Status of Biomedical Waste Management in the State of Maharashtra , 2010

For
Maharashtra Pollution Control Board
Kalpataru Point, Sion, Mumbai

June 2011

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Status of Biomedical Waste Management in the State of Maharashtra

Prepared for:

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List of Abbreviations

BMW	Bio-Medical Waste
BMW Rules	Biomedical Waste (Management and Handling) Rule, 1998 (as amended to date)
CBMWTDF	Common Bio Medical Waste Treatment and Disposal Facility
CPCB	Central Pollution Control Board
EPA	Environment (Protection) Act, 1986 (as amended to date)
HCE	Health Care Establishments
MPCB	Maharashtra Pollution Control Board
RO	Regional Office/ Officer of MPCB
SPCB	State Pollution Control Board

1 Introduction

1.1 Preamble

Bio-Medical Waste (BMW) refers to any waste, which is generated during the diagnosis, treatment or immunization of human beings or animals or in research activities pertaining thereto or in the production or testing of biological and including categories mentioned in Schedule I of the Bio-Medical Waste (Management and Handling) Rules, 1998.

Biomedical Waste (Management and Handling) Rules (BMW Rules) were promulgated under the Environment (Protection) Act, 1986. In Maharashtra, Maharashtra Pollution Control Board (MPCB) is the apex agency to enforce these Rules. The role of MPCB includes –

Authorization of HCEs for generation and handling of BMW (Form I of BMW Rules)
Authorization of CBMWTDFs for collection, treatment and disposal of BMW (Form I of BMW Rules)
Periodic inspection and review of the "system" for compliance
Take action on non-compliance
Carry out inventorization of BMW to report the status
Undertake awareness programs at HCEs

Health Care Establishments (HCEs) are the major generators of the BMW. HCEs need to take authorization from MPCB for handling of BMW.

The HCEs are classified into two categories:

  i.   Bedded HCEs- (Hospitals/ Nursing Homes with Bed Facility)
  ii.   Non-bedded HCEs
         a. Treating/ Providing Service to 1000 and above Patients per Month
         b. Treating/ Providing Service to less than 1000 Patients per Month
         c. Education, Research Institute, Veterinary Hospitals, etc. (herein referred to as 'Others')

As per Bio-Medical Waste (Management and Handling) Rules, 1998– Schedule I, the waste is classified into 10 categories. HCEs are required to declare their BMW generation in these 10 categories. The treatment and disposal method for each of the categories is prescribed in Schedule I.

Schedule II of the Rules gives the colour coding for the containers, the category of waste that goes into each container and the treatment options. At the point of generation, waste is to be segregated into red, yellow, blue/black bags and in a canister for sharps is produced. Refer **Table 1** for colour coding, type of container and corresponding treatment/disposal options.

Table 1 – Mapping between Categories, Colour Coding and Treatment/Disposal of BMW

Colour Coding of Containers	Type of Container -I Waste Category	Treatment options as per Schedule I
Yellow	Plastic bag Cat. 1, Cat. 2 and Cat. 3 Cat. 6.	Incineration/deep burial
Red	Disinfected container/plastic bag Cat. 3 Cat. 6, Cat.7.	Autoclaving/Microwaving/ Chemical Treatment
Blue/White Translucent	Plastic bag/puncture proof Cat. 4 Cat. 7 Container	Autoclaving/Microwaving/ Chemical Treatment and destruction/shredding

Colour Coding of Containers	Type of Container -I Waste Category	Treatment options as per Schedule I
Black	Plastic bag Cat. 5 and Cat. 9 and Cat. 10. (solid)	Disposal in secured landfill

Source: MPCB

Bedded HCEs have option of BMW treatment at their facility or send the same to Common Biomedical Waste Treatment and Disposal Facilities (CBMWTDF). CBMWTDF operators usually provide transportation or collection service apart from treatment and disposal.

The Urban Local Bodies (ULBs) play an important role in BMW management. The operators of CBMWTDF are usually contracted by the ULBs through a tendering process. Generally the Majority of the time the operator is provided land by the ULB for setting up the facility.

1.2 Biomedical Waste Management in Maharashtra

Analysis of the BMW data from 2005-2010 shows that there was a significant increase in the number of HCEs in Maharashtra from 2008 to 2009. The total volume of BMW generated in 2006 was higher than any other year.

As in 2009, Maharashtra had a total of 46,676 HCEs. Out of the total, 16,060 HCEs belonged to bedded and 30,616 HCEs were non-bedded.[1]

In 2010, Maharashtra has as total of 45,784 HCEs. Out of the total establishments, 14,438 HCEs are bedded and, 31,346 HCEs are non-bedded. It may be observed that the bedded HCEs decreased by 10 % and non-bedded HCEs increased by 2%.

Figure 1 illustrates the composition of HCEs in Maharashtra as of, 2010. Approx. two-third is non-bedded HCEs, whereas only one-third is bedded. This composition indicates difficulty in the inventorization as well as towards the enforcement of the rules.
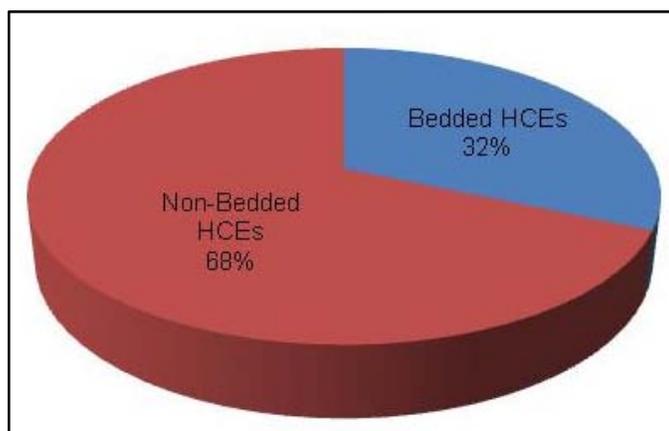
Source: MPCB

Figure 1 - Composition of HCEs in Maharashtra, 2010

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[1] http://mpcb.gov.in/images/pdf/Annexure-III.pdf, summary sheet of BMW management in the state of Maharashtra

1.3 Terms of Reference for Study

The report aims at presenting the status of bio-medical waste management as it exists currently in Maharashtra. The terms of reference for the study are as follows:

1. Review and analysis of secondary data on biomedical waste management.

Secondary data collected from Regional Offices (ROs) of MPCB has been considered for review and analysis.

Accordingly a review and analysis of the data has been carried out for the following terms:

  i. Total No. of Health care establishments (bedded hospitals) and no. of beds
  ii. Total No. of HCEs non bedded
  iii. Categorization of HCEs into small, medium and large based on no. of beds
  iv. Total quantity of BMW generated and got collected for treatment and disposal
  v. No. of HCEs granted authorization by MPCB
  vi. No. of HCEs CBMWTDF and transporters and their capacities
  vii. No. of HCEs member to CBMWTDF and having own treatment arrangement
  viii. Violations and actions taken
  ix. Awareness programmes conducted by MPC board.

2. Carry out detailed survey in HCEs

A detailed survey in representative HCEs was carried out to assess the existing practices of collection, segregation, storage, transportation, and disposal of BMW.

3. Carry out field monitoring in CBMWTDF for evaluation of performance and compliance to BMW rules.

EMC in consultation with MPCB has selected 2 nos. CBMWTDF for field monitoring with an aim to evaluate its compliance with BMW Rules and CPCB Guidelines[2]. It involved in-depth assessment of the CBMWTDF functioning in terms of reception handling, storage, treatment, disposal of BMW and meeting the statutory requirements/guidelines.

4. Identification of improvement required in implementation of BMW management and recommendations for improvement.

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[2] CPCB Guidelines for CBMWTDFs http://www.cpcb.nic.in/wast/bioimedicalwast/BMWtreatmentfacilities.pdf

1.4 Organization of the Report

The report aims at presenting the status of bio-medical waste management as it exists currently in Maharashtra.

- **Chapter 1** gives a brief background of BMW management in Maharashtra, trends in BMW generation in Maharashtra from 2005-2010 and also the Terms of Reference (ToR) for this study and the organization of the report.

- **Chapter 2** explains the data collection methodology and the data collected from ROs of MPCB. Chapter 2 also presents the analysis of the primary information collected from different regions of Maharashtra, to understand the existing BMW management scenario.

- **Chapter 3** presents the finding from the primary survey cum assessment of selected HCEs.

- **Chapter 4** presents the field monitoring methodology and corresponding results for selected CBMWTDFs. The CBMWTDFs were evaluated for general performance and compliance with BMW Rules and guidelines of Central Pollution Control Board (CPCB).

- **Chapter 5** gives the recommendations to address gaps identified through this study for the consideration of MPCB.

2 Review and Analysis of Secondary Data on BMW

2.1 Data Collection Formats

Data collection formats were prepared referring to the BMW Rules and CPCB guidelines for capturing information related to management of BMW. These formats were developed in consultation with MPCB.

In all, seven data collection formats were developed.

- Format 1 to Format 4 focused on HCEs. Each format was aimed at capturing information from different types of HCEs like bedded HCEs, non-bedded HCEs > 1000 patients/month, non-bedded HCEs <1000 patients/month and other HCEs like pathology labs, blood banks, veterinary hospitals etc. Data captured from each HCE included number of HCEs, quantity of waste generated by HCEs, authorization from MPCB, membership of CBMWTDF, HCEs having own facility for treatment and disposal, no. of violations and action taken against violations etc.
- Format 5 captured details of CBMWTDF operators. This format includes information about number of HCEs served, quantity of BMW treated, treatment and disposal facilities installed and the capacities etc.
- Format 6 captured information on CBMWTDF transporters. This included information about number of HCEs served, quantity of BMW transported/day, number of vehicles deployed, total distance travelled/day etc.
- Format 7 captured information on awareness initiatives taken by Regional Offices (RO) on BMW management.

These formats are enclosed in **Annexure 1.**

2.2 Data Collection Methodology

The formats were circulated to the ROs of MPCB through RO-PAMS. ROs gathered the data in the prescribed format from the records available with them. Completed formats as received from MPCB are enclosed in **Annexure 2.**

Data analysis was carried out for 11 regions of MPCB as follows:

Table 2 - MPCB's Regions in Maharashtra

1.	Amravati	7.	Nasik
2.	Aurangabad	8.	Navi Mumbai
3.	Kalyan	9.	Pune
4.	Kolhapur	10.	Raigad
5.	Mumbai	11.	Thane
6.	Nagpur		

Data from Chandrapur region was not received and hence it was excluded from analysis.

2.3   Data Analysis

Table 3 gives a summary status report of Biomedical Waste for Maharashtra Region, 2010.

Table 3 – Status Report of BMW for Maharashtra 2010

Sl. No.	Category of HCE	Total Nos. of HCE	Total Nos. of Beds	No. of HCEs obtained Authorization from MPCB (Excluding renewals)	No. of HCEs member of CBMWTDF	No. of HCEs having Own facility for treatment and disposal	Total Quantity of BMW generated (Kg/day)	Total Quantity of BMW treated (Kg/day)	No. of HCEs Violated BMW Rules	No. of Actions taken by MPCB on violations
Bedded HCEs										
1	>500 beds	49	34420	1081*	845**	309	7052	5154	0	0
2	200 -499 beds	87	24362	67	81	2	4633	3652	0	0
3	50- 199 beds	349	28638	241	270	28	4615	3824	2	17
4	< 50 beds	13953	107203	10586	10997	1242	14584	13971	1908	1624
	TOTAL (A)	**14438**	**194623**	**11975**	**12193**	**1581**	**30884**	**30256*****	**1910**	**1641**
5	>1000 patients/month	7179	N/A	439*	385	…	532	478	31	26
6	<1000 patients/month	23727	N/A	19020	19354	…	6952	6512	5115	3417
7	Others - Education, Research Institute, etc.	440	N/A	81	80	…	5013	956	345	30
	TOTAL (B)	**31346**	**-**	**19540**	**19819**	**…**	**12496**	**7946**	**5491**	**3473**
	GRAND TOTAL (A+B)	**45784**	**194623**	**31515**	**30967**	**1581**	**43380**	**38202**	**7401**	**5114**

*Break-up not provided by Nagpur, total number added to >500 beds category, **Break-up of members not provided by Nagpur, total number added to >500 beds category,*** Break-up not provided by Nagpur, total BMW added to Total (A)*

2.3.1 Total nos. of HCEs

Total no. of HCEs in Maharashtra is approx. 45,784 (excluding Chandrapur region), out of which 14,438 (~31%) are bedded and 31346 are non-bedded. In the bedded HCEs, total nos. of beds is around 1, 94,623.

Refer **Table 4** for total number of HCEs in Maharashtra.

Table 4 - Total Nos. of HCEs in Maharashtra

Sl. No.	Category	Amravati	Aurangabad	Kalyan	Kolhapur	Mumbai	Nagpur	Nasik	Navi Mumbai	Pune	Raigad	Thane	Maharashtra
1	Bedded HCEs	913	2678	558	1543	1417	1166	2569	191	2764	404	235	**14438**

2.3.2 Nos. of Beds

Refer **Table 5** for total number of beds in Maharashtra.

Table 5 - Total Nos. of Beds

Category	Amravati	Aurangabad	Kalyan	Nasik	Kolhapur	Mumbai	Nagpur	Navi Mumbai	Pune	Raigad	Thane	Maharashtra
≥500	500	3878	0	2248	2500	10704	4893	750	8447	0	500	34420
200-499	1868	1668	200	2876	700	9057	1221	850	4016	1170	736	24362
50-199	1990	2941	1455	2409	1150	6561	3889	938	6145	820	340	28638
≤50	7657	16159	5990	12817	17832	15166	9007	1760	14650	3717	2448	107203
TOTAL	**12015**	**24646**	**7645**	**20350**	**22182**	**41488**	**19010**	**4298**	**33258**	**5707**	**4024**	**194623**

It could be observed that approx. 55% of the beds belong to HCEs with less than 50 beds. Among other categories HCEs with > 500 beds are dominant (18%). Geographically, Mumbai has the highest number of beds, followed by Nasik, Pune, Aurangabad and Kolhapur. **This indicates that, if we assume that BMW generation is directly related to the number of beds, then the focus of BMW management should be shifted to HCEs with less than 50 beds.**

2.3.3 Non bedded HCEs

The non bedded HCEs are categorized into:

i. HCEs with >1000 patients/month
ii. HCEs with <1000 patients/month
iii. Others (Education, Research Institute, Veterinary Hospitals, etc.)

Table 6 – Number of Non-Bedded HCEs

Sr. No	No. of Non bedded HCEs	Amravati	Aurangabad	Kalyan	Kolhapur	Mumbai	Nagpur	Nasik	Navi Mumbai	Pune	Raigad	Thane	Maharashtra
1	>1000 patients/month	1	37	17	5	6704	160	28	35	172	20	0	**7179**
2	<1000 patients/month	3126	1450	426	1975	6702	2231	1634	514	4232	642	795	**23727**
3	Others	0	2	--	5	2	37	357	15	17	3	2	**440**
	TOTAL	**3127**	**1489**	**443**	**1985**	**13408**	**2428**	**2019**	**564**	**4421**	**665**	**797**	**31346**

Analysis of Non- bedded HCEs shows that in number of non-bedded HCEs with less than 1000 patients/month is the largest. Refer **Figure 2**.

Total no. of Non-bedded HCEs is around 31346 (excluding Chandrapur). Maximum number of HCEs with > 1000 and < 1000 patients is located in Mumbai. Mumbai has the highest number of non bedded HCEs are in Mumbai (13408), followed by Pune, Amravati, Nasik and Kolhapur.
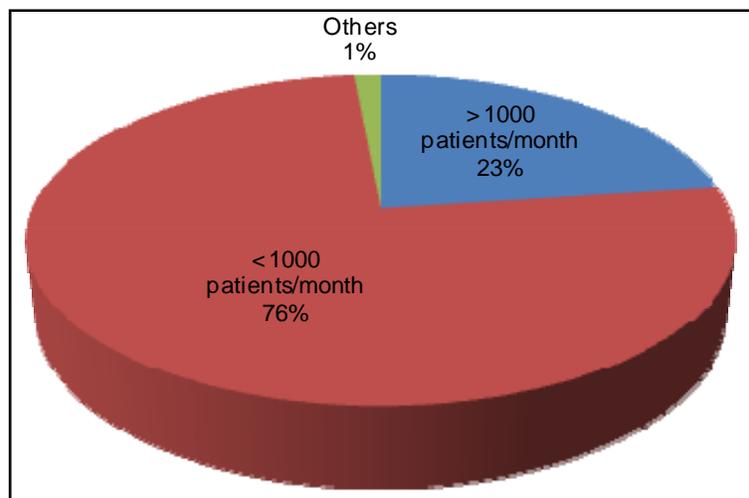
Source: MPCB

Figure 2 - Classification of Non-Bedded HCEs in Maharashtra

2.3.4   Classification of Bedded HCEs into Categories

The bedded HCEs are classified into:

    i. HCEs with >500 beds,
    ii. HCEs Between 200-499 beds
    iii. Between 50- 199 beds
    iv. HCEs with < 50 beds

Figure 3 shows the distribution of the first three categories. It could be seen that Mumbai has the highest number of HCEs in all three categories. Next regions are Pune. Nagpur, Aurangabad and Nasik. Raigad and Kalyan regions have no HCE beyond 500 beds.

In all regions HCEs with < 50 beds are more dominant over other three categories of HCEs. **Figure 4** illustrates that Pune, Aurangabad and Nasik has highest number of HCEs with less than 50 beds. Incidentally the figures for Mumbai are much lower than Pune, Nasik or Aurangabad.
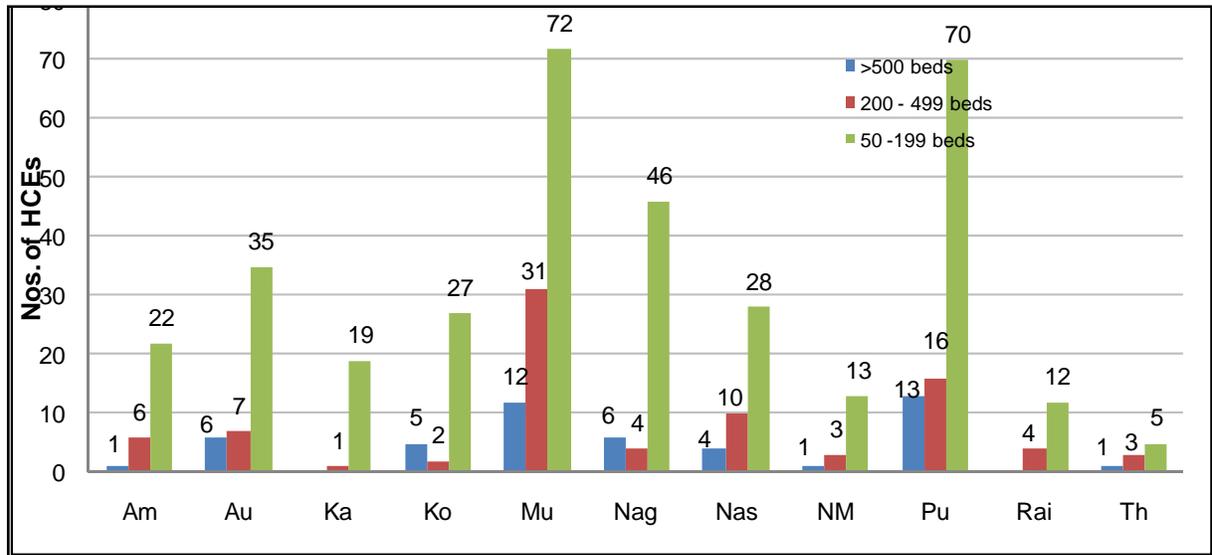
Source: MPCB

Figure 3 - Classification of HCEs bedded

Am : Amravati, Au : Aurangabad, Ka: Kalyan, Ko: Kolhapur, Mu: Mumbai, Nag: Nagpur, Nas: Nasik, NM : Navi Mumbai, Pu: Pune, Rai: Raigad, Th: Thane
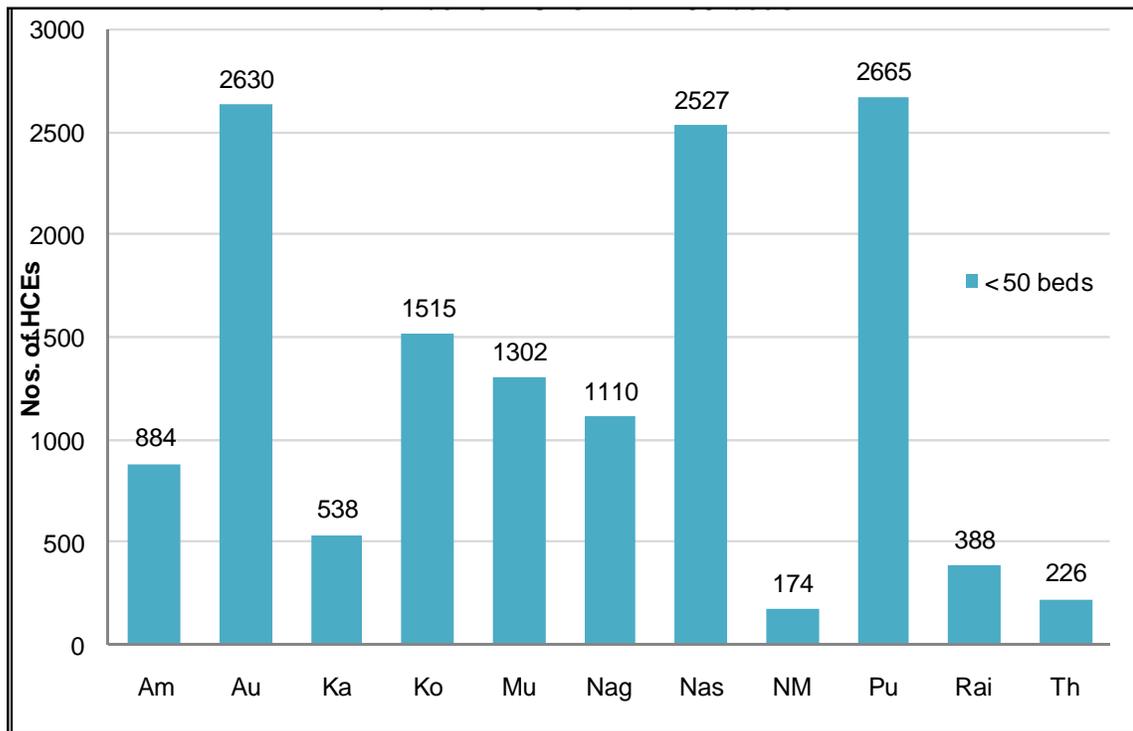
Source: MPCB

Figure 4 - Nos. of HCEs with < 50 beds

2.3.5 Total Quantity of BMW Generated and Treated

I. BMW Generated

Total BMW generated[3] in Maharashtra is close to 43,380 kg/day. This estimate includes BMW generated from both bedded and non bedded HCEs. Region wise, as expected Mumbai contributes approx. 23.26% of the total BMW load. Pune contributes approx. 19.58% and Nagpur is close third with 17.33% contribution. Please refer to **Figure 5**.

Table 7 - BMW Generated in Different Regions of Maharashtra

Source	Am	Au	Ka	Ko	Mu	Nag	Nas	NM	Pu	Rai	Th	Mah.
Bedded	1427	3107	836	3240	5929	6131	3198	229	4158	1297	702	**30884**
Non-Bedded	157	373	74	950	4160	1386	410	312	4337	189	148	**12496**
TOTAL	1584	3480	910	4190	10089	7517	3608	541	8495	2116	850	**43380**
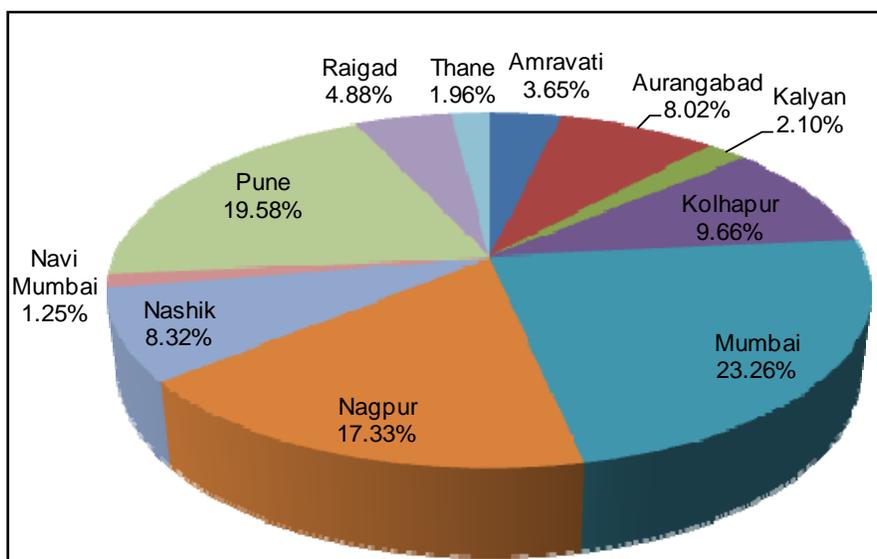
Figure 5 - Region wise BMW generated (as % of total) in Maharashtra

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[3] From the data received, it is noted that the quantity of BMW generated is actually the quantity of BMW authorized to HCEs by MPCB. Hence, in this report, BMW generated refers to BMW authorized by MPCB.
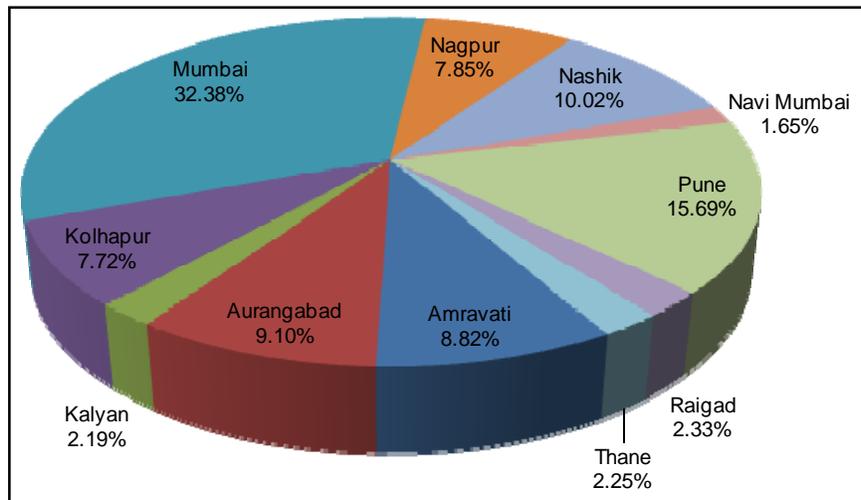
Figure 6 - Percentage Distribution of HCEs in Maharashtra

Mumbai has 32.4% share of HCEs and 23.26% share in BMW generated, Pune has 15.69% share of HCEs and has 19.58% share in BMW generated and Nagpur has only 7.85% HCEs but contributes 17.33% of total BMW generated. On the other hand Amravati has 8.82% HCEs and 3.65% BMW generated.

Figure 7 illustrated the quantity of BMW Generated (kg/day) in each region of Maharashtra State.
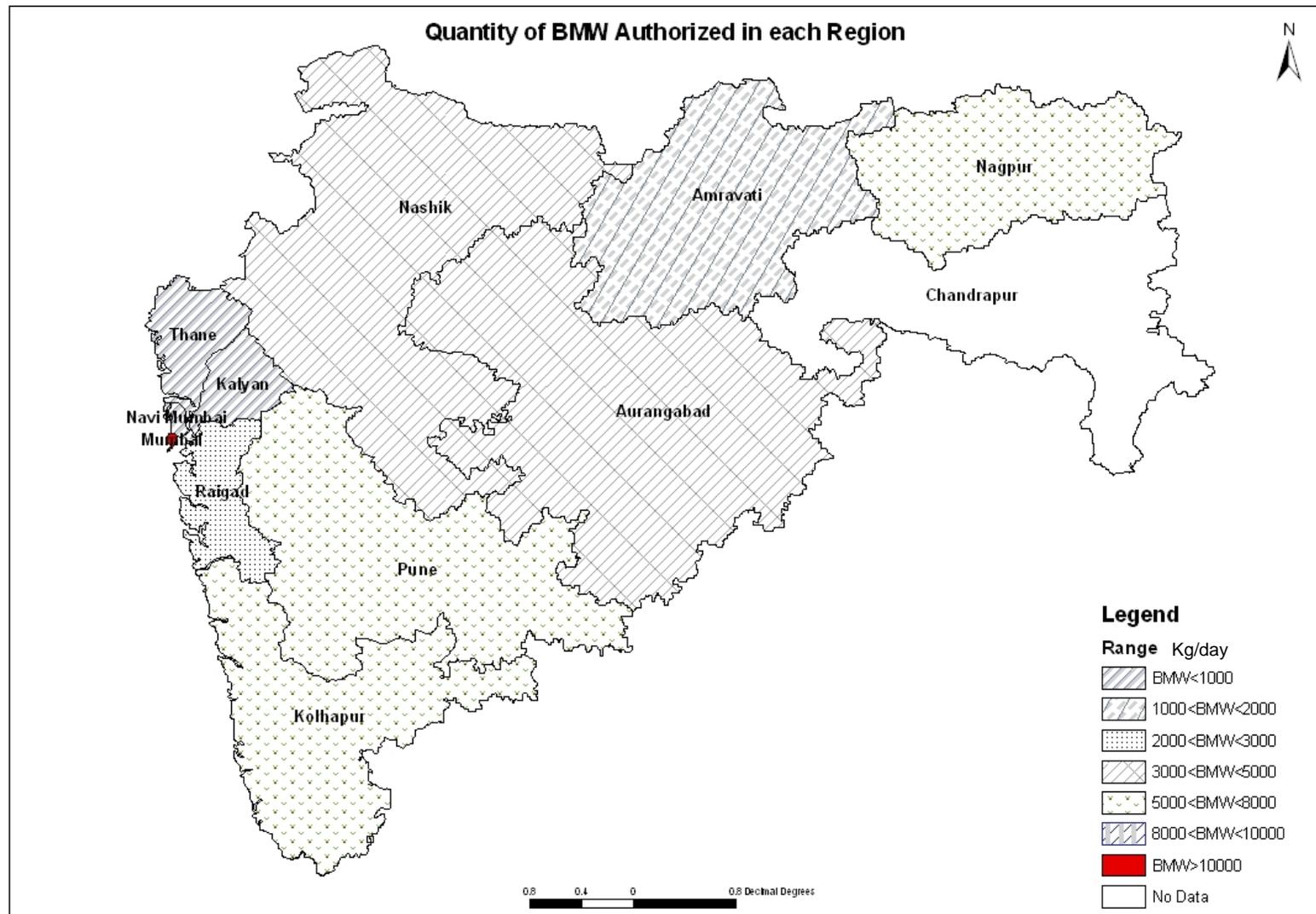
Figure 7 – Quantity of BMW generated in each Region

II.   BMW Treated

Total BMW treated in Maharashtra is close to 38,202 kg/day out of a total of generated BMW of 43,380 kg/day. This estimate includes BMW treated from both bedded and non bedded facilities. Source of this data is from HCEs. Refer **Table 8.** As reported by the CBMWTDF Operators however the total BMW treated in Maharashtra is close to 41,154 kg/day. Refer **Table 9. There is a need therefore to develop a harmonized schema of data coordination on BMW - between MPCB, HCEs and CBMWTDF operators.**

Table 8 – Total BMW Treated (kg/day) as reported by HCEs

	BMW Treated (kg/day) as reported by HCEs	Am	Au	Kal	Kol	Mu	Nag	Nas	NM	Pu	Ra	Th	**Mah.**
Bedded	500 and above beds	21	637	0	1650	1539	…	237	9	1056	0	5	5154
	200 to 499 beds	493	217	50	620	1182	…	400	24	502	15	149	3652
	50 to 199 beds	256	379	262	540	763	…	686	50	765	16	107	3824
	Less than 50 beds	656	1984	524	3670	2445	…	1759	147	1835	627	324	13971
	Total	**1427**	**3217**	**836**	**6480**	**5929**	**3654**	**3082**	**230**	**4158**	**658**	**585**	**30256***
Non-Bedded	< 1000 and Above Patients per Month	0	61	4	13	no data	160	48	105	86	0	0	478
	> 1000 Patients per Month	31	302	60	224	4085	904	278	122	329	171	5	6512
	Education, Research Institute, etc.	0	2	0	5	75	41	32	85	717	0	0	956
	Total	**32**	**365**	**64**	**242**	**4160**	**1104**	**358**	**312**	**1132**	**171**	**5**	**7946**
	OVERALL TOTAL	**1459**	**3582**	**900**	**6722**	**10089**	**4758**	**3440**	**542**	**5290**	**829**	**590**	**38202**

Table 9 – Total BMW Treated (kg/day) in Maharashtra as reported by CBMWTDF Operators

	Am	Au	Kal	Kol	Mu	Nag	Nas	NM	Pu	Ra	Th	Mah.
BMW Treated by Own Facilities (Self reported by HCEs)	422	977	15	3240	0	1892	488	0	473	226	0	**7734**
BMW Treated by CBMWTDF Operators (As reported by Operators)	1037	2445	885	2590	10401	1877	3198	1531	4817	3933	707	**33420**
TOTAL	**1459**	**3423**	**900**	**5830**	**10401**	**3769**	**3686**	**1531**	**5290**	**4159**	**707**	**41154**

2.3.6   HCEs granted Authorization by MPCB

a.   *Authorization by MPCB- Bedded HCEs*

In Kolhapur, Mumbai, Navi-Mumbai, Thane, Kalyan and Raigad, all bedded HCEs have authorization from MPCB.

In Pune, Aurangabad, Nasik, Nagpur and Amravati regions some of the bedded HCEs are without authorization. **Table 11** illustrates the gap in authorization.

Table 10 - Number of Bedded HCEs obtained Authorization from MPCB

Sl. No.	Region	Total Bedded HCEs	Bedded HCEs obtained Authorization by MPCB	Bedded HCEs not obtained Authorization by MPCB
1.	Amravati	913	893	20
2.	Aurangabad	2678	2666	12
3.	Kalyan	558	558	0
4.	Kolhapur	1543	1543	0
5.	Mumbai	1417	1417	0
6.	Nagpur	1166	1051	115
7.	Nasik	2569	2443	126
8.	Navi Mumbai	191	191	0
9.	Pune	2764	574	2190
10.	Raigad	404	404	0
11.	Thane	235	235	0
	TOTAL	**14438**	**11975**	**2463**

Table 11 - Comparison of Regions based on Number of Authorized Bedded HCEs

	HCEs with >500 beds	HCEs with 200 – 499 beds	HCEs with 50-199 beds	HCEs with >50 beds
Pune	Authorized 7.69% Not authorized 92.31%	Authorized 6.25% Not authorized 93.75%	Authorized 20.00% Not authorized 80.00%	Authorized 20.94% Not authorized 79.06%
Nasik	Not authorized 25.00% Authorized 75.00%	Not authorized 10.00% Authorized 90.00%	Not authorized 7.14% Authorized 92.86%	Not authorized 4.83% Authorized 95.17%
Nagpur	Not authorized 9.86% Authorized 90.14%			

	HCEs with >500 beds	HCEs with 200 – 499 beds	HCEs with 50-199 beds	HCEs with >50 beds
Amravati	Not authorized 0.00% / Authorized 100.00%	Not authorized 0.00% / Authorized 100.00%	Not authorized 18.18% / Authorized 81.82%	Not authorized 1.81% / Authorized 98.19%

Note: Category wise authorization data not provided for Nagpur. Only total data provided.

2.3.6.1 Authorization by MPCB- Non-Bedded HCEs

In Kolhapur, Navi Mumbai, Pune and Thane all non-bedded HCEs have authorization from MPCB.

In Mumbai, in the <1000 patients/month category, all HCEs in Mumbai have authorization from MPCB.

In Amravati, Aurangabad, Kalyan, Nagpur, Nasik and Raigad regions some of the HCEs are without authorization.

Table 12 - Number of Non-Bedded HCEs obtained Authorization from MPCB

Sl. No.	Region	Total Non-Bedded HCEs	Non-Bedded HCEs obtained Authorization from MPCB	Non-Bedded HCEs not obtained Authorization from MPCB
12.	Amravati	3127	791	2336
13.	Aurangabad	1489	710	779
14.	Kalyan	443	347	96
15.	Kolhapur	1985	1985	0
16.	Mumbai	13408	6702	6706
17.	Nagpur	2428	1343	1085
18.	Nasik	2019	1491	528

Sl. No.	Region	Total Non-Bedded HCEs	Non-Bedded HCEs obtained Authorization from MPCB	Non-Bedded HCEs not obtained Authorization from MPCB
19.	Navi Mumbai	564	564	0
20.	Pune	4421	4421	0
21.	Raigad	665	391	274
22.	Thane	797	795	2
	TOTAL	**31346**	**19540**	**11806**

2.3.7 CBMWTDF Operators and Transporters and their Capacities

There are 31 CBMWTDF operators and transporters for BMW in Maharashtra. All the operators have taken responsibility for transportation of BMW. Maximum number of operators and transporters are in Pune region. Some of the operators and transporters cover HCEs in more than one region.

Data captured for CBMWTDF Operators included the following -

The number of HCEs served

- Number of beds served,
- BMW handled/day,
- Incinerable waste handled/day,
- Incinerator capacity,
- Autoclave capacity,
- Charging policy
- Number and type of violations

Similarly, data captured from CBMWTDF transporters includes the following –

- Number of HCEs served
- BMW handled/day
- Number of vehicles
- Total distance travelled
- Number and type of violations

A format has been prepared to present information on each CBMWTDF operator and transporter. Please refer to **Annexure 3.**

Based on the data collected, some Key Performance Indicators (KPIs) were identified. These included average incinerator run time/day and BMW transported per km distance etc. Some highlights of the analysis of collected are presented in **Table 13** and **Table 14.**

Table 13 - KPIs for Incinerators at CBMWTDF

Sl. No.	Name of Operator	District(s)	Total Nos. of HCEs	Total Nos. of Beds	BMW handled/day	Incinerator Capacity (kg/hr)	Average Incinerator Run Time	Incinerable Waste/Total Waste %	BMW / bed	Remarks
1	Atul Environment Services	Amravati, Aurangabad	1225	6439	300.9	50	3.62	60%	0.05	-
2	Global Eco Save Systems	Amravati	960	6110	931.5	100	9.04	97%	0.15	-
3	M/s Water Grace Products	Aurangabad	783	4724	1221	300	3.82	93.94%	0.26	-
4	M/s Akshay Industries	Aurangabad	271	1695	305	100	2.60	85.25%	0.18	-
5	M/s Superb Hygienic Disposals (I) Pvt. Ltd	Aurangabad	347	1918	180.5	100	1.76	97%	0.09	-
6	M/s Champawati Waste Management	Aurangabad	956	3414	458	50	5.60	61.14%	0.13	-
7	M/s Sangmeshwar Pollution Control Society	Aurangabad	78	245	458	-	Not Applicable*	No Incinerable waste	1.87	*Only Deep Burial Facility
8	M/s PRS Enterprises	Kalyan	1001	7480	884.7	90	8.00	81.35%	0.12	-
9	M/s Daas Enterprises	Kolhapur	642	4600	570	50	9.80	85.96%	0.12	-
10	M/s S.S. Services	Kolhapur	636	1947	295	50	4.40	74.58%	0.15	-

Sl. No.	Name of Operator	District(s)	Total Nos. of HCEs	Total Nos. of Beds	BMW handled/day	Incinerator Capacity (kg/hr)	Average Incinerator Run Time	Incinerable Waste/Total Waste %	BMW / bed	Remarks
11	M/s. Bio Medical Waste Disposal Association	Kolhapur	97	950	288	-	Not Applicable*	0%**	0.3	*Only Autoclave Facility **Only Non incinerable waste
12	M/s Surya Central Treatment and Disposal Facility	Kolhapur	1021	3203	882	55	14.27	89.00%	0.28	-
13	M/s Maharashtra Bio-Hygienic Waste Management	Kolhapur and Raigad	743	3247	Insufficient Data*	50	Insufficient Data*	Insufficient Data*	0	* Data not provided by Raigad District
14	M/s Shri Govind Bio-Medical Waste Corporation Ltd.	Kolhapur	331	1157	325	-	Not Applicable*	0%**	0.28	*Only Autoclave Facility **Only Non incinerable waste
15	M/s SMS Envoclean Pvt. Ltd.	Mumbai	8121	41488	10401	700	13.12	88.29%	0.25	-
16	Superb Hygienic Disposals	Nagpur	1459	7989	1742	200	8.40	96.44%	0.22	-
17	Krupa Wastages	Nagpur	124	903	135	180	0.45	60.00%	0.15	-
18	M/s Water Grace Products	Nasik	1400	7679	1900	300	5.50	86.84%	0.25	-
19	Bioclean Systems (I) Pvt. Ltd	Nasik	924	6149	550	100	5.00	90.91%	0.09	-

Sl. No.	Name of Operator	District(s)	Total Nos. of HCEs	Total Nos. of Beds	BMW handled/day	Incinerator Capacity (kg/hr)	Average Incinerator Run Time	Incinerable Waste/Total Waste %	BMW / bed	Remarks
20	M/s Manasi Bio-Medical Waste Enterprises	Nasik	698	2817	398.3	70	4.71	82.85%	0.14	-
21	M/s Shree Swami Samarth Enterprises Pvt.	Nasik	285	1135	300	100	1.60	53.33%	0.26	-
22	M/s Evergreen Env	Navi Mumbai	68	275	45	-	Not Applicable*	0%**	0.16	*Only Autoclave Facility **Only Non incinerable waste
23	M/s Mumbai Waste Management Ltd*	Navi Mumbai and Raigad	1387	8348	1486	150	9.51	95.96%	0.18	-
24	M/s Passco Environmental Solutions Pvt. Ltd.	Pune	1681	10888	1177	60	11.85	60.41%	0.11	-
25	M/s Jai Bhavani Bio Medicare Systems Pvt. Ltd.	Pune	367	2645	251	30	4.97	59.36%	0.09	-
26	M/s Life Secure Enterprises	Pune and Raigad	1235	2783	793	50	10.57	66.63%	0.28	-
27	M/s Nature in Need	Pune	1564	2920	1095	100	6.62	60.44%	0.38	-
28	M/s Karad Hospital Association	Pune	448	1830	314	30	6.33	60.48%	0.17	-
29	M/s Sumitra Incinerator	Pune	1157	7225	809	75	6.48	60.07%	0.11	-

Sl. No.	Name of Operator	District(s)	Total Nos. of HCEs	Total Nos. of Beds	BMW handled/day	Incinerator Capacity (kg/hr)	Average Incinerator Run Time	Incinerable Waste/Total Waste %	BMW / bed	Remarks
30	Bioclean Systems	Pune	897	1765	628	75	5.06	60.43%	0.36	-
31	Enviro Vigil	Raigad and Thane	1335	4802	2903.6	50	27.91	48.06%	0.6	-
	MAX	-	-	41488	10401	700	28	97%	1.87	-
	MIN	-	-	68	245	50	0	0.0%	0	-
	AVERAGE	-	-	5122	1033	-	6.16	0.63%	0.25	-

Table 14 - Summary Table of KPIs for CBMWTDF Transporters

Sl. No.	Name of Transporter	District	Total Nos. of HCEs	BMW handled/day	BMW transported [(km/day)/(km/day)]
1	Atul Environment Services	Amravati, Aurangabad	990	955	0.39
2	Global Eco Save Systems	Amravati	960	931.5	0.58
3	M/s Water Grace Products	Aurangabad	829	1238	1.43
4	M/s Akshay Industries	Aurangabad	271	305	1.56
5	M/s Superb Hygienic Disposals (I) Pvt. Ltd	Aurangabad	347	180.5	1.39
6	M/s Champawati Waste Management	Aurangabad	866	429	0.26
7	M/s Sangmeshwar Pollution Control Society	Aurangabad	78	68	0.43

Sl. No.	Name of Transporter	District	Total Nos. of HCEs	BMW handled/day	BMW transported [(km/day)/(km/day)]
8	M/s PRS Enterprises	Kalyan	897	884.7	3.36
9	M/s Daas Enterprises	Kolhapur	642	570	7.13
10	M/s S.S. Services	Kolhapur	636	295	2.19
11	M/s. Bio Medical Waste Disposal Association	Kolhapur	97	288	5.76
12	M/s Surya Central Treatment and Disposal Facility	Kolhapur	1021	882	4.41
13	M/s Maharashtra Bio-Hygienic Waste Management	Kolhapur and Raigad	743	370	Insufficient Data
14	M/s Shri Govind Bio-Medical Waste Corporation Ltd.	Kolhapur	331	325	1.25
15	M/s SMS Envoclean Pvt. Ltd.	Mumbai	8121	10401	3.47
16	Superb Hygienic Disposals	Nagpur	1459	1742	4.98
17	Krupa Wastages	Nagpur	124	135	0.49
18	M/s Water Grace Products	Nasik	1400	1900	1.97
19	Bioclean Systems (I) Pvt. Ltd	Nasik	924	550	0.42
20	M/s Manasi Bio-Medical Waste Enterprises	Nasik	698	550	1.53
21	M/s Shree Swami Samarth Enterprises Pvt.	Nasik	430	300	0.55
22	M/.s. Evergreen Env	Navi Mumbai	68	45	2.25
23	M/s Mumbai Waste Management Ltd*	Navi Mumbai and Raigad	1387	1486	24.77
24	M/s Passco Environmental Solutions Pvt. Ltd.	Pune	1681	1177	14.71
25	M/s Jai Bhavani Bio Medicare Systems Pvt. Ltd.	Pune	367	251	5.02
26	M/s Life Secure Enterprises	Pune and Raigad	1182	793	2.73

Sl. No.	Name of Transporter	District	Total Nos. of HCEs	BMW handled/day	BMW transported [(km/day)/(km/day)]
27	M/s Nature in Need	Pune	1564	1095	6.05
28	M/s Karad Hospital Association	Pune	448	314	7.3
29	M/s Sumitra Incinerator	Pune	1157	809	4.68
30	Bioclean Systems	Pune	897	628	5.71
31	Enviro Vigil	Raigad and Thane	1213	853.11	1.71
	MAX			10401	25
	MIN			245	0
	AVERAGE			**5122**	**4**

a. *Composition of Incinerable waste*

Nearly 79% of the total waste generated is incinerable waste. **Figure 8** illustrates incinerable waste generated in each region.
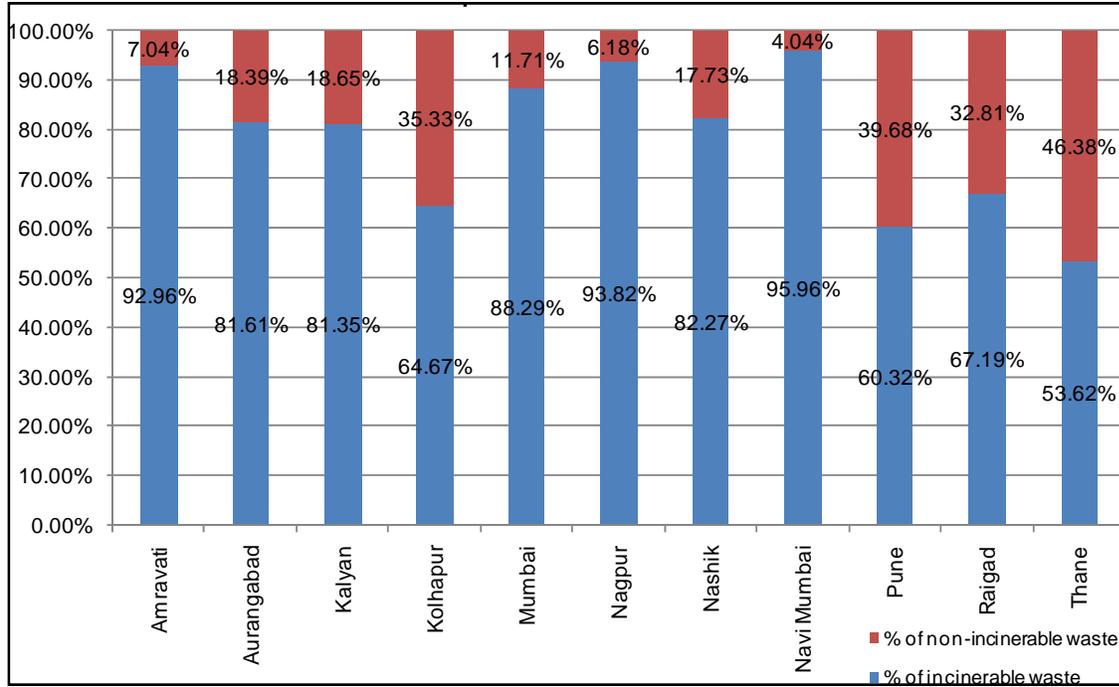
Figure 8 - Composition of Incinerable waste

For the CBMWTDF, there is a large variation in the average incinerator run time. The maximum incineration run time is by Enviro Vigil (Thane) of 27 hours/day (which is not feasible!) whereas the minimum time only 0.45 hours by Krupa Wastages (Nagpur) (which is not viable!).This shows need for verification of the data.
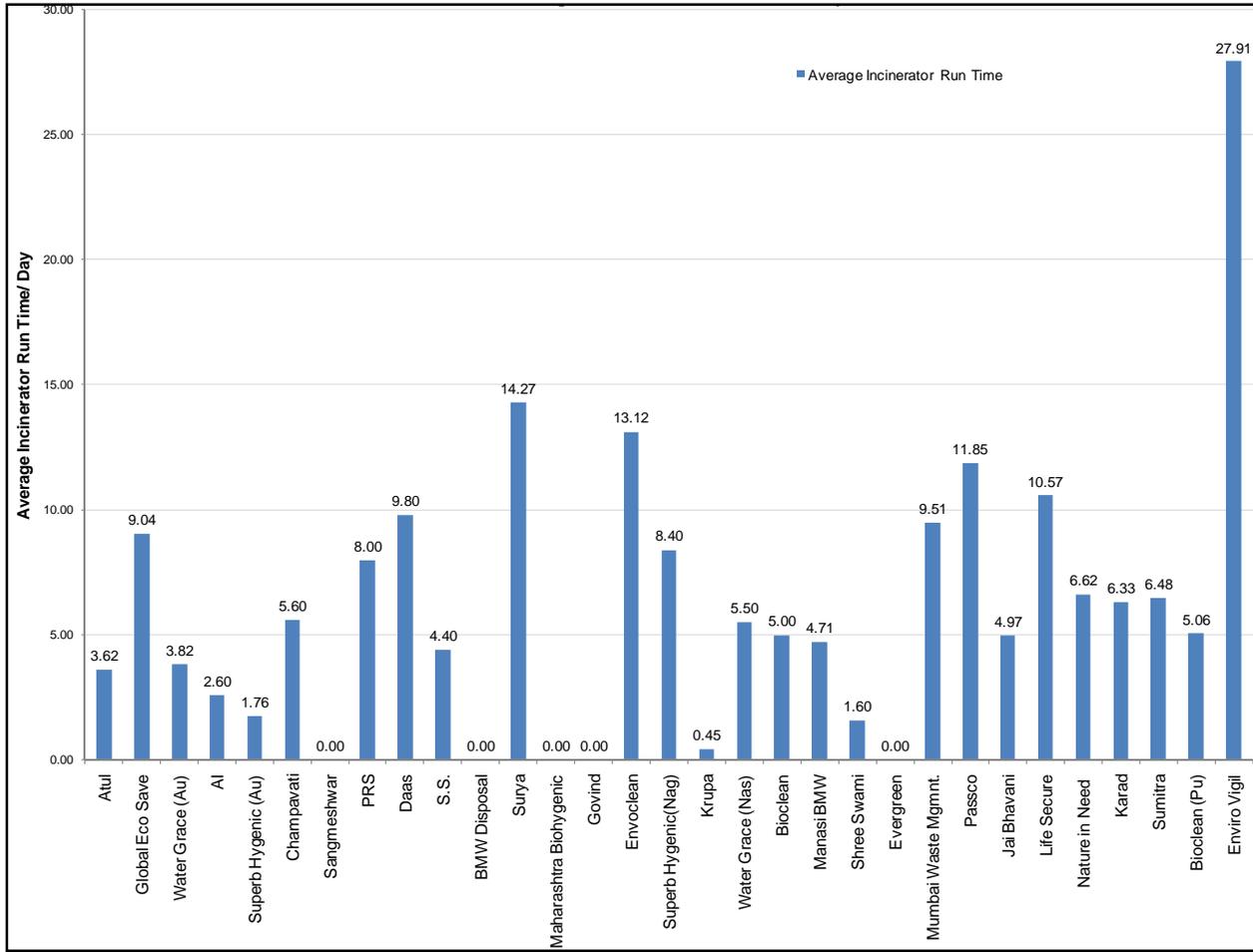
Source MPCB

Figure 9 – Average Incinerator Run Time for CBMWTDF in Maharashtra

Figure 11 illustrates the quantity of BMW treated by CBMWTDF Operators in each region with location of Regional Operators and Transporters in Maharashtra State.

Figure 12 illustrates the quantity of BMW treated/day by each CBMWTDF Operator in Maharashtra.
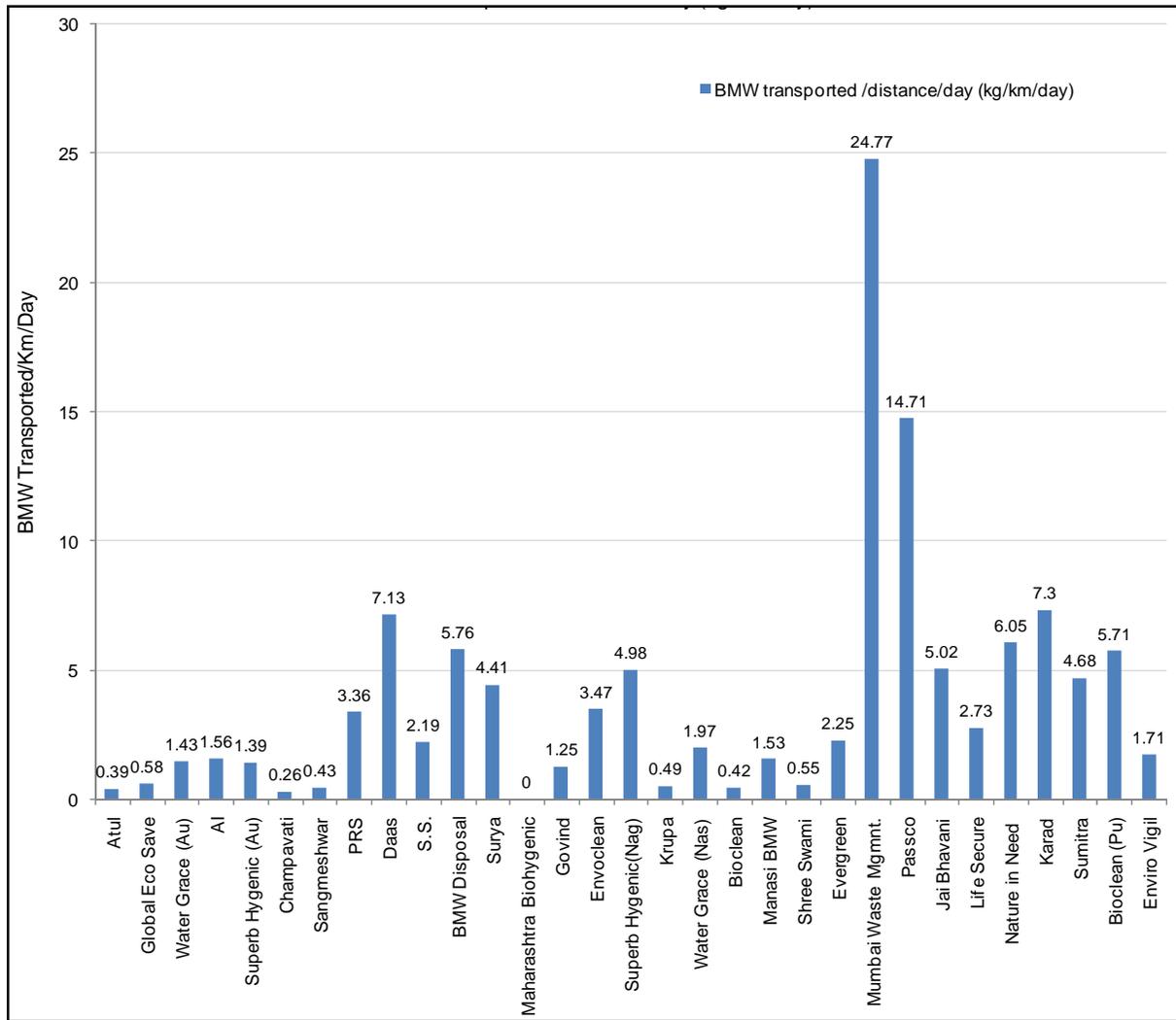
Source MPCB

Figure 10 – Maximum BMW transported/km/day for all transporters in Maharashtra

It may be observed that for transporters, there is a large variation in amount of BMW handled/km. The maximum amount is by Mumbai Waste Management (Raigad) of 25 kg/km/day; whereas the minimum is 0.45 kg/km/day by Krupa Wastages (Nagpur). Higher is the BMW handled/km more cost-effective is expected to be the CBMWTDF.
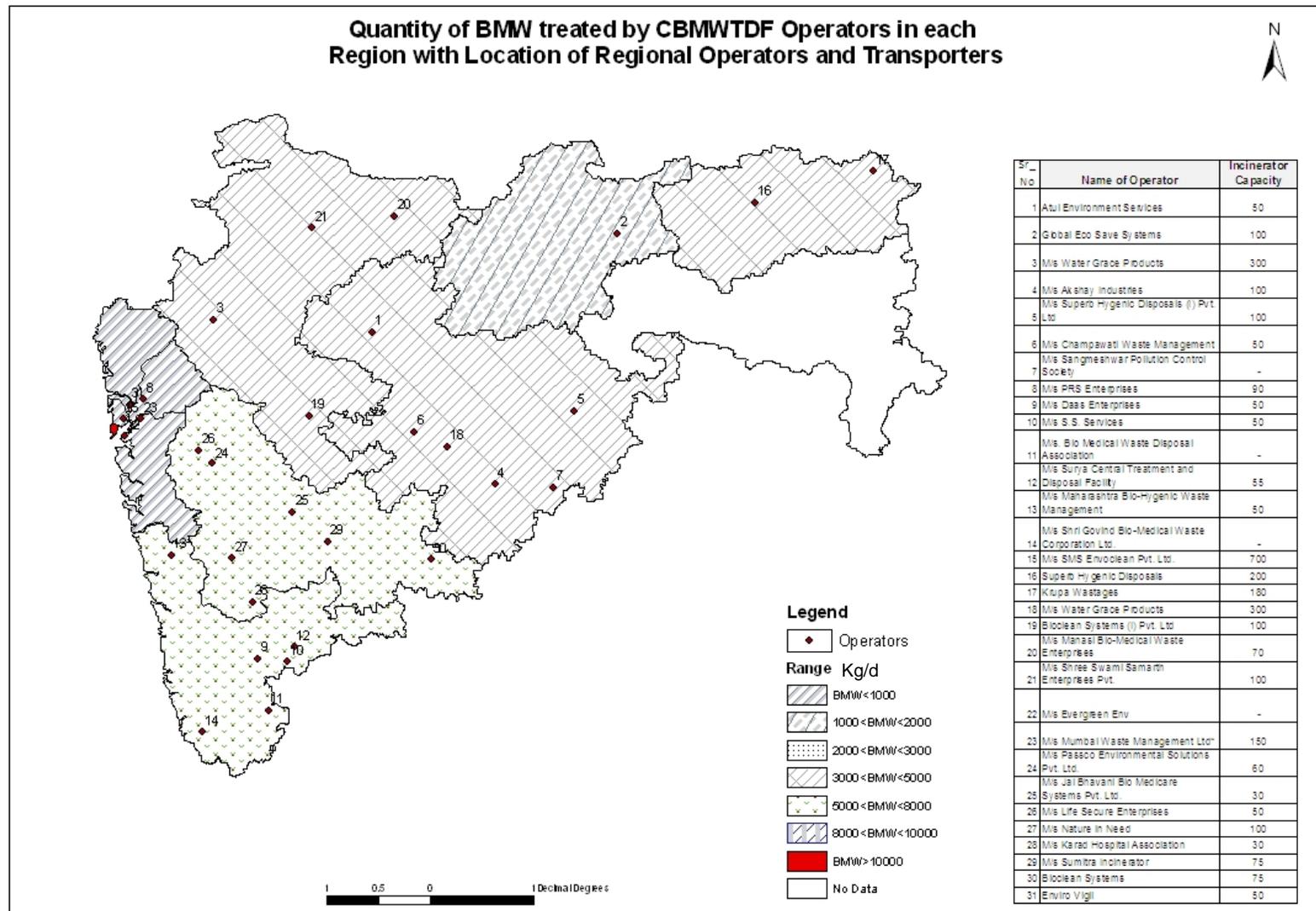
Figure 11 – Quantity of BMW treated in each region by CBMWTDF Operators with location of Regional Operators and Transporters
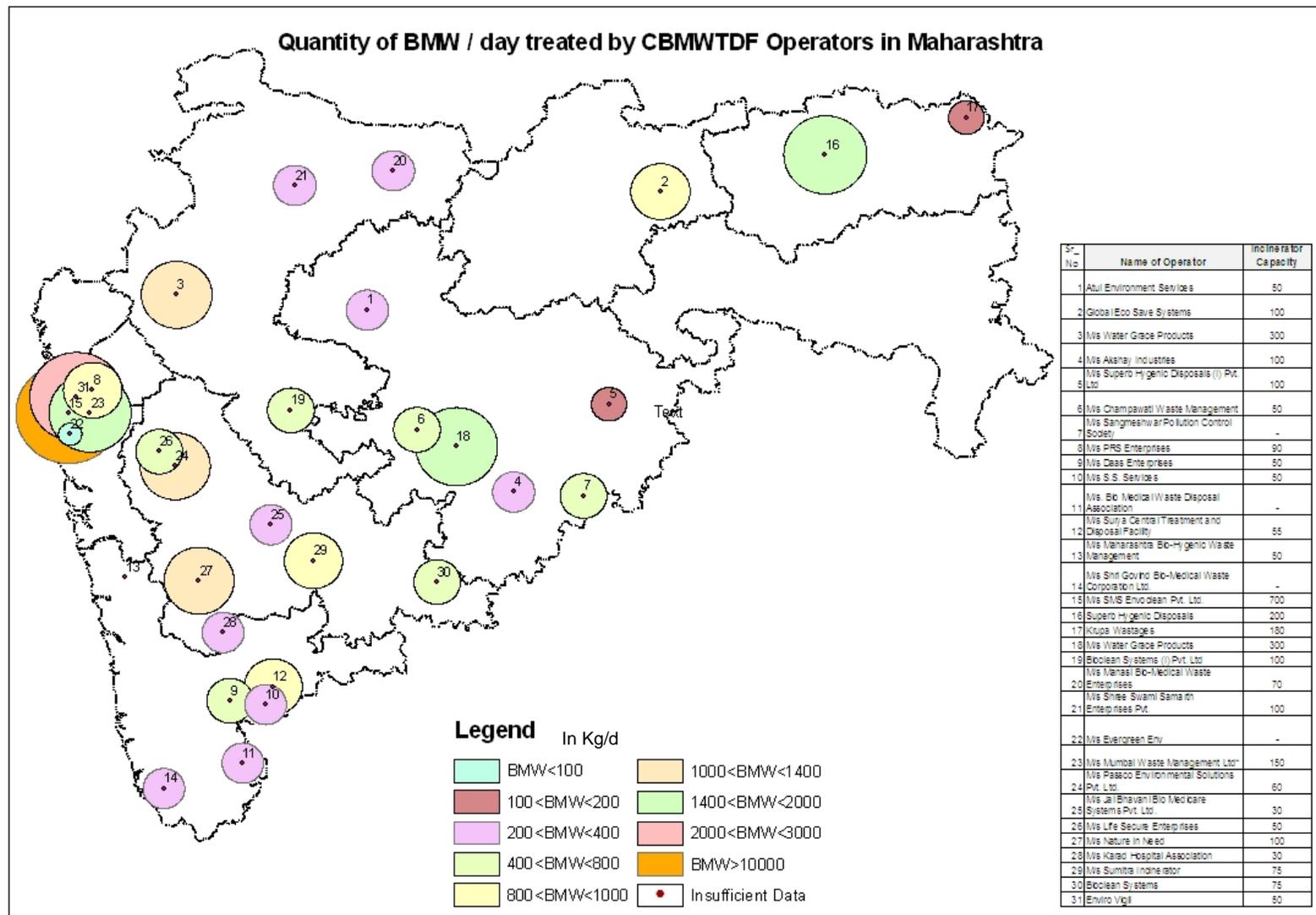
Figure 12 – Quantity of BMW treated/day by CBMWTDF Operators in Maharashtra

2.3.8 Number of Bedded HCEs member of CBMWTDF and having own Treatment Facility

Table 15 shows the number of bedded HCEs which are neither members of a CBMWTDF nor have own treatment facility. It is assumed that any HCE that has its own BMW Treatment Facility is not a member of any CBMWTDF.

Table 15 - Number of Bedded HCEs not member of CBMWTDF and not having own Treatment Facility

Sl. no.	Region	Total No. of HCEs	Nos. of HCEs that are Member of CBMWTDF	HCEs having own facility for treatment and disposal	No. of HCEs not member of CBMWTDF and not having own Treatment facility
1.	Amravati	913	707	187	19
2.	Aurangabad	2678	1641	526	511
3.	Kalyan	558	536	22	0
4.	Kolhapur	1543	1543	0	0
5.	Mumbai	1417	1417	0	0
6.	Nagpur	1166	810	301	55
7.	Nasik	2569	2265	238	66
8.	Navi Mumbai	191	191	2	0**
9.	Pune	2764	2485	279	0
10.	Raigad	404	363	26	15
11.	Thane	235	235	0	0
	TOTAL	**14438**	**12193**	**1581**	**666**

*This indicates that 2 HCEs are members of CBMWTDFs and have their own facility for treatment and disposal.

** As per data, there may be overlap between HCEs member of CBMWTDF and own facilities. Therefore, nos. of HCEs not a member of CBMWTDF and without any facilities is taken as zero

Aurangabad region has the highest number of HCEs that do not have membership of CBMWTDF nor have own treatment facility.

Table 16 shows number of Non- Bedded HCEs which are not member of CBMWTDF and not having own treatment facility.

Table 16 - Non-Bedded HCEs neither member of CBMWTDF and not having own Treatment Facility

Sl. No.	Region	Total Non bedded HCEs	Non bedded HCEs Member of CBMWTDFs	No. of HCEs not member of CBMWTDF and not having own Treatment facility
23.	Amravati	3127	629	2498
24.	Aurangabad	1489	1179	310
25.	Kalyan	443	347	96

Sl. No.	Region	Total Non bedded HCEs	Non bedded HCEs Member of CBMWTDFs	No. of HCEs not member of CBMWTDF and not having own Treatment facility
26.	Kolhapur	1985	1985	0
27.	Mumbai	13408	6704*	6704*
28.	Nagpur	2428	1308	1120
29.	Nasik	2019	1581	438
30.	Navi Mumbai	564	564	0
31.	Pune	4421	4332	89
32.	Raigad	665	393	272
33.	Thane	795	797	0
	TOTAL	31346	19819	11527

* Insufficient Data

HCEs that are neither members of CBMWTDFs nor having own treatment facility may be deemed as not compliant.

2.3.9 Violations and Actions taken

Data on total number of violations of BMW rules by the HCEs was collected from respective ROs. Total number of actions taken by MPCB against these violations has also been reported. This data has been analyzed for four categories-

Bedded HCEs
- Non - Bedded HCEs Serving > 1000 and Above Patients/ Month
- Non - Bedded HCEs Serving < 1000 Patients/ Month
- Non - Bedded HCEs Education, Research Institute, Veterinary Hospitals, etc

Based on available data, regions that have reported maximum number of violations have been identified. Actions taken by MPCB have also been noted. The violations have been further classified into four categories –

- Type I – HCEs not obtained authorization from MPCB
- Type II – HCEs not obtained authorization from MPCB nor become a member of CBMWTDF
- Type III – HCEs not having own treatment facility nor have become a member of CBMWTDF
- Type IV - Any other serious nature of violations not covered under (I), (II) and (III)

It could be observed that in most cases, all the cases of violations have not been addressed by MPCB.

a. Number of Violations and Actions taken on Bedded HCEs

Please refer to **Table 17** for the details of violations made by and actions initiated against bedded HCEs. It could be noted that maximum numbers of violations are recorded in Aurangabad region, against which no actions have been initiated. Kolhapur region follows Aurangabad in terms of violations; however, the

number of actions taken is higher than the violations. In Pune and Kalyan there are no violations but actions have been initiated in 415 cases in Pune and 15 cases in Kalyan.

Table 17 - Number of Violations and Actions taken against Bedded HCEs

Sr. no.	Region	Total No. of HCEs (Bedded)	Total Nos. of Violations	Total Nos. of Actions
1.	Amravati	913	17	12
2.	Aurangabad	2678	705	0
3.	Kalyan	558	0	15
4.	Kolhapur	1543	612	618
5.	Mumbai	1417	--	--
6.	Nagpur	1166	22	22
7.	Nasik	2569	554	559
8.	Navi-Mumbai	191	0	0
9.	Pune	2764	0	415
10.	Raigad	404	0	0
11.	Thane	235	--	--
	TOTAL	**14438**	**1910**	**1641**

Note: -- refers to no data available

b. Categorization of Violations in Bedded HCEs

It is noted that almost 3/4th of the violations are of Type I. Please refer to **Figure 13**. Approximately 25% of the violations are of Type II when HCEs have not been granted authorization and have not become members of CBMWTDF. Type III violations are nearly zero.
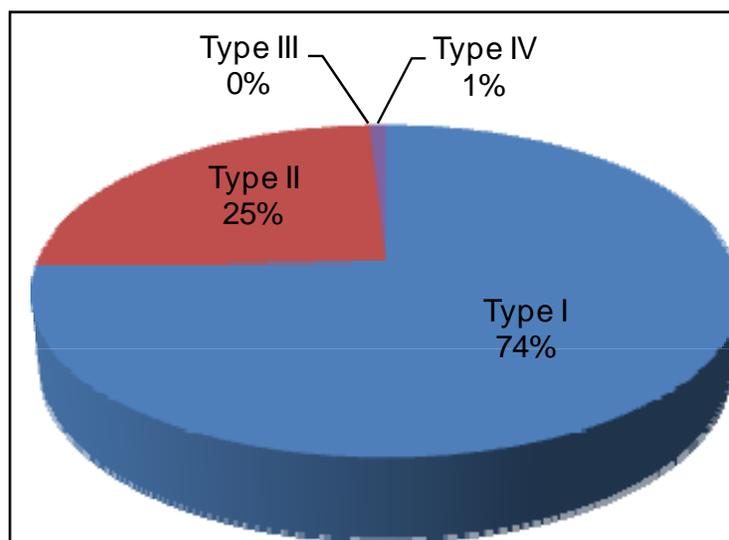
Source: MPCB

Figure 13 - Categorization of Violations in Bedded HCEs

c. Number of Violations and Actions taken on Non - Bedded HCEs serving > 1000 Patients / month

Please refer to **Table 18** for the violations by non bedded HCEs serving > 1000 patients/month. Maximum numbers of violations are recorded in Nasik region. However, actions have been taken against all of the violations.

Table 18 - Number of Violations and Actions in Non-Bedded HCEs Treating/ Providing Service >1000 Patients / month

Sr. no.	Region	Total No. of HCEs (Non- Bedded serving > 1000 Patients per Month)	Total Nos. of Violations	Total Nos. of Actions
1.	Amravati	1	0	0
2.	Aurangabad	37	0	0
3.	Kalyan	17	0	0
4.	Kolhapur	5	10	5
5.	Mumbai	6704	--	--
6.	Nagpur	160	0	0
7.	Nasik	28	21	21
8.	Navi-Mumbai	35	0	0
9.	Pune	172	0	0
10.	Raigad	20	0	0
11.	Thane	0	0	0
	TOTAL	**7179**	**31**	**26**

Note: -- refers to no data available

d. Categorization of Violations in Non-Bedded HCEs Treating/Providing Service to 1000 and Above Patients/ Month

It is noted that approx 84% violations are Type I Violations (HCE is not authorized).Type III violations are nil.
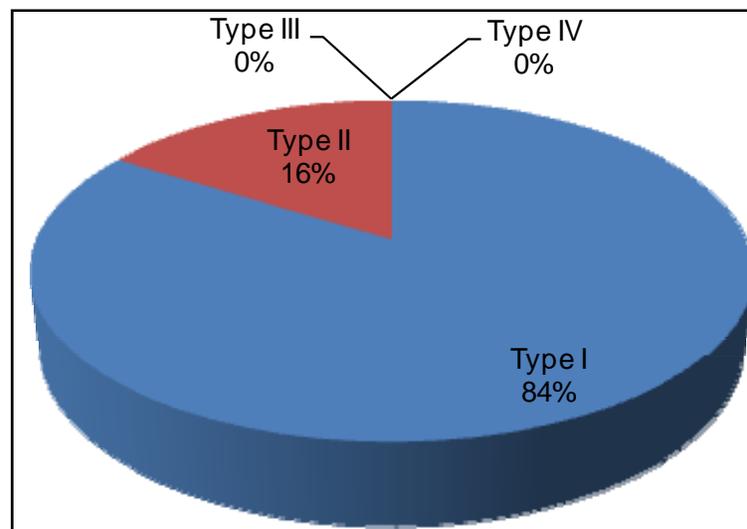
Source MPCB

Figure 14 - Categorization of Violations in Non Bedded HCEs (1000 and above patients/month)

e. *Number of Violations and Actions Taken in Non - Bedded HCEs serving < 1000 Patients/ Month*

Maximum numbers of violations are recorded in Kolhapur Region. Action has been taken against 67% of the violations. In Aurangabad, the number of actions taken is higher than the number of violations.

Table 19 - Number of Violations and Action in Non - Bedded HCEs serving <1000 Patients/ Month

Sl. no.	Region	Total No. of HCEs (Non- Bedded serving < 1000 Patients per Month)	Total Nos. of Violations	Total Nos. of Actions
1.	Amravati	3126	0	0
2.	Aurangabad	1450	353	630
3.	Kalyan	426	81	81
4.	Kolhapur	1975	3950	1975
5.	Mumbai	6702	78	78
6.	Nagpur	2231	0	0
7.	Nasik	1634	653	653
8.	Navi-Mumbai	514	0	0
9.	Pune	4232	0	0
10.	Raigad	642	--	--

Sl. no.	Region	Total No. of HCEs (Non- Bedded serving < 1000 Patients per Month)	Total Nos. of Violations	Total Nos. of Actions
11.	Thane	795	0	0
	TOTAL	**23727**	**5115**	**3417**

Note: -- refers to no data available

f. *Categorization of Violations in Non - Bedded HCEs Treating/ Providing Service to less than 1000 Patients/ Month*

It is noted that maximum violations are of Type II category. It is noted that there are 42% Type I violations. However, Type I violations are not valid for non-bedded HCEs treating/providing service < 1000 patients/month.
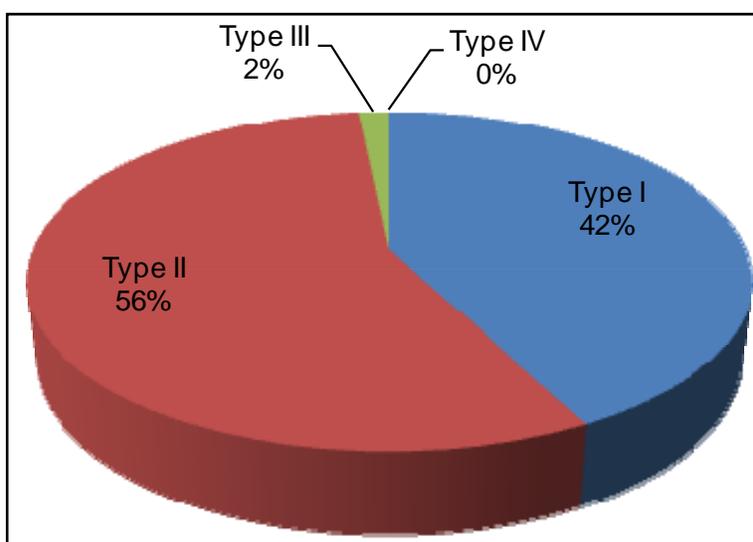
Source MPCB

Figure 15 - Categorization of violations- Non-bedded(less than 1000 patients/month)

g. *Number of Violations and Actions in Non - Bedded HCEs in Others Category*

Maximum numbers of violations are recorded in Nasik Region. It is noted that action has not been taken against any of the violations.

Table 20 - Number of Actions and Violations in Non-Bedded HCEs in Others Category

Sl. No.	Region	Total No. of Other category HCEs	Total Nos. of Violations	Total Nos. of Actions
1	Amravati	No Data	No Data	No Data
2	Aurangabad	2	0	0
3	Kalyan	0	0	0

Sl. No.	Region	Total No. of Other category HCEs	Total Nos. of Violations	Total Nos. of Actions
4	Kolhapur	5	0	0
5	Mumbai	No Data	No Data	No Data
6	Nagpur	37	0	0
7	Nasik	357	345	30
8	Navi-Mumbai	15	0	0
9	Pune	17	0	0
10	Raigad	3	No Data	No Data
11	Thane	No Data	No Data	No Data
	TOTAL	436	345	30

h. Categorization of Violations in Non - Bedded HCEs in Others Category

It is noted that all violations are of Type II category. There are no Type I, III or IV violations.

2.3.10 Awareness

Few awareness generation activities have been undertaken by ROs of MPCB. Please refer to **Table 21.** However it could be seen that the efforts are isolated. Awareness is crucial for the compliance. Thus, the frequency of such programmes needs to be increases, especially across non-bedded HCEs and bedded HCEs with less than 50 beds.

Table 21 - Awareness Generation Activities by MPCB ROs

Sr. No	Region	Nature of initiative	Date of event	Location of event	No of participants	Expenditure
1	Aurangabad	5 workshops in Nanded 2 workshops in Aurangabad 1 workshop in Beed	X	IMA bhawan, NIMA Bhawan	X	X
2	Kalyan	Awareness campaign in association with AIILSG. ROs appealed to all medical practitioners to comply with BMW rules	Feb	Achayre Atre Natya Mandir	100	Organized by MPCB H.Q
3	Kolhapur	One day workshop/training program Highlights of the event well described	18th March 2009	Hotel Vrushali Executive	100	30,000

Sr. No	Region	Nature of initiative	Date of event	Location of event	No of participants	Expenditure
4	Mumbai	Generic data	X	X	X	X
5	Nagpur	Generic description on agreement with BMW rules	X	Regional Office, Udyog Bhawan, Civil Lines	X	Nil
6	Nasik	Meeting on Implementation of BMW rules Submission of Annual report	28th May 2009	2nd floor, Meeting Hall, Udyog Bhavan	87	30,000
7				-No data-		
8	Pune	Awareness campaign in association with AIILSG Detail description of activities given	16th March 2009	Dr. Neetu Mandke Hall, Tilak Road	153	X
9	Raigad	Three meetings along with medical associations are conducted.	23rd March 2009	R. G. Karnik Sabhagrah, Pant Nagar, Chendre, Alibag, Tal. Alibag, Dist. Raigad	200	X
10	Thane			-No data-		
11	Amravati					

3   Survey of HCEs

As per the ToRs a field survey was carried out at selected HCE. These surveys were carried out at Mumbai, Thane, Kalyan-Dombivali, Pune and Sangli-Miraj-Kupwad regions. Identification of HCEs was undertaken in discussion with the local MPCB ROs. All types of HCEs, large and small were captured in the survey. Also, in the sample, different types of HCEs, e.g. general, specialized and super-specialized etc were included. In all, a total of 15 HCEs of varying capacities were visited. During visit, team of EMC was assisted by MPCB officials from respective ROs.

3.1   Survey Methodology

The survey methodology included the following key elements:

Interview of HCE's staff member (that included both senior and junior staff who handle BMW);
Visits to different sections of HCEs (to see BMW generation) and physical observations of back-of-the-house (BotH) facilities (where BMW is sorted and stored),
Questionnaire filling, data validation and review

During the interview, emphasis was laid on assessing awareness of the nursing staff and ward boys / house-keeping staff who usually handle BMW and come in contact of BMW on a regular basis. It was understood that following factors are critical in ensure effective management of BMW at HCE.

Emphasis and commitment from the top management and
Awareness of the workers - This is a key factor for minimization and segregation of BMW
Vigilance of ROs of MPCB as well as operators of CBMWTDF

3.2   Survey findings

The survey findings are presented in **Table 22**. A detailed format filled for each HCE is included as **Annexure 4.**

A negative but weak correlation (-0.54) exists between the nos. of beds and BMW generated/bed/d. That implies possibility that higher the nos. of beds, the lower the BMW generation/bed/d.
Some Govt. hospitals appear to have better on ground BMW management compared to Private HCEs.

Most of the HCEs maintain a register, in which the number of red, yellow of black bags and carbuoys and total weight collected/day are mentioned. In most cases this is done at the insistence of the CBMWTDF transporters. Category wise BMW generation data is not captured in any HCEs (barring Hinduja Hospital). In many places the BMW stored is located at the back-of-the-house facility (BotH). These facilities are found to be grossly inadequate (either unprotected or have access to vermin).
BMW generated, in most cases did not match with the number presented in the BMW Authorization.
In some HCEs per bed BMW generation figures were way higher (0.7-0.5 kg/bed/d) than the average (0.3-0.1 kg/bed/d). On enquiry it was revealed that sometimes even non–contaminated waste was disposed off along with BMW waste.
Efficient BMW management is usually dependent on the awareness of the lowest rung of staff (including nursing staff and ward boys)

MPCB should consider preparing some training material in Marathi/ Hindi and disseminate them through NGOs/CBOs working in public health sector.

Table 22 - Findings of Survey of HCEs in Maharashtra

Sl. No.	HCE	Location	Under RO	Nos. of beds	BMW generated (apporx.) (kg/month)	BMW generation / bed / day	Awareness	BMW Management Level	Remarks
1	Parmanand Deepchand Hinduja National Hospital and Medical Centre	Mumbai	Mumbai	350	3236.5	0.31	High	Good	Training is provided. Awareness high. Management of BMW adequate.
2	Bombay Hospital and Medical Research Centre	Mumbai	Mumbai	721	2000	0.09	Low	Bad	No wt. wise or category wise measurements done at hospital. Only nos. of bags is counted. Training and awareness level among staff is poor.
3	St. Georges Hospital (and Grant Medical College)	Mumbai	Mumbai	467	2700	0.19	Average	Good	The BMW storage area is not enclosed. Details of awareness sessions not known. Otherwise BMW management adequate.
4	Hiranandni Hospital, Thane	Thane	Thane	15	240	0.53	Average	Good	Awareness level high. CBMWTDF conducts training. BMW management adequate.
5	Jupiter Lifeline Hospital	Thane	Thane	200	3300	0.55	Low	Very Poor	Awareness level is low. BMW generation is very high. Management intervention req. BMW management not adequate.
6	Chhrapati Shivaji Maharaj Hospital and Rajiv Gandhi Medical College	Thane	Thane	500	156	0.01	High	Good	Awareness level high. Management is very willing. BMW management adequate.

Sl. No.	HCE	Location	Under RO	Nos. of beds	BMW generated (apporx.) (kg/month)	BMW generation / bed / day	Awareness	BMW Management Level	Remarks
7	Icon Hospital Pvt. Ltd.	Dombivali	Kalyan	60	550	0.31	Average	Average	Awareness level is average to low. BMW storage is poor. BMW management is less than adequate.
8	Asian Institute of Medical Science (AIMS)	Dombivali	Kalyan	100	120	0.04	Low	Bad	Awareness level is low. BMW storage is very poor. BMW management is less than adequate.
9	Fortis Hospital Ltd.	Kalyan	Kalyan	63	581.5	0.31	High	Good	Awareness level is very high. BMW management adequate.
10	Sancheti Institute of Orthopedics and Rehabilitation	Pune	Pune	100	1575	0.53	Average	Average	Awareness level average to poor. BMW storage inadequate. BMW management is less than adequate.
11	Hardikar Hospital	Pune	Pune	60	500	0.28	Low	Very Poor	Extremely poor awareness. Segregation was very poor. BMW management absolutely not adequate.
12	Noble Hospital	Pune	Pune	250	1238	0.17	Average	Average	Increased beds to 250 without approval. Generating BMW (1000 -1500 kg/month) way higher than proposed (430-450 kg/d). Average awareness.
13	Bharati Hospital and Medical College	Miraj	Kolhapur	500	347.52	0.02	High	Good	Awareness high in hospital. ETP in good condition. BMW management adequate.

Sl. No.	HCE	Location	Under RO	Nos. of beds	BMW generated (apporx.) (kg/month)	BMW generation / bed / day	Awareness	BMW Management Level	Remarks
14	Pasmabhushan Vasantdada Patil Govt. Hospital	Sangli	Kolhapur	388	2800	0.24	Average	Average	Average awareness. BMW management adequate.
15	Dr. G. S. Kulkarni Orthopedic Hospital	Miraj	Kolhapur	100	375	0.13	Average	Average	Average awareness. BMW management adequate.

It could be seen that a HCE with high or average level of awareness is more likely to adopt good BMW management practices. HCEs with average to low levels of awareness have higher chances of ending up with poor BMW management system. Thus raising awareness amongst HCE staff should be a key thrust area in MPCB's agenda.

3.3 Observations

The observations from the survey conducted are as below:

- There is no definite pattern in between number of beds, waste generation and operation of BMW management.
- A negative correlation (-0.54) exists between the nos. of beds and BMW generated/bed/d. That implies the higher the nos. of beds, the lower the BMW generation/bed/d.
- Some Govt. hospitals appear to have better system on the ground BMW management compared to Private HCEs.
- Category wise BMW generation data is not captured in any HCEs (barring Hinduja Hospital in Mumbai). There is hardly any monitoring mechanism at the point of generation.
- Most of the HCEs maintain a register, in which the number of red, yellow of black bags and carbuoys and total weight collected/day are mentioned. In most cases this is done at the insistence of the CBMWTDF transporters.
- In many places the BMW stored is located at the back-of-the-house facility (BotH). These facilities are found to be grossly inadequate (either unprotected or have access to vermin).
- BMW generated, in most cases did not tally with the number presented in the BMW Authorization.
- In some HCEs per bed BMW generation figures were way higher (0.7-0.5 kg/bed/d) than the average (0.3-0.1 kg/bed/d). On enquiry it was revealed that even non–contaminated waste was disposed off along with BMW.
- Effective BMW management is usually dependent on the awareness of the lowest rung of staff (including nursing staff and ward boys)
- MPCB should consider preparing some training material in Marathi/ Hindi and disseminate them through NGOs/CBOs working in public health sector.
- The proactive nature of the CBMWTDF and/or MPCB Regional Office could be a major driving force towards compliance of HCEs.

4 Field Monitoring of CBMWTSDFs for Performance Evaluation and Compliance with BMW Rules

4.1 Identification of CBMWTDFs for Monitoring

M/s Mumbai Waste Management Pvt. Ltd. (MWMPL) and M/s SMS Envoclean Ltd. were selected for monitoring and performance evaluation in consultation with MPCB. These two facilities are the largest CBMWTSDFs and serve the most populated Konkan coastal belt including Mumbai.

Accordingly EMC team with assistance of local MPCB Regional Offices (Navi Mumbai for MWMPL and Mumbai for SEL) visited these two facilities, conducted monitoring and analyzed the data. The results of monitoring and performance assessment are presented below.

4.2 Parameters and Monitoring Methodology

Monitoring was conducted by a third party environmental laboratory under the direction of EMC. This laboratory is certified by MoEF under Environmental Protection Act, 1986. Refer **Annexure 5** for monitoring results.

- *Incinerator* – stack monitoring was conducted at incinerator stack for a period of 1 hour. Parameters monitored are listed in **Table 23.**
- *Effluent Treatment Plant (ETP)* – Grab samples were collected from the inlet and outlets in sterilized bottles
- *Incineration Ash* – grab samples of fresh ash were collected in sterilized and airtight containers.
- *Autoclave* – Spore test was conducted. Sterilized bottles with bacterial spores were kept along with autoclave batches and removed later on.

The standard guidelines "Evaluation of BMW Treatment Facility" by CPCB and BMW Rules, 1998 were followed for monitoring.

Table 23 - Parameters to be Monitored in a CBMWTDF

Incineration stack	Effluent Treatment Plant	Incineration Ash	Autoclave/ Microwave
Temperature	pH	VOCs	Spore Test
SPM	Total Suspended Solids		
NO_x,	BOD		
HCl,	Oil and Grease		
CO	COD		
CO_2	Bioassay test		
O_2			
Combustion efficiency			

Source: BMW Rules, 1998 and 2003. CPCB guidelines

4.3   Results of Monitoring

4.3.1   Mumbai Waste Management Ltd., Taloja, Raigad (MWML)

Mumbai Waste Management Ltd. (a Ramky Group company) was put to operations in November, 2002. It is one of the largest CBMWTDF in Maharashtra. Sampling and Monitoring was carried out on 31st March 2010.

Treatment Equipments and their existing status as observed during visit to the facility are given below in **Table 24.**

Table 24 - MWML Basic Information

#	Equipment	Existing status
1.	Incinerator	1 no., Capacity = 250 kg/hr.
2.	Autoclave	1 no. Capacity= 120 lit. Top feeding type.
		1 no. Capacity = 600 lit. Horizontal feed type. Found to be in out of operation on the day of visit.
3.	Shredder	1 no.; Capacity = 200 kg/hr.
4.	Sharp pit/ Encapsulation facility	- Not available.
5.	Effluent Treatment plant	- Treated effluent is used for quenching purpose in the common Hazardous Waste Incinerator in the same premise.
6.	Vehicle/ container washing facility	- Available.
		-

Infrastructure set up and their existing status as observed during visit to the facility are given below in **Table 25.**

Table 25 - MWML Infrastructure

#	Infrastructure	Existing status
1.	Treatment Equipment Room	- All the equipments are provided in a single house. - Same room is used for storage of untreated waste. - Separate room is provided for storage of treated wastes. - Rooms are provided with well designed roof and wall. - Floor and side walls (height of 2-meter from floor) are provided with tiles. - No separate cabin is provided for supervise the operation of equipments.
2.	Main waste storage room	- One portion (at entry side) of the equipment is used for unloading and storage of biomedical waste which are transported to the facility by vehicle.

#	Infrastructure	Existing status
		- There is slope and drainage provision for diverting the liquid generated handling of waste and washing into ETP.
3.	Treated waste storage room	- One room is provided for stage of treated waste.
		- Treated wastes are not stored in separate group as per the disposal requirements.
4.	Administrative room	- Provided.
5.	Generator set	- Standby generator set is provided.
6.	Site security	- Available.
7.	Parking	- Available
8.	Sign board	- Available
9.	Green Belt	- Green belt is developed in the open area.
10.	Washing room	Facility is provided for hand/ eye washing
11.	Other imp. provisions	
11.1	*Telephone*	*Provided and maintained*
11.2	*First Aid Box*	*Provided and maintained*
11.3	*Adequate lighting*	*Provided*
11.4	*Odour prevention*	*No provision is there to keep the facility and surrounding odour free.*
11.5	*Fire fighting*	*Fire extinguishers are provided and maintained.*
11.6	*Pest and insect control measures*	*No measures are evidenced for control of pest and insect*
11.7	*Measures to control the escape of litter*	*As observed, the area surrounding the facility was litter free. It is that*
11.8	*Control of noise*	*Noise level seemed within the acceptable level*
11.9	*PPE for waste handler*	*Necessary PPEs were provided to the waste handlers and found to be used.*
11.10 Vehicle washing facility		Inadequate collection and treatment of wash water, which is disposed on land.

Record keeping:

The following types of records are maintained:

- Waste accepted;
- Treated waste removed;

- Equipment operation logbook;
- Records related to site.

Disposal scheme of Treated BMW is provided in **Table 26.**

Table 26 - Disposal scheme of Treated Waste

#	Waste category	Disposal method followed by the facility operator
1.	Plastic waste (treated)	- Recycling
2.	Incineration ash	- Secured landfill
3.	Oil and grease	- Incineration
4.	Disinfected and other solid waste	- Secured landfill
5.	Wastewater	- Used in hazardous waste incinerator for quenching purpose.

The results of monitoring carried out in are provided below in **Table 27.**

Table 27 - Results of Monitoring

#	Location/ Source	Parameters	Measured Value	Limit	Remarks
1.	BMW Incinerator Stack	Temperature (^{O}C)	74	Not specified	Stack height = 30 meter.
		SPM (suspended particulate matter) (mg/Nm^3 at 12% CO_2 correction)	80.26	150	Within the limit.
		NOx (mg/Nm^3 at 12% CO_2 correction)	3.28	450	Within the limit.
		HCl (mg/Nm^3 at 12% CO_2 correction)	2.09	50	Within the limit.
		CO ppm	15	Not specified	
		CO_2 (%)	4	Not Specified	
		O_2 (%)	20	3.0 (Minimum)	Within the limit. Very high O_2 however indicates excess air in combustion. Leading to heat loss and inefficient operation.
		Combustion efficiency (%)	99.96	99 (At least)	Within the limit.

#	Location/ Source	Parameters	Measured Value	Limit	Remarks
2.	Incineration Ash	VOCs (%)	<0.000005	0.01	Within the limit.
3.	Autoclave and/ or Microwave whichever is available	Spore Test	No growth	No growth	Complete destruction of bacteria and other pathogenic organisms.
4.	Untreated effluent *(Input to ETP)*	pH	12.21	Not applicable	
		Total Suspended Solids (TSS) (mg/l)	118	Not applicable	
		Oil and Grease (OandG) (mg/l)	10	Not applicable	
		$BOD_{3days@27oC}$ (mg/l)	360	Not applicable	
		COD (mg/l)	871	Not applicable	
		Bio-assay test (% survival of fish after 96 hrs. in 100% effluent)	75	Not applicable	
5.	Treated effluent *(output from ETP)*	pH	12.36	6.3 – 9.0	Not meeting the limit
		Total Suspended Solids (TSS) (mg/l)	76	100	Within the limit.
		Oil and Grease (OandG) (mg/l)	3	10	Within the limit.
		$BOD_{3days@27oC}$ (mg/l)	110	30	Not meeting the limit
		COD (mg/l)	277	250	Not meeting the limit
		Bio-assay test (% survival of fish after 96 hrs. in 100% effluent)	100	90	Within the limit.

4.3.2   SMS Envoclean Ltd., Deonar, Mumbai (SEL)

SEL is the largest CBMWTDF in Maharashtra in terms both number of beds served and total BMW generated. It commenced its operation in 2009. The monitoring was carried out on 11-05-2010.

Treatment Equipments and their existing status as observed during visit to the facility are given below in **Table 28**.

Table 28 – SEL Basic Equipment Configuration

#	Equipment	Existing status
1.	Incinerator	- 02 nos. with capacity of 250kg/hr.
2.	Autoclave	- 01 no., Capacity = 300 lit
3.	Shredder	- 02 nos., capacity = 100kg/hr and 200 kg/hr.
4.	Sharp pit/ Encapsulation facility	- Not available.
5.	Effluent Treatment plant	- Available.
6.	Vehicle/ container washing facility	- Not available.

In case of SEL, there were 2 stacks and monitoring was carried out for each individual stack as well as in the main (common) stack Infrastructure set up and their existing status as observed during visit to the facility is given below in **Table 29**.

Table 29 - SCL Infrastructure available

#	Infrastructure	Existing status
1.	Treatment Equipment Room	- All the equipments are provided in a single shed. - Same room is used for storage of untreated waste. No separate room is provided. - No separate room is provided for storage of treated wastes. - Rooms are provided with well designed roof and wall. - Floor and side walls (height of 2-meter from floor) are provided with tiles. - No separate cabin is provided for supervise the operation of equipments.
2.	Main waste storage room	- One portion (at entry side) of the equipment room is used for unloading and storage of biomedical waste which are transported to the facility by vehicle. - There is no provision for diverting the liquid generated handling of waste and washing into ETP.
3.	Treated waste storage room	- No separate room is provided for storage of treated waste. - Treated wastes are not stored in separate group as per the disposal provision.
	Administrative room	- Provided.
	Generator set	- Standby generator set is provided.
	Site security	- Available.
	Parking	- Available

#	Infrastructure	Existing status
	Sign board	- Available
	Green Belt	- Hardly any open area is available for development of Green belt
	Washing room	- Facility is provided for hand/ eye washing
	Other important provisions	
	Telephone	- Provided and maintained
	First Aid Box	- Provided and maintained
	Adequate lighting	- Provided
	Odour prevention	- No provision is there to keep the facility and surrounding odour free.
	Fire fighting	- Fire extinguishers are provided and maintained.
	Pest and insect control measures	- No measures are evidenced for control of pest and insect
	Measures to control the escape of litter	- As observed, the area surrounding the facility was litter free.
	Control of noise	- Noise level was within the acceptable level as experienced.
	PPE for waste handler	- Necessary PPEs were provided to the waste handlers and found to be used.

Record keeping:

The following types of records are maintained:

- Waste accepted;
- Treated waste removed;
- Equipment operation logbook;
- Records related to site.

Details of disposal of treated bio-medical waste or its components are undertaken in the following manner as provided in **Table 30**.

Table 30 - SEL Disposal scheme of Treated Waste

#	Waste category	Disposal method followed by the facility operator
1.	Plastic waste (treated)	- Recycling
2.	Incineration ash	- Secured landfill. Proper storage facility is not available for storage of incineration ash.
3.	Oil and grease	- Incineration

#	Waste category	Disposal method followed by the facility operator
4.	Disinfected and other solid waste	- Secured landfill
5.	Treated wastewater	- Disposed in municipal drain.

The results of monitoring at incinerator stacks, incinerator ash, autoclave and ETP are presented in **Table 31.**

Table 31 – SEL Monitoring Results

Sl. No.	Location/ Source	Parameters	Measured Value			Limit	Remarks
			Inc-1 + 2	Inc-1	Inc-2		
1.	BMW Incinerator Stack	Temperature (^{O}C)	76	72	73	--*	
2.		SPM (suspended particulate matter) (mg/Nm^3 at 12% CO_2 correction)	77.16	74.54	80.39	150	Within the limit.
3.		NOx (mg/Nm^3 at 12% CO_2 correction)	3.18	4.02	3.82	450	Within the limit.
4.		HCl (mg/Nm^3 at 12% CO_2 correction)	4.16	6.31	2.10	50	Within the limit.
5.		CO ppm	19	21	15	--	
6.		CO_2 (%)	4.93	6.19	5.10	--	
7.		O_2 (%)	19.88	19.76	20	3.0 (Min)	Within the limit. Very high O_2 indicated too much of excess air in combustion. Leading to heat loss and inefficient operation.
8.		Combustion efficiency (%)	99.96	99.96	99.97	99 (Min)	Within the limit.

-- refers to No limits specified

Table 32 – SEL Monitoring Results (Contd.)

Sl. No.	Location/ Source	Parameters	Measured Value	Limit	Remarks
2.	Incineration Ash	VOCs (%)	<0.000005	0.01	Within the limit.
3.	Autoclave and/ or Microwave whichever is available	Spore Test	No growth	No growth	Complete killing of bacteria and other pathogenic organisms.
4.	Untreated effluent (Input to ETP)	pH	6.93	Not applicable	
		Total Suspended Solids (TSS) (mg/l)	492	Not applicable	
		Oil and Grease (OandG) (mg/l)	160	Not applicable	
		$BOD_{3days@27oC}$ (mg/l)	12500	Not applicable	
		COD (mg/l)	34566	Not applicable	
		Bio-assay test (% survival of fish after 96 hrs. in 100% effluent)	100	Not applicable	
5.	Treated effluent (output from ETP)	pH	7.54	6.3 – 9.0	Within the limit
		Total Suspended Solids (TSS) (mg/l)	28	100	Within the limit.
		Oil and Grease (OandG) (mg/l)	<0.5	10	Within the limit.
		$BOD_{3days@27oC}$ (mg/l)	13	30	Within the limit.
		COD (mg/l)	38	250	Within the limit.
		Bio-assay test (% survival of fish after 96 hrs. in 100% effluent)	100	90	Within the limit.

It could be seen that both of these facilities are mostly compliant with respect to the BMW Rules, 1998 (as amended on 2003). In case of ETP, MWMPL is non-compliant for parameters such as BOD and COD.

For both the plants, excess O_2 is present in the flue gases. This excess air indicates heat loss and higher fuel consumption. The plants should make every effort to minimize excess air to optimize the costs of the incineration operation.

5   Recommendations

The present practice of BMW Management involves key stakeholders such as (a) HCEs (bedded, non-bedded and others); (b) CBMWTDFs and (c) Regulators (including ULBs, MPCB, CPCB and MoEF) and (d) community including users of HCEs. The effectiveness of BMW management rests on the dynamics of their interactions and linkages between policy/regulations; technology options; data harmonization; economics (charging policy) and awareness; Recommendations regarding each of these elements in the perspective of key stakeholders are presented below.

1. **Revisit Categorization and Color Coding**: HCEs, while filling in their authorization and / or filing Form II (annual report) have to submit details pertaining to waste categories and waste generated. The Biomedical Waste (Management and Handling) Rules, 1998, as amended in 2003 have classified BMW in 10 categories. However, in practice, it is practically difficult for the HCEs to monitor the waste generated under different categories. Only nos. of colored bags and total weight of bags are recorded and reported in the registers. Instead of 10 category data, data on colored bags is only used in transactions (viz. between the HCEs and CBMETDF transporters/operators or CBMWTDF operators and MPCB). Furthermore there is no 'one to one' mapping between color codes and categories, i.e. Category I may be put in either color code 'b' or 'c'. This can lead to difficulties in exact mapping between data from authorization and data generated through weighing of color coded bags. It may be worth therefore to revisit categorization and color codes to achieve simplicity as well as mapping in data recording and management.

2. **Establish linkage between ULBs and MPCB's in permitting procedures:** The role of Urban Local Bodies (ULBs) in the BMW management is not well defined under the BMW Rules. ULBs are responsible for providing license to smaller HCEs including clinics, nursing homes etc. under the Shops and Establishment Act. In many cases, the CBWTDFs are contracted by ULBs, with premises/land leased. Some ULBs take royalty or levy fees to the operators of CBWTDFs.

   Unfortunately, there is poor coordination between ULBs and MPCB. If requirements (under the Shops and Establishment Act, and BMW Rules) could be integrated with BMW authorization then this will ensure that more HCEs (which are not authorized and /or not members of CBMWTDFs) will be brought under compliance net.

3. **Improve Data Flow to establish a Common Central Database**: Data flow between the HCEs, MPCB and CBMWTDFs is shown in **Figure 16.** The actual data on BMW generation (that flows from HCEs to CBMWTDFs) is not shared with MPCB. This may be done to allow MPCB to validate the estimates of authorization and actual BMW generation. This will also help in establishment of realistic BMW generation factors that could be used for authorization and verification.
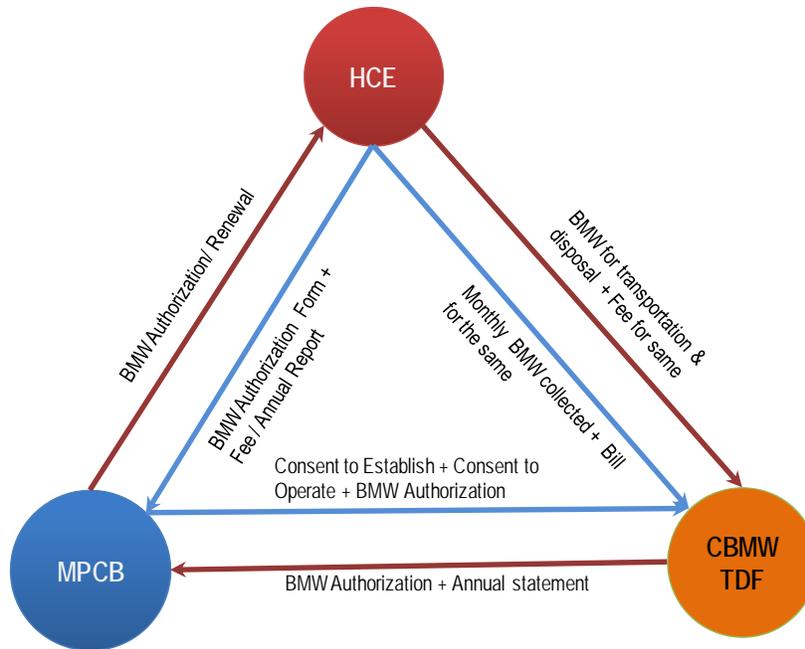
Figure 16-Flow of Information between MPCB, HCEs and CBMWTDFs (at present)
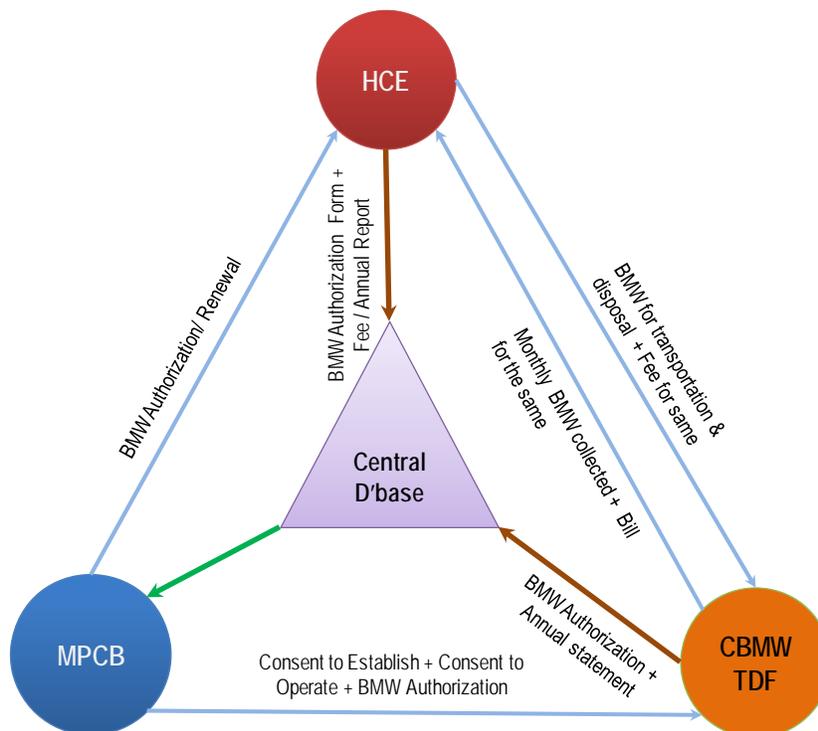
Figure 17-Flow of Information between MPCB, HCEs and CBMWTDFs (proposed)

4. **Establish a Web based System:** Overall, there is a critical need to improve on data collection, harmonization and processing. A web based system (equivalent to XGN system)[4] could be used for data capture, sharing and reporting that will serve as a central database. This web portal could be used for the purposes of sharing information with the public.

5. **Share information with Public:** All information available regarding BMW management should be made available on the public domain using MPCB's website. For this purpose, the central data base could be used. This will increase the transparency of operations in MPCB.

6. **Develop BMW Generation Factors:** After implementation of a central database for BMW, MPCB should undertake development of BMW generation factors (which may include BMW generated/bed/d/ and /or BMW generated/clinic/month). HCEs should be encouraged to use these generation factors whiling filling up BMW authorization application form for the first time. Such criteria need to be category specific and typical for a type of HCE.

Several studies (e.g. study by Nasima Akhtar[5]) suggest that BMW generation/day/bed in developing countries usually range between 0.1- 0.6 kg/bed/day. In a study commissioned by MPCB in 2009, the figure for Maharashtra was also close to 0.2 kg/bed/day[6]. **Figure 18**, **Figure 19** and **Figure 20** indicate amount of BMW generated per bed for bedded HCEs (kg/day) as well as for non-bedded as analyzed in this study.
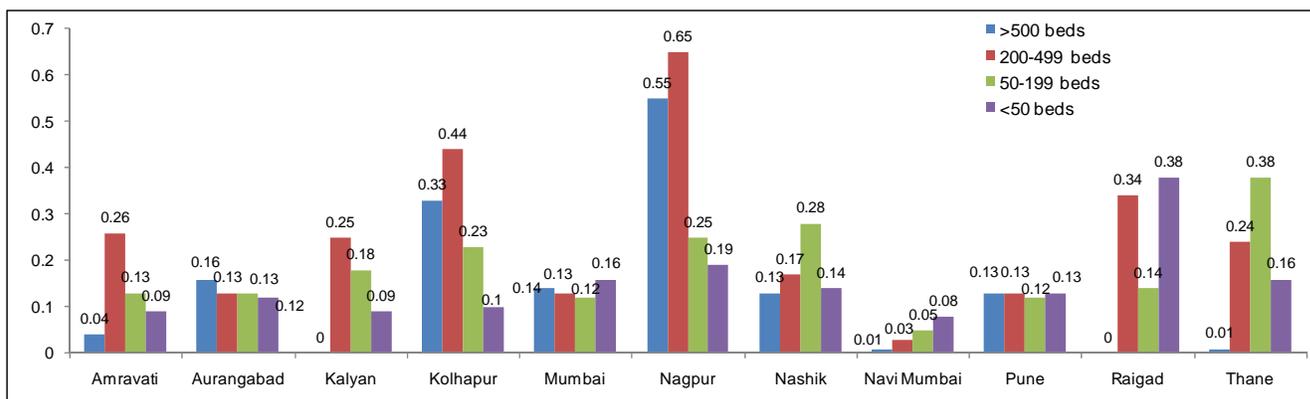
Figure 18- Amount of BMW generated per bed for bedded HCEs

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[4] Like XGN system adopted by Gujarat State Pollution Control Board see www.gpcb.gov.in
[5] http://www.eng-consult.com/BEN/papers/Paper-anasima.PDF
[6] Fixing of Reasonable Charges on Health Care Establishments by Authorized Operators and Transporters of Common Bio-Medical Waste Transport and Disposal Facility. EMC. 2009
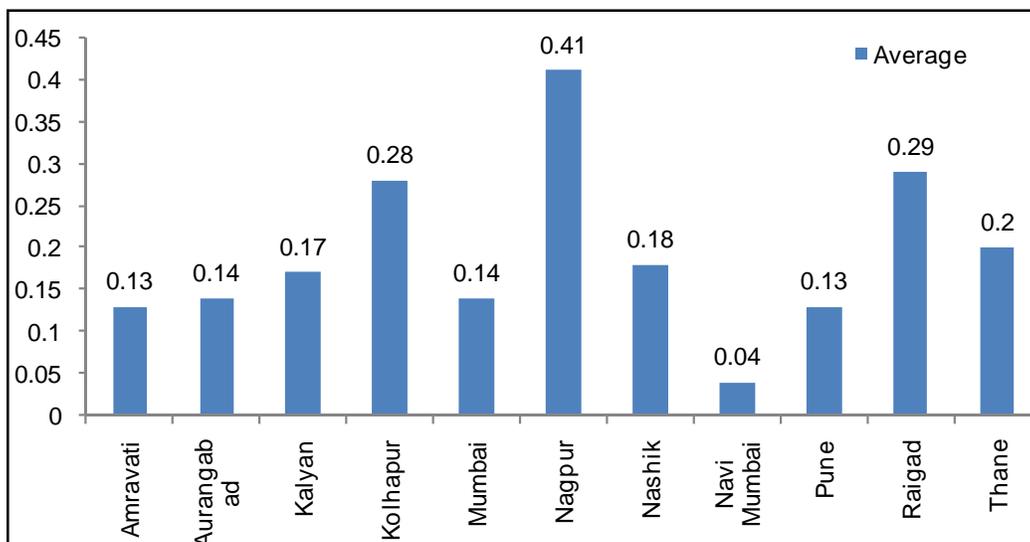
Figure 19-Average BMW generated /day/bed
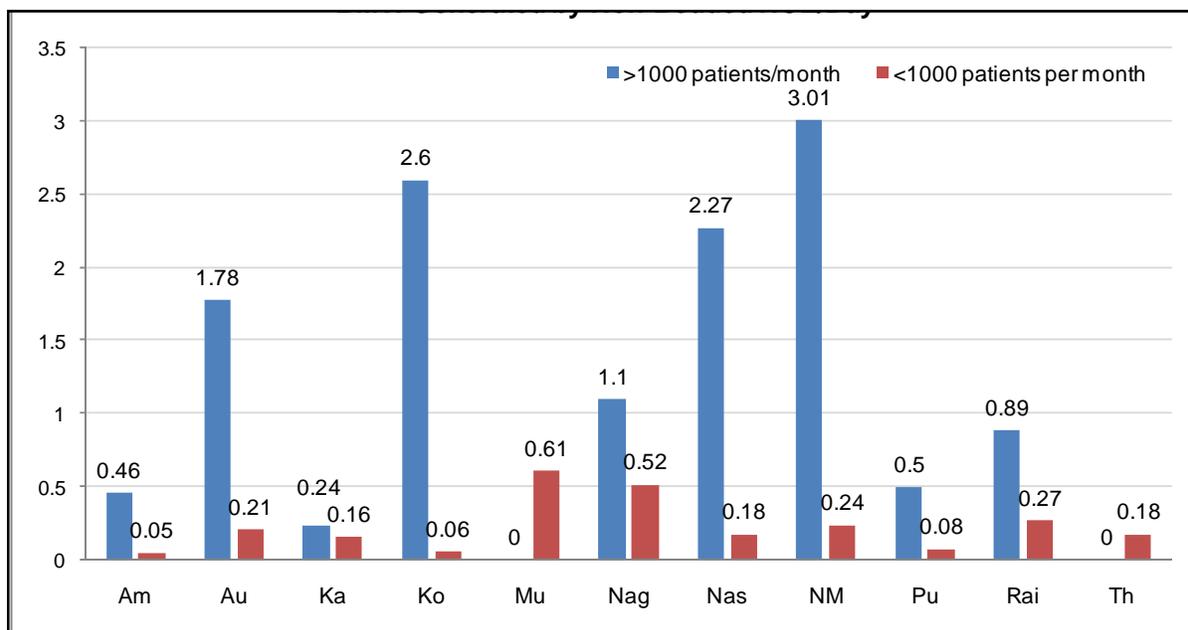
Figure 20- BMW generated by Non-bedded HCE/day/HCE

The above results clearly show that there is no consistency followed while granting authorization and estimates provided by HCEs are taken for granted. Hence, creation of central database with development of rational BMW generation factors will greatly help towards improving consistency as well as better estimation of BMW. Once the central database is created and actual generation data is

available, then MPCB may even provide incentive in case there is lesser BMW generated than calculated.

7. **Rationalize fee structure for Authorization:** The charge for BMW authorization is based on number of beds for bedded HCEs and on a lump sum or normative basis for non-bedded HCEs. The authorization fees payable to MPCB are depicted below in **Table 33**.

Table 33-Present annual fee for BMW Authorization

(a)	Bed Capacity		Fees to be paid (p. a)
	i)	Between 01-05	No Fees
	ii)	Between 06-25	Rs. 1,250/-
	iii)	Between 26-50	Rs. 2,500/-
	iv)	Between 50-200	Rs. 5,000/-
	v)	Between 201-500	Rs. 10,000/-
	vi)	Above 501	Rs. 15,000/-
(b)	Treatment Facility provider for bio-medical waste		Rs. 10,000/- per year
(c)	Transporter of Bio-Medical Wastes		Rs. 7,500/- per year
(d)	All other bio-medical waste generating and handling agencies. (Except a, b, c above)		Rs. 02,500/- per year

Source: http://mpcb.gov.in/consentmgt/bmwrules.php

There is no discrimination between 50 and 200 beds, and 201 and 500 beds. So, if a 50 bedded hospital is authorized for say 10 kg/day (based on 0.2 kg/per bed/day) and a 200 bedded hospital that may generate 40 kg/day, the fees for authorization remain the same. This may lead to a tendency to "overestimate" BMW waste generation and a 50 bedded hospital may well seek an authorization of 30 kg/day instead of 10 kg/day. MPCB may therefore link the authorization fee directly to the number of beds instead of "block based" approach.

Table 34 shows bed based ranges of authorization fees for various bed capacities. It may be observed that the existing fee structure for authorization favors HCEs with higher number of beds. This can well be a barrier to HCEs with smaller bed capacities.

Table 34 - Bed based fee for BMW Authorization (Existing and Recommended)

(a)	Bed Capacity		Range of fees to be paid on bed basis) in Rs	Proposed fee on bed basis
	i)	Between 01-05	No Fees	No fees
	ii)	Between 06-25	50 to 200	20
	iii)	Between 26-50	50 to 100	25
	iv)	Between 50-200	25 to 100	30
	v)	Between 201-500	20 to 50	35
	vi)	Above 501	Maximum 30	40

Thus, larger bedded hospitals will pay higher authorization fee as compared to the smaller HCEs. The fee will be bed based and hence rational avoiding thereby tendency to seek higher authorization.

8. **Disseminate Technology Information and set Technology Performance Standards (TPS)**
Technology Providers (TP) should be encouraged to provide replicable, feasible, and environment-friendly solutions for BMW management. MPCB along with CBMWTDFs and Indian Medical Association (IMA) could arrange for :
   – Annual exhibition of suppliers in partnership with IMA and CBMWTDF at different Regional Offices
   – Development of Technology Performance Standards (TPS) for a specific type and generation of equipment, including Testing and Monitoring methods.
   – The TPS should be made aware of the importance of energy audits. Energy audits should be made mandatory for renewal of Consent to Operate.

9. **Standardization of Incinerator Operating Hours**: CBMWTDs were found operating their incinerators as low as 0.45 and 1.6 hrs. /day. An incinerator takes considerable time (which may be close to 1.5 hrs. depending on model and age) to reach the desired temperature (850 ± 50°C in primary and 1050 ± 50°C in secondary chamber). Thus, running the incinerator for this short period may result into loss of heat and fuel in addition to increased risks of non-compliance. While issuing Consent to Operate to CBMWTDFs therefore MPCB may put in a condition that average incinerator runtimes should not be less than 4 hrs. /day.

Also, larger incinerators (say, beyond 200 kg/hr) could have a direct online interface into MPCB's central BMW database transmitting details like kg of BMW fed, temperatures of primary and secondary chambers and run hours/day. This will also result into better performance from CBMWTDFs and lesser efforts on field based manual sampling.

10. **Mandate Management Systems for CBMWTDFs:** CBMWTDFs should be mandated for ISO 14001: 2004 and OHSAS 18001:2007 certification. As an incentive, the CBMWTDF may be provided a one timely ex gratia grant in the form of reduced Consent to Operate renewal fees. This could be ensured if this condition and timeline is included in the Consent to Operate conditions.

    This will ensure that (a) increase in credibility of CBMWTDF, (b) better Health, Safety and Environment (HSEs) compliance from CBMWTDFs side, (c) increased safety of CBMWTDF's employees. Special incentive may be provided to those who are also ISO 9001: 2008 certified

11. **Conduct awareness and training programmes on a campaign basis:** Arrangement should be made for periodic awareness programs to raise awareness amongst MPCB, HCEs, CBMWTDF operators and transporters as well as common public understand the risk associated with BMW management. MPCB has already carried out various awareness programs for this purpose in scattered manner, a need is felt to consolidate these. The following steps should be adopted by MPCB:

    o *Conduct surveys to understand the gaps in (a) understanding of BMW Management rules, (b) practical problems at ground level etc.*
    o *Design awareness programs to answer these specific queries. Such programmes should be timely, focused and flexible.*
    o *Make easily accessible materials like e-resource (manual) on BMW management to all parties.*
    o *Parameters related to awareness should be selected and monitored before and after training to evaluate the change imparted by training.*

Good Practice: BMW Training

Many organizations are thinking and working positively towards BMW Management. Centre for Environmental Education (CEE) and Toxics Link (TL) are one of these. Training material developed by these agencies may be consulted while designing suitable training programmes.
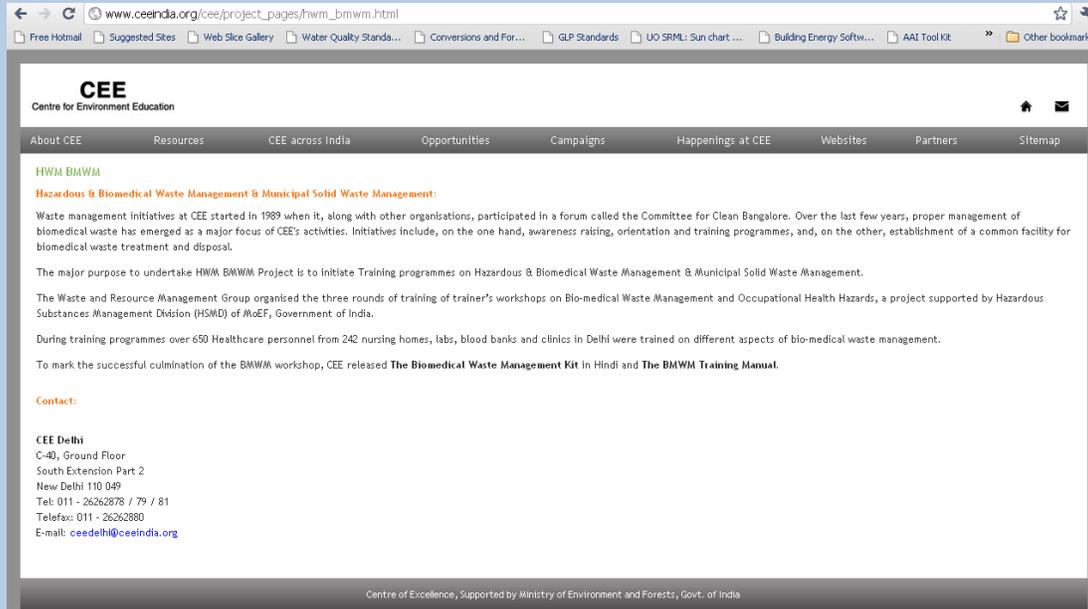
Source: http://www.ceeindia.org/cee/project_pages/hwm_bmwm.html
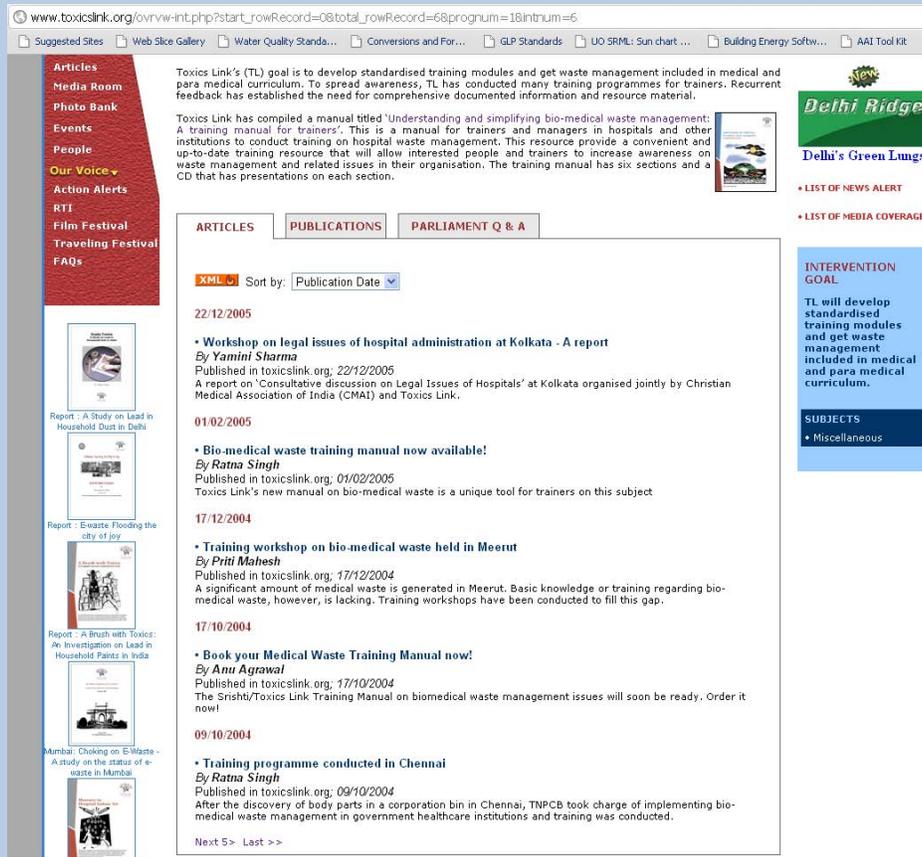
Also Passco Environmental Solutions Pvt. Ltd. has come up with a documentary film on BMW management in Marathi. This film could be a very useful tool for BMW management training.
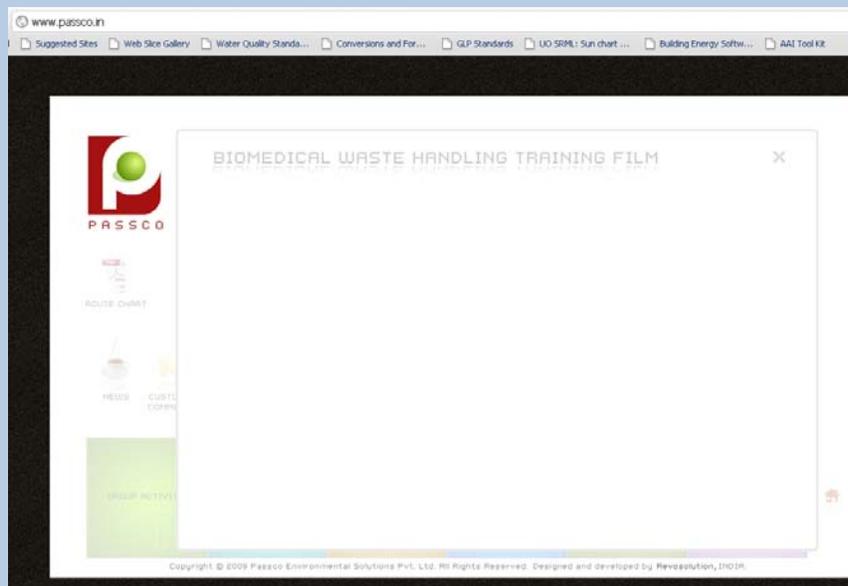
MPCB may launch a statewide awareness campaign on the BMW management along with local municipal corporations and/or municipal councils and Advanced Locality Management (ALM) and /or other community based action groups. This drive will help to generate awareness amongst the common people

These groups may together formulate an action plan to keep a check on the open lands and municipal vats which may be used for illegally dumping BMW. This dive may be widely published with the help from both print and television media. A helpline number may be provided to the ALM/local people/ clubs and community organizations to report such cases.

12. **ITI Training of Incinerator Operators:** in most cases the incinerator is operated by operators with little or no formal training. MPCB may consider devising a instruction based course dedicated to BMW and hazardous waste incinerator operators. Such a course may be offered in local languages in Marathi and Hindi only. Indian Training Institutes (ITI) may be approached to offer this course. Also there should be a facility where the existing CBMWTDFs may nominate their operators to be trained at concession rates.