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STUDIES ON GENERATION OF BIO-MEDICAL SOLID WASTE FROM HEALTH CARE UNITS IN REWA (MADHYA PRADESH)

***Rashmi Arnold**

Department of Botany, Govt. Model Science College, Rewa, M.P.

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***Correspondence for Author**
Rashmi Arnold
Department of Botany, Govt. Model Science College, Rewa, M.P.

ABSTRACT

A hospital is one of the complex institutions, which is frequented by peoples of every walk of life of the society without any distinction between age, sex, race and religion. The normal inhabitants of hospital i.e. patients and staff, who produces varied amount of waste. It has been emphasized that for the proper disposal of Bio-medical waste, introduction of laws is not sufficient enough. The awareness of these laws among the general public as well as development of policies and enforcement is essential. The proper management of Bio-medical waste has become a worldwide humanitarian topic today. This study was undertaken to put some light on the generation of Bio-medical solid waste in different Health Care Units, Rewa, M. P. in rainy, winter and summer season.

KEYWORDS: HCU, WHO, solid waste, recycling etc.

INTRODUCTION

Solid waste is the unwanted or useless solid materials generated from combined residential, industrial and commercial activities in a given area. It may be categorized according to its origin (domestic, industrial, commercial, construction or institutional);according to its contents (organic material, glass, metal, plastic paper etc); or according to hazard potential (toxic, non-toxin, flammable, radioactive, infectious etc).[1,2]

Solid waste can be classified into different types, depending on their source; household waste is generally classified as municipal waste; industrial waste as hazardous waste, and biomedical waste or hospital waste as infectious waste. The term "solid waste" means any garbage, refuse, or sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or

contained gaseous material resulting from industrial, commercial, mining, and agricultural operations (US Law-Solid Waste Act 2, 1999).The term "disposal" means the discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that such solid wastes, hazardous wastes, or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground waters, from community activities (US Law-Solid Waste Act 2, 1999).[3,4,5]

Waste generation increases with population expansion and economic development. Improperly managed solid waste poses a risk to human health and the environment. Uncontrolled dumping and improper waste handling causes a variety of problems, including contaminating water, attracting insects and rodents, and increasing flooding due to blocked drainage canals or gullies. In addition, it may result in safety hazards from fires or explosions. Improper waste management also increases greenhouse gas (GHG) emissions, which contribute to climate change (for more information on climate change and the impacts from solid waste, see next page). Planning for and implementing a comprehensive program for waste collection, transport, and disposal—along with activities to prevent or recycle waste-can eliminate these problems.[6]

Recycling is commonly considered to be the most environmentally sensitive method after waste reduction available to reduce solid waste disposal. Even though recycling is faced with many challenges, especially fluctuating commodity markets, it still continues to provide numerous benefits including t he reduction of landfilling of materials, conserving energy and natural resources and creating jobs and economic development. Siting new landfills is sometimes difficult due to public concern and because environmental risks are, at best, not well defined. As siting becomes more difficult, and as the volume of waste increases, solid waste disposal, which was once considered solely a local problem, has become a combined local, State, regional, and national concern.[7]

Recycling makes use of materials that otherwise would become waste by turning them into valuable resources. Recycling helps reduce greenhouse gas emissions, in part, by diverting waste from land-fills. In some countries, a great deal of recycling occurs before the waste reaches the landfill. Scrap dealers buy directly from households and businesses, waste pickers or scavengers collect materials from waste bins, and waste collectors separate materials that

can be sold as they load their trucks. Governments can build on these practices by providing support to organize and improve recycling efforts.[8]

Another form of recycling is composting-the controlled aerobic biological decomposition of organic matter, such as food scraps and plant matter, into humus, a soil-like material. Compost acts as a natural fertilizer by providing nutrients to the soil, increasing beneficial soil organisms, and suppressing certain plant diseases, thereby reducing the need for chemical fertilizers and pesticides in landscaping and agricultural activities. Organic materials often comprise a large portion of the solid waste stream, particularly in communities that rely heavily on tourism. Composting can be particularly helpful to communities managing their waste and thus reducing greenhouse gas emissions.[9]

Combustion is the controlled burning of waste in a designated facility to reduce its volume and, in some cases, to generate electricity. Combustion is an ISWM option for wastes that cannot be recycled or composted, and is sometimes selected by communities where landfill space is limited. While the combustion process can generate toxic air emissions, these can be controlled by installing control equipment such as acid gas scrubbers and fabric filters in combustors. Combustion of solid waste can help reduce amount of waste going to landfills. It also can reduce reliance on coal, one of the fossil fuels that produce greenhouse gases when burned.[10]

Uncontrolled dumping of waste can contaminate groundwater and soil, attract disease-carrying rats and insects, and even cause fires. Properly designed, constructed, and managed landfills pro-vide a safe alternative to uncontrolled dumping. For example, to protect groundwater from the liquid that collects in landfills (leachate), a properly designed landfill has an earthen or synthetic liner. As waste decomposes, it emits methane, a greenhouse gas that can also cause fires. To prevent fires, a properly designed and fill should have a way to vent, burn, or collect methane. Landfill operators can also recover this methane - thereby reducing emissions—and generate electricity from the captured gas.[11]

MATERIALS AND METHODS

Study area

Rewa city is the head of the district and the division. The word Rewa is derived from “REWA” the second name of the pious river Narmada that originates from Amarkantak hill in Shahdol district. Rewa is located in the eastern part of Madhya Pradesh. It is linked by

three modes of transportation viz Road, Rail and Air. Its regional road pattern fans out in all directions. The city is served by the board gauge railway line, state highways and other roads connect the city with the state capital Bhopal.

Study Sites

The Rewa Municipal Corporation has 45 wards and the survey was carried out as per the list of Government Hospitals, Private Nursing Homes and Pathological centers provided by C.M.O. Rewa. In Rewa city two Government Hospitals were Surveyed viz. Sanjay Gandhi Memorial Hospital and Kusabhau Thakare district hospital, Bicchia. Total numbers of Private Nursing Homes studied were 22 to 13 pathological centers were also surveyed for data collection.

Table 1- Ward wise list of various Govt. Hospital, District Hospital, Pvt. Nursing Homes and Pathological Center

Ward No.	Name of HCUs'
5	Jeevean Jyoti Nursing, Bus Stand, Rewa
	Sai Kripa Nursing Home, Bodabag, Road Rewa
7	Parsonia Nursing Home, Infront of Church, Bodabag Road, Rewa
	Tirth Memorial Nursingh Home, Subhash Chauraha, Kutehi Road, Rewa
12	Agarwal Memorial Nursing Home, Khutehi Rewa
	Rewa Medical Centre Behind of Anguri Building, Rewa
	Pushpanjali Nursing Home, Bajarang Nagar, Rewa
	M.R. Singal Memorial Nursing Home, Bara Saman
13	Santi Hospital, Indra Nagar
14	Savitri Nursing Home, Near of Chuna Bhatta Rewa
16	Shankar Nursing Home, Azad Nagar
	Mithilesh Memorial Nursing Home, Opposite of Pawan Gas Godown, Rewa
	Anupam Nursing Home, Opposite of P.K. School Rewa
	Children Medical Center Opposite of P.K. School, Rewa
	Chahak Children Hospital, Opposite of P.K. School, Rewa
17	Sagar Nursing Home, Near of College Churaha, Rewa
	Sanjvani Hospital, Narendra Nagar, College Churaha, Rewa
	Neeta Nursing Home, College Churaha, Rewa
	Goswami X-Ray and Patholagy, Near of Amahiya Nala, Rewa
	Gurukripa Nursing Home, Kala Mandir, Rewa
24	Chaurasiya Hospital and Research Center, Jail Road, Rewa
25	Gyaneshwari Chaya Nursing Home, Rewa
40	M.P. Arya Memorial Hospital and Research Center, Gurh Churaha, Rewa

Table 2- List of Bio-Medical Waste Treatment Facilities In Various Govt. Hospital, District Hospital, Pvt. Nursing Homes and Private Nursing Homes In Rewa City

Sr. No.	Name of HCUs' and Address	Disposal Facility	Govt./Pvt.	Remark
1.	Govt. Sajay Gandhi Memorial Hospital, Rewa	Incinerate/STP	Govt.	Treatment facility only for Sanjay Gandhi Hospital, BMW
2.	District Hospital Rewa	Common Bio-Medical Waste Treatment Facilities	Govt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
3.	Agrawal Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
4.	Chaurasia Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
5.	Chahak Child Care Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
6.	M.P. Arya Memorial Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
7.	Personial Surgical Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
8.	Sai Kripa Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
9.	M.R. Singhal Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
10.	Shanti Hospital and Trama Center Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
11.	Shankar Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
12.	Mithilesh Memorial Hospital, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
13.	Neeta Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
14.	Puspanjali Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
15.	Sagar Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
16.	Tirth Memorial Hospital, Rewa	Common Bio-Medical	Pvt.	Treated by M/s Indo water

		Waste Treatment Facilities		Management and Pollution Control Coporation, Satna
17.	Savitri Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
18.	Shree Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
19.	Anupam Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
20.	Child Cara Hospital, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
21.	Chitiz Hospital, Research Center, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
22.	Guru Kripa Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
23.	Jeevan Jyoti Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna
24.	Pasoniya Nursing Home, Rewa	Common Bio-Medical Waste Treatment Facilities	Pvt.	Treated by M/s Indo water Management and Pollution Control Coporation, Satna

Table 3- Treatment work Facilities in various pathological centers in Rewa

Sr. No.	Name of HCUs' and Address	Disposal Facility	Govt./Pvt.	Remark
1.	Goswami X-ray and Pathology Center, Rewa	Deep Burial in self land	Pvt.	Waste management by Hospital
2.	Advance X-ray and pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
3.	Shivam Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
4.	Raman Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
5.	Sarweswari Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
6.	New Agarwal Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
7.	Unidiomond Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
8.	Nahar Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
9.	Mishra Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
10.	Agarwal Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital

11.	Rajesh Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
12.	Devam Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital
13.	Swaroop Pathology	Deep Burial in self land	Pvt.	Waste management by Hospital

METHODOLOGY

The study has been undertaken to assess the Bio-medical solid waste Generation and its Management in Rewa city. The study focuses on the Bio-Medical Solid Waste generated from the various Government Hospitals, Private Nursing homes and Pathological centers within the Rewa city. Methodology adopted for the given topic is given below:

PRIMARY DATA

The following steps were involved in the observation of the Bio-medical waste generated from different HCUs' in the study area-

(1) The quantitative determination of waste was collected by surveying the various HCU's (Government Hospital/Private Nursing Homes/Pathological centers) of

(2) The Bio-Medical Waste data was then kept under different waste categories as per rules.

(3) The quantification of Bio-Medical W Waste generated is than tabulated in various tables.

(4) The disposal pattern of Bio-Medical Waste is then clarified and classified in two divisions on site and off site disposable.

(5) The Bio-Medical waste is also recorded in infectious and non-infectious scale.

SECONDARY DATA

The secondary data were provided by different source like Rewa Municipal Corporation office of town and country planning, meteorological station, Kuthuliya Statistical Department and Chief Medical Officer, Rewa.

The waste generation units thus identified were categorized as per Bio-Medical Waste (Management & Handling) Rules 1998 In 8 Categories. The data based on Bio-Medical Waste generated from these Health Care Units (HCU's) were collected in kg/day basis under various categories of Bio-Medical Waste.

RESULTS AND DISCUSSIONS

In the present study, the various government and private Health care Units (UCUs') have been dived into three categories according to bed numbers. The first category consists of

HCUs above 500 beds. In this category only Sanjay Gandhi Memorial Hospital, Rewa (1141 beds) comes. The Bio=-Medical waste generation during rainy season was observed to be approximately 258.9 kg/day while in summer season it was estimated at 222.89 kg/day & during winter seaon 193.77 kg/day of bio-medical waste was produced (Table 1-3).

The second category contains HCUs having 50-200 beds. Under this category lies Kushabhau Thakare Government District Hospital, Bicchiya, Rewa (M. P.) of 50 beds. The bio-medical waste was approximately 15.35 kg/day during rainy season followed by 10.52 kg/day during summer season & 6.88 kg/day is generated during winter season (Table 1-3).

Similarly the 3rd category consists of HCUs" having 0-30 beds, in which 22 private nursing homes of Rewa city comes. Their approximately Bio-Medical Waste generation during rainy season was 103,88 kg/day, While during summer season, it was estimated out to be 69.91 kg/day followed by winter season where Bio-medical waste was 42.9kg/day was observed (Table 1-3).

Further the Bio-Medical Waste has been classified in various categories as per Bio-Medical waste (Management & Handling) Rules 1998. for HCU's more than 500 beds the Bio-Medical waste generation in Category 1-was 97kg/day, Category 3-21.3 kg/day, Category 4-9.67 kg/day and Category 9-7.89 kg/day was observed. For HCUs' under 50-200 beds Bio-medical waste generation under Category 1 was 4.25 kg/day, Category 4-2.67 kg/day, Category 6-1.85 kg/day and Category 7-1.63, Category 90.37 kg/day. Similar for HUSu' 0-50 beds the bio-medical waste generated under Category 1-13.75 kg/day, Category 15.91 kg/day, Category 6.23.86 kg/day, category 7-12.99 and category 4.24 kg/day (table -4).

Table 1: Generation of Bio-Medical Waste in Government Hospitals and Private Nursing Homes of Rewa City (In kg) During Rainy Season

Sr. No.	Grouping of According to Beds Nos.	Name of HCUs'	No. Of HCUs'	Category wise generation wise generation of BMW in Kg/day (Approx.)								Avg. BMW Kg/day 1+3+4+ 5+6+7+9	% Avg. BMW Kg/day	BMW kg/ Month	BMW Generated in season kg
				1	2	3	4	5	6	7	9				
1	Above 500 Beds	Govt. S.G. M.H.,Rewa	1	110	-	26	15	3	68	27.9	9	258.9	68.47%	7767.0	31.68.00
2	50-200 Beds	Dist. Hospital Rewa	1	5.93	-	-	3.66	-	2.83	2.33	0.6	15.35	4.06%	460.5	1842.00
3	0-50 Beds	Pvt. Nursing Homes	22	20.7	-	-	25.14	-	30.77	10.28	6.82	103.8	27.47%	3116.4	12465.6
Total Bio-Medical waste generation kg/day												378.13			

Cat-1 = Human Anatomical waste Cat-2 = Animal waste Cat-3 = Microbiology and biotechnology waste

Cat-4 = Waste Sharps Cat-5 = Discarded medicine and cytotoxic drugs Cat-6 = Soiled waste

Cat-7 = Solid waste

Table 2- Generation of Bio-Medical Waste in Government Hospitals and Private Nursing Homes of Rewa City (In kg) During Summer Season

Sr.No.	Grouping of According to Beds Nos.	Name of HCUs'	No. Of HCUs'	Category wise generation wise generation of BMW in Kg/day (Approx.)								Avg. BMW Kg/day 1+3+4+ 5+6+7+9	% Avg. BMW Kg/day	BMW kg/ Month	BMW Generated in season kg
				1	2	3	4	5	6	7	9				
1	Above 500 Beds	Govt. S.G.M. H, Rewa	1	96	-	21	9	3	60	26	7.89	222.89	73.48%	6686.7	26746.8
2	50-200 Beds	Dist. Hospital Rewa	1	4.23	-	-	2.76	-	1.67	1.54	0.32	10.52	3.47%	315.6	1262.4
3	0-50 Beds	Pvt. Nursing Homes	22	14.23	-	-	16	-	25	12.81	3.49	6.914	23.05%	2097.42	8389.68
Total Bio-Medical waste generation kg/day												303.324			

Cat-1 = Human Anatomical waste Cat-2 = Animal waste Cat-3 = Microbiology and biotechnology waste

Cat-4 = Waste Sharps Cat-5 = Discarded medicine and cytotoxic drugs Cat-6 = Soiled waste

Cat-7 = Solid waste Cat-9 = Incineration Ash

Table 3- Generation of Bio-Medical Waste in Government Hospitals and Private Nursing Homes of Rewa City (In kg) During Winter Season

Sr.No.	Grouping of According to Beds Nos.	Name of HCUs'	No. Of HCUs'	Category wise generation wise generation of BMW in Kg/day (Approx.)								Avg. BMW Kg/day 1+3+4+ 5+6+7+9	% Avg. BMW Kg/day	BMW kg/ Month	BMW Generated in season kg
				1	2	3	4	5	6	7	9				
1	Above 500 Beds	Govt. S.G.M. H, Rewa	1	85	-	17	5	2	57	21	6.77	193.77	79.56%	5813.1	23252.4
2	50-200 Beds	Dist. Hospital Rewa	1	3.02	-	-	1.57	-	1.07	1.02	0.2	6.88	2.82%	206.4	825.6
3	0-50 Beds	Pvt. Nursing Homes	22	6.32	-	-	6.6	-	15.8	5.79	2.42	42.9	17.61%	1287.0	5148.0
Total Bio-Medical waste generation kg/day												243.55			

Cat-1 = Human Anatomical waste Cat-2 = Animal waste Cat-3 = Microbiology and biotechnology waste

Cat-4 = Waste Sharps Cat-5 = Discarded medicine and cytotoxic drugs Cat-6 = Soiled waste

Cat-7 = Solid waste Cat-9 = Incineration Ash

Table 4- Generation of Bio-Medical Waste in Government Hospitals and Private Nursing Homes of Rewa City (In kg) on average basis

Sr.No.	Seasons	Category wise generation wise generation of BMW in Kg/day (Approx.)								Avg. BMW Kg/day 1+3+4+ 5+6+7+9	% Avg. BMW Kg/day	BMW kg/ Month	BMW Generated in season kg
		1	2	3	4	5	6	7	9				
Group -1 (Above 500 Bed : Govt. S.G.M.H., Rewa)													
1	Rainy	110	-	26	15	3	68	27.6	9	258.9	68.47%	7767	31068.00
2	Summer	96	-	21	9	3	60	26	7.89	222.89	73.48%	6686.7	26746.8
3	Winter	85	-	17	5	2	57	21	6.77	193.77	79.56%	5813.1	23252.4
Total		291	0	64	29	8	185	74.9	23.66	675.56			
Average		97.00	0.00	21.33	9.67	2.67	61.67	24.97	7.89	225.19			
Group-2 (50-200 Beds : Distt, Hospital, Rewa)													
Sr.No.	**Seasons**	**Category wise generation wise generation of BMW in Kg/day (Approx.)**								**Avg. BMW Kg/day 1+3+4+ 5+6+7+9**	**% Avg. BMW Kg/day**	**BMW kg/ Month**	**BMW Generated in season kg**
		1	2	3	4	5	6	7	9				
1	Rainy	5.93	-	-	3.66	-	2.83	2.33	0.6	15.35	4.06%	460.5	1842.00
2	Summer	4.23	-	-	2.76	-	1.67	1.54	0.32	10.523	3.47%	315.6	1262.4
3	Winter	3.02	-	-	1.57	-	1.07	1.02	0.2	6.88	2.82%	206.4	825.6
Total		13.18	0	0	7.99	0	5.57	4.89	1.12	32.75			
Average		4.39	0.00	0.00	2.66	0.00	1.86	1.63	0.37	10.92			
Group-3 (0-50 Beds : Pvt. Nursing Homes, Rewa)													
Sr.No.	**Seasons**	**Category wise generation wise generation of BMW in Kg/day (Approx.)**								**Avg. BMW Kg/day 1+3+4+ 5+6+7+9**	**% Avg. BMW Kg/day**	**BMW kg/ Month**	**BMW Generated in season kg**
		1	2	3	4	5	6	7	9				
1	Rainy	20.7	-	-	25.14	-	30.77	10.28	6.82	103.8	27.47%	3116.4	12464.6
2	Summer	14.23	-	-	16	-	25	12.81	3.49	69.91	23.05%	2097.42	8389.68
3	Winter	6.32	-	-	6.6	-	15.8	5.79	2.42	42.9	15.61%	1287.0	5148.0
Total		41.25	0	0	47.74	0	71.57	28.88	12.73	216.61			
Average		13.75	0.00	0.00	15.91	0.00	23.86	9.63	4.24	72.20			

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