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Solid Waste Management of Kashmir Valley

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ABSTRACT

The valley of Kashmir is presently facing a lot of problems, in terms of Solid Waste Management. There is no proper disposal facility, nor any modern method for its treatment . Although the solid waste is collected by Municipal Corporations, the same is not disposed of scientifically. This has given rise to problems like over flowing dust bins, choking of streams, land pollution by Leachate, pollution of water bodies and public inconvenience.

The Urban Local Bodies contacted NIT Srinagar to resolve this problem. The Water Resources Section of Civil Engineering Department took up the work along with the Environmental Engineering Section, to formulate a procedure for collection, transportation and finally the treatment of Solid Waste. The target areas were divided in four clusters namely:-Baramullah cluster, Pulwama Cluster, Kupwara Cluster and Bandipur Cluster. All these clusters consisted of villages and towns joined to them. The data regarding quantity and quality was collected for all the clusters , analyzed and based on the data, the appropriate type of technology was designed. The various components of the treatment facility included the main treatment plant , leachate treatment plant and sanitary landfill design. Method of collection and transportation of the solid waste was also taken in to account. The paper gives the technical details of the treatment facility for Baramullah cluster. All design parameters were chosen strictly in accordance with Solid Waste Management Rules-2016 and CPHEEO manual-2016

KEYWORDS

Solid Waste, Collection, Transportation, Leachate, Windrows, Aerobic, Inert, Landfill

INTRODUCTION

The towns covered under this cluster are Pattan, Tangmarg , Wattar Gam , Baramula proper, Uri and Sopore. It is proposed to transport all the solid waste from these towns and finally transport it to Baramullah Proper where the treatment facilities will be located.

Baramulla town is situated at 34.0 34’0 N longitude and 74. 0 45’ 0 E latitude and it is about 55km from Srinagar, capital of Jammu and Kashmir State. As of 2011 India census Baramulla had apopulation of 160413 and the projected population of town in 2016 will be 217616. NationalHighway NH-1A connects the city with the rest of the country, and taxi and bus service is available from Srinagar and Jammu.

Baramulla district is the largest district in the entire valley both with reference to the population and area .The district is spread over an area of 4190 Sq kms. The district is bounded by Kupwara in the North and West, Budgam and Poonch in the South, Bandipore District in the North East . Baramulla district has distinction of having geographical diversity as it has in its jurisdiction, sub temperate / sub tropical areas apart from vast area falling in temperate zone. It has severe cold climate in winter and a pleasant weather in summer. Almost all parts of the district experience snowfall during winter. Average annual rainfall in District Baramulla has been recorded as 1270 mm.

DESIGN YEAR

The design year selected was 2026 and the population of all towns contributing, including Baramullah is tabulated below:-

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Table-1 Population and Solid waste generated by Baramullah Cluster

TOWN	POPULATION as of 2026	RATE Kgs/ c / day	MSW QUANTITY T / Day (1)	Street sweep T/Day (2)	Slaughter Waste T/Day (3)	Total T/Day (2+3)	NET T/Day =1-(2+3)
Baramullah	295218	0.489	144.4	11.3	2.3	13.6	130.8
Pattan	26875	0.478	12.84	1.0	0.2	1.2	11.64
Tangmarg	55870	0.488	27.26	2.1	0.4	2.5	24.7
Watergam	15367	0.47	7.22	0.6	0.1	0.7	5.62
Uri	17237	0.40	6.89	0.5	0.1	0.6	5.4
Sopore	125921	0.49	61.7	4.8	1.0	5.8	55.9
TOTAL	536488	0.469	260	20.3	4.1	24.4	234

The net solid waste to be treated is exclusive of street sweep slaughter house waste, which needs to be disposed off separately , as per SWM Rules--2016. The total quantity of solid waste projected for the design year 2026 worked out to be 234 Tons per day,. The treatment facility was designed for this quantity keeping in view the fact that the per capita solid waste generation was likely to increase as observed over the past years. The present average per capita waste generation is around 0.4 kgs as per codal provisions.

QUALITY OF SOLID WASTE

For ascertaining the quality of solid waste generated in the Kashmir valley, it was observed that the solid waste originated from places like households, market places , commercial establishments , restaurants, offices, fruit and vegetable mandis , education institutions. There is hardly any major factory or industry producing solid waste. So metal , chemical, and other hazardous materials are not present in the solid waste. Small amounts of cells, bulbs, glass, nails etc are found and need removal by appropriate means. Besides this, construction and demolition waste was in appreciable amounts and has not been included for treatment purposes.

SAMPLING METHODS

Sampling was done from various places like dump sites, huge heaps of Solid waste etc. Care was taken to ensure to obtain samples from all places of the dump , that is from sides, from middle portions so as to make the sample a true representative of the dump. Sampling was done for seven consecutive days and average values were calculated. MSW is heterogeneous in nature and consists of varied waste fractions, requiring multiple samples at multiple locations. The method of Quartering and Coning was followed in appropriate places. As most of the solid waste is from residential areas, the following categorization was obtained.

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Table-2 **Components of Solid Waste**

(A)Wet waste	**(B) Dry Waste**	**(C) Other**
1 Kitchen Waste= 31.30%	Plastic containers = 8.9%	Battery etc=1.5%
2 Food Waste= 18.20%	Paper,cardboard,cartons=3.8%	
3 Fruit/Flower Waste= 13.10%	Rubber =0.4%	
4 Tree/Grass/Leaf Waste=5.20%	Rags/clothes =0.6%	
	Wood =0.6%	
	Metal =0.6%	
	Glass =0.50	
	Inert =15.3%	
TOTAL =67.80%	**TOTAL =30.7%**	**TOTAL=1.50%**

PHYSIOCHEMICAL ANALYSIS

The Physiochemical analysis of the solid waste was done in accordance with IS 10158 for various parameters like moisture content, pH value, Total Nitrogen(N), Total Phosphate, Potash, Total Solid, Organic Carbon, C/N Ratio, Gross calorific Value and Bulk Density. The results given to us are tabulated on the next page.

Table-3 **Physio Chemical Characterists of Solid Waste**

Parameter	Bio degradable	Dry waste	Commercial Waste	Mixed Waste
Moisture Content	42.12%	23.20%	28.02%	36.30%
pH of 10% Solution	7.7	8.8	9.1	8.1
Total Nitrogen (N)	0.96%	1.69%	1.47%	1.23%
Total Phosphates (P2O5)	0.80%	0.74%	0.43%	0.50%
Potash (K2O)	0.62%	0.85%	0.54%	0.53%
Total Solid	25.10%	35.48%	29.70%	25.50%
Organic Carbon	30.40%	38.80%	40.40%	36.50%
Carbon: Nitrogen Ratio (C : N)	31.66	22.9	27.4	29.6
Gross Calorific Value in Cal/gm	789	1832	1290	868
Bulk Density Kg/m3	468	332	359	384

DATA ANALYSIS

From the above information, the moisture content of the solid waste was high and as such would require high energy for drying. Apart from this, the suitability of the waste to be converted to energy seemed less as the benefit to cost ratio would turn out to be low. As kashmir valley experiences low temperatures and snow fall, the moisture content has no chance of decreasing.

On the other hand, the Gross Calorific Value of the mixed waste is low and hence cannot be used for energy recover. The C/N ratio is 29.6 which is feasible for composting. The chemical composition of solid waste points towards feasibility of a decomposition process as a treatment alternative.

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SELECTION OF METHOD OF TREATMENT

Based on the physiochemical characteristics of solid waste, the appropriate technology pointed towards a process by which it could be decomposed and converted to a useful entity like organic fertiliser. Composting has many types, namely open windrow composting, in vessel composting, and vermi composting. For a large quantity of solid waste, the process of open windrow composting was chosen for a large number of advantages. They are:-

1. Cheaper than In vessel/Mechanical composting
2. Requires lowest power and hence min. running machine cost as compared to mechanical Composting
3. Bulk quantity handled as compared to vermi composting
4. Procurement of worms is difficult for vermi composting
5. Artificial aeration under Indian conditions doesn't not reduce composting time hence not recommended.(static pile)
6. It is preferred to first stabilise the raw material and then subject it to picking and size reduction in mechanical composting, which will require the same windrow area .
7. Mechanical composting require Hammer mills which have a high running cost.
8. Large storage hoppers may be required for other types of composting.

Composting, as a whole is beneficial as India being an agricultural country , needs organic fertilizers. on the other hand, artificial fertilizer is proposed to be phased out and at present, it is mandatory to sell 3-4 bags of bio fertiliser with 6-7 bags of chemical fertiliser.

TRANSPORTATION OF SOLID WASTE

The transportation of the solid waste is an important aspect of integrated solid waste management. The transportation system was designed by considering requirement of vehicles as per IS 12662 part-1 and IS 12662 part-11. The transportation of solid waste was proposed firstly as primary and then secondary system using means starting from hand carts to heavy trucks and properly covered during transportation to prevent spillage.

TREATMENT PROCEEDURE

As the solid waste arrived at the proposed site of treatment, it will be subjected to various procedures. They are:-

* Hand sorting on a conveyor belt to remove large objects, metals, plastic, C&D waste and other materials which would interfere with the process of composting. Recyclable material will be separated out and bailed out.
* Placing the Solid waste inside trommels for screening size sorting. Screen sizes of 100mm, 50 mm and 25 mm has been proposed. Inert material will be taken for land filling.
* The bio degradable material will be arranged in to long rows called Windrows.
* Each windrow will be turned by a windrow turner after a period of 7 days. Turning will enhance aeration and bring down the temperature of the heap which could attain a temperature as high as 60 degrees centigrade.
* The turning process will continue for 35 days during which aerobic decomposition will take place and there will be a large volume reduction.
* The material will be placed on curing pads for maturation of compost for a period of 21 days.

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* The final product, which is organic compost , will be packed in bags and sent for sale.

TECHNICAL DETAILS OF DESIGNED WINDROWS AND OTHER COMPONENTS

(A) WINDROWS

* The cross section of windrows is trapezoidal
* Height of Windrow=2 to 3 meters
* Base width=5 to 6 meters
* length=continuous
* Movement space in between Windrows=1.5 to 2 meters depending on the size of turner.
* Period of turning=7 days or when temperature exceeds 60^0 C.
* Curing period=21 days on curing pads
* Windrow Pad area, Circulation area and curing pad area not to exceed 16796m^2 as per CPHEEO Manual-2016 .

(B) AREAS FOR OTHER COMPONENTS

* Area for compost storage godown to be adopted=845m^2
* Buffer area for future requirement=5200m^2
* Green belt area to be provided=5200m^2
* Area for demonstration and parking=2250m^2

COMPOST QUALITY

It should conform to FCO-2009, FCO-2013 and SWM Rules-2016

LEACHATE GENERATION TREATMENT AND MANAGEMENT

* Leachate from windrows :-Be rolled back in to windrows strictly as per the procedure mentioned in the manuals.
* Leachate from tipping:- Be collected and sent to the leachate treatment plant.
* Leachate from Sanitary Land Fill:- The leachate generated from Sanitary Land Fill will depend on the precipitation and field capacity of the waste.
* In addition to normal tanks for leachate collection from windrows, tipping area and sanitary Land fill on daily basis , it was recommended to provide additional large leachate retention ponds/settling tanks to accommodate large volumes of leachate from sanitary land fills and uncovered areas during high storm periods for several days. As per CPHEEO manual part-11, two ponds were recommended so that one can be cleaned alternatively. The pond will also provide a pre treatment process and prevent over flow . This will also prevent contamination of surrounding areas due to generation of high volumes of untreated leachate in high precipitation periods.

Based on the characteristics of leachate, some of the treatments recommended by manuals and other relevant text materials were:-

(a) Bio logical processing
(b) Chemical processes
(c) Physical processes.

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LANDFILL DESIGN

The landfill was proposed for inert and non bio degradable fraction of solid waste. A proper lining of the landfill based was proposed which consisted of PU layers and compacted earth. The bottom of the landfill was covered with a grid of pipes for collection of leachate and prevent the ground water from pollution. Only Non bio degradable , Non combustible, Non Recyclable, Non reactive Inert material, and Rejects from processes shall be disposed to land fill as per SWM Rules-2016

ENVIRONMENTAL ASPECTS

* Minimum Distance criteria of various components of the Waste treatment plant and Sanitary Land fill, from all Important places including human habitation to be followed strictly as per the prescribed norms/Manuals

* The selection of appropriate site for waste processing and Land fill shall be in accordance with the relevant norms.

* Regular Monitoring of Environmental components like ground water, Drinking water, water bodies, population effected, Land, Air pollution monitoring etc. be ensured in accordance with the relevant rules.

* Clearance to be obtained from all related quarters.

* All prescribed safety norms to be followed strictly, including fire hazards

CONCLUSION

The proper solid waste management of kashmir valley will improve the overall sanitation condition of the entire area. Door to door collection , segregation at source will reduce the treatment cost. Proper transportation will enhance the solid waste management system. The solid waste will be treated with least Environmental pollution and leachate treatment will prevent ground water pollution. The compost produced will enhance crop growth where as the excess compost can be sold outside the state, thus generating revenue. The valley, being a tourist destination will get a face lift.

REFERENCES

[1] CPHEEO Manual Municipal Solid Waste Manual Part-1 , Part-2 and part-3

[2] IS 12662--part 1 & 2-Guidelines for use of Vehicles for Solid Waste Disposal

[3[IS 9234-Methods for preparation of Solid waste

[4[IS 10477 - Guidelines for utilization and disposal of Solid Waste

[5] IS 9622-1980-Indian standard guidelines for management of SW

[6] IS 12647- Solid Waste collection equipment guidelines

[7] IS 16557--2016- S W Management : Segregation, Collection , Utilization, at house hold/ Community level guidelines

[8] IS 10152- Guidelines for utilization and Disposal of SW from paper Industry

[9] IS 10158- Method of Analysis of Solid Waste

[10] IS 9533- Guidelines for Selection of Methods of Urban S W Disposal

[11] Solid Waste Management Rules-2016

[12] Plastic waste management Rules-2016

[13] Hazardous waste management Rules-2016

[14] C&D waste management Rules-2016

[16] Bio medical waste management rules-2016