of 279.76 g/capita/day, has a moisture content of 53.42%, density of about 110.37 kg/m³, energy content of 26289 KJ/KG and contains 85.01% of organics. Landfilling would be an efficient method of solid waste disposal as a sanitary landfill provides disposal facility for about 20-30 years.

Keywords: Disposal, Landfill, Management, MSW, Technique, Transport

1. Introduction

Solid wastes are the waste materials produced by various activities of the society, which have lost their value to the first user. In delicate transport and disposal of solid wastes pollutes all the components of the living environment both at local and global levels.

In Srinagar, increase of MSW has led to great pressure on the Government as well as the Municipality for proper collection, transport and disposal of the waste. Quantity of waste is increasing day by day and municipal authorities are not able to improve the facilities required for proper management of such wastes. Population increase is the basic and the major reason for the increase in generation of solid waste.

The present study aims to study the management of solid waste, identify the zone generating the maximum amount of solid waste, ascertain composition and characteristics of the solid waste and suggests the proper disposal technique for the waste. In Table 1, it is shown that the maximum waste is generated in planned colonies which shape the medium density areas. Also, the generation is analogously less in unplanned colonies and high density inner areas because these areas are inhibited by the economically rich people as compared to the other zones. Zone wise distribution of solid waste generation is shown in Table 1.

2. Methodology

The first phase of the study comprised of collecting the samples of MSW from different places of Planned Colonies in different seasons. The composition of waste was determined on a weighing balance after sorting and weighing the individual components separately. For determining the Composition of MSW, sample collection was carried out from the areas of the zone generating the maximum amount of solid waste.

In the second phase of the study, the physical and chemical characteristics of waste were determined in the
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laboratory. The per capita generation rate was determined as follows:

\[
\text{Generation rate (g/capita/day)} = \frac{\text{Quantity of solid waste (g/day)}}{\text{Population (capita)}}
\]

The third phase of the study comprises of suggesting the suitable management technique for the waste disposal so as to minimize the hazardous effects of the waste generated.

3. Result and Discussions

The results show that the per capita MSW generation rate is 279.76 grams/capita/day. It has been observed that the MSW contains 85.01% of organics as shown in Figure 1. The percentage of recyclable materials has been found to be very low. The moisture content of the MSW came out to be 53.42% and the density was 110.37 kg/m$^3$. Energy content came out to be 26289 KJ/Kg. The determination of percentage of chemical components (carbon, nitrogen, sulphur, oxygen) has also been done and is established with the help of a graph as shown in Figure 2.

Table 1. Zone wise per capita daily generation of solid waste

| Sl. no. | Zones     | Areas                          | MSW in MT/day |
|--------|-----------|--------------------------------|---------------|
| 1      | A         | Inner City                     | 264           |
| 2      | B         | Planned Colonies               | 323           |
| 3      | C         | Unplanned Colonies             | 248           |
| 4      | D         | Settlements in Water Bodies    | 271           |
| 5      | E         | Recent Extension               | 249           |

Figure 1. Composition of MSW in Srinagar city.

Figure 2. Combustible components of MSW.

4. Design of Landfill Cell at Achan, Srinagar

Waste generation = 323 MT/day

Total waste generation in one year = \( T = 365 \times 323 \) = 117895 MT

Considering density = 0.85 MT/m$^3$

Total volume of waste = \( V_w = \frac{T}{0.85} \)

\[= 117895 \text{ MT}/0.85 \text{ MT/m}^3\]

\[= 138700 \text{ m}^3\]

Volume of daily cover = \( V_{dc} = 0.1 \times V_w \)

\[= 0.1 \times 138700 \]

\[= 13870 \text{ m}^3\]

Considering 15 cm soils cover on top and sides for lift height of 1.5 m to 2 m

Volume of Liner and cover system = \( V_c = k \times V_w \)

On the assumption of 1.5 m thick liner system including Leachate collection layer and 1.0 m thick cover system including gas collection layer \( k = 0.25 \) for 10 m high landfill, 0.125 for 20 m high land fill and 0.08 for 30 m high landfill.

Since the width of the landfill is significantly larger than the height of the landfill, the above is valid.

Here it is assumed to have 20 m high landfill, hence \( k = 0.125 \)

Therefore \( V_c = 0.125 \times 138700 \)

\[= 17337.5 \text{ m}^3\]

Some volume of landfill likely becomes available within 10 years due to settlement/ biodegradation of waste. However, in this case the cell operation period is much less therefore this aspect is not considered though in future there will be some settlement.
Total volume of Land required for 1 (one) year operation
\[ V_t = V_w + V_{dc} + V_c \]
\[ = (138700 + 13870 + 17337.5) \text{ m}^3 \]
\[ = 169907.5 \text{ m}^3 \]
Height of the landfill (assumed) = H = 16 m
Area required for one year = 169907.5 \text{ m}^3 / 16 m
\[ = 10619.21 \text{ m}^2 \]
Total area required for 2 (two) years = 2 * 10619.21 \text{ m}^2
\[ = 21238.43 \text{ m}^2 \]
Total operating period = 2 years
The life of the Landfill cell would be 2 Years
Assume Inside area (139.5 m x 158 m) = 22041 \text{ m}^2 > 21238.43 \text{ m}^2; Hence okay

5. Conclusion

The characterization of Municipal Solid Waste (MSW) shows the carbon content is more in it which indicates that the waste has high heating value and can be used as a fuel. After the seasonal analysis of MSW Srinagar, it was found that the winter season is composed of maximum proportion of organic waste (86.22%) as compared to the spring and summer seasons respectively. This may be due to the food habits of people, indicating that the most of the organic waste is being consumed in winter season. Composting can be the best disposal technique; however, land filling can also serve the purpose as a sanitary landfill provides disposal facility for about 20-30 years. It was also found that the waste contains very high energy content of about 26829 KJ/kg so it can be sent for energy recovery. Also the waste has 53.4% of moisture content, should be reduced as high moisture content can reduce the efficiency of mechanical sorting. Re-use of waste and energy recovery can be done from the waste so as to make the Srinagar city as one of the zero waste cities. Also the Sorting or Segregation of waste can reduce the burden on landfills.

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