ಕರ್ನಾಟಕ ವಿಧಾನ ಪರಿಷತ್ತು

ಚುಕ್ಕೆ ಗುರುತಿಲ್ಲದ ಪ್ರಶ್ನೆ ಸಂಖ್ಯೆ : 858(886)
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ಉತ್ತರಿಸಬೇಕಾದ ದಿನಾಂಕ : 15.12.2025.
ಉತ್ತರಿಸುವ ಸಚಿವರು : ಅರಣ್ಯ, ಜೀವಿಪರಿಸ್ಥಿತಿ ಮತ್ತು ಪರಿಸರ ಸಚಿವರು.

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ಕ್ರ. ಸಂ	ಪ್ರಶ್ನೆ	ಉತ್ತರ
(ಅ)	ರಾಜ್ಯದಲ್ಲಿ ಅಪಾಯಕಾರಿ ತ್ಯಾಜ್ಯಗಳನ್ನು ನಿರ್ವಹಿಸುವ ಕೈಗಾರಿಕೆಗಳು ಯಾವುವು; (ಜಿಲ್ಲಾವಾರು ಪ್ರತ್ಯೇಕ ಮಾಹಿತಿ ನೀಡುವುದು);	ರಾಜ್ಯದಲ್ಲಿ ಅಪಾಯಕಾರಿ ತ್ಯಾಜ್ಯಗಳನ್ನು ನಿರ್ವಹಿಸುವ ಕೈಗಾರಿಕೆಗಳು ಈ ಕೆಳಕಂಡಂತಿರುತ್ತವೆ; 1. Solvent Recovery units 2. Tyre Pyrolysis Units 3. Hazardous Waste Incinerators 4. Alternative Fuel and Raw Material Units (AFR units) 5. Hazardous Waste Landfill sites (TSDF) 6. Contaminated Empty Barrel Recycling units 7. Used / Waste Oil Recyclers 8. Lead / Lithium Battery Recyclers ಕೈಗಾರಿಕೆಗಳ ಹೆಸರು ವಿಳಾಸದ ಜಿಲ್ಲಾವಾರು ಮಾಹಿತಿಯನ್ನು **ಅನುಬಂಧ-1**ರಲ್ಲಿ ಲಗತ್ತಿಸಲಾಗಿದೆ.
(ಆ)	ರಾಜ್ಯದಲ್ಲಿ CFE & CFO ಹೊಂದದೆ ಇರುವ ಕೈಗಾರಿಕೆಗಳು ಯಾವುವು; (ಹೆಸರಿನೊಂದಿಗೆ ವಿವರ ನೀಡುವುದು);	2025ನೇ ಸಾಲಿನಲ್ಲಿ ಮಂಡಳಿಯಿಂದ CFE & CFO ಪಡೆಯದೆ ಅಪಾಯಕಾರಿ ತ್ಯಾಜ್ಯ ನಿರ್ವಹಣೆ ಮಾಡುವ 05 ಕೈಗಾರಿಕೆಗಳು Lead Recycling ಚಟುವಟಿಕೆಯಲ್ಲಿ ಕಾರ್ಯಾಚರಣೆ ಮಾಡುತ್ತಿರುತ್ತವೆ. ಇವುಗಳನ್ನು ಮಂಡಳಿಯ ಅಧಿಕಾರಿಗಳು ಗುರುತಿಸಿ ಮಂಡಳಿಯಿಂದ ಯಾವುದೇ CFE & CFO ಪಡೆಯದೆ ಕಾರ್ಯಾಚರಣೆ ಮಾಡುತ್ತಿರುವುದರಿಂದ, ಸದರಿ ಕೈಗಾರಿಕೆಗಳಿಗೆ ಮುಚ್ಚುವ ಆದೇಶ ನೀಡಲು ವರದಿಯೊಂದಿಗೆ ಶಿಫಾರಸ್ಸು ಮಾಡಿರುವುದರಿಂದ ಮಂಡಳಿಯು ರಾಜ್ಯ ಮಟ್ಟದ ಜಾರಿ ಸಮಿತಿ ಸಭೆಯಲ್ಲಿ ಚರ್ಚಿಸಿ ಆ 05 ಕೈಗಾರಿಕೆಗಳಿಗೆ ಮುಚ್ಚುವ ಆದೇಶವನ್ನು ನೀಡಲಾಗಿರುತ್ತದೆ. ಅವುಗಳ ಪಟ್ಟಿಯನ್ನು **ಅನುಬಂಧ -2 ರಲ್ಲಿ** ಲಗತ್ತಿಸಿದೆ.
(ಇ)	ರಾಜ್ಯದಲ್ಲಿರುವ ಕೈಗಾರಿಕೆಗಳು ಪರಿಸರ ಕಾನೂನನ್ನು ಪಾಲನೆ ಮಾಡುತ್ತಿರುವ ಬಗ್ಗೆ ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿ ಹೇಗೆ ಖಚಿತ ಪಡಿಸಿಕೊಳ್ಳುತ್ತಿದೆ; ಅದರ ಸಮಗ್ರದತ್ತಾಂಶದವಿವರನೀಡುವುದು;	ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿಯ ಅಧಿಕಾರಿಗಳು ಕಾಲಕಾಲಕ್ಕೆ ಘಟಕಗಳ ಪರಿವೀಕ್ಷಣೆ ನಡೆಸಿ, STP / ETPಗಳ ನೀರಿನ ಮಾದರಿಗಳನ್ನು ಸಂಗ್ರಹಿಸಿ, ವಿಶ್ಲೇಷಿಸಲಾಗುವುದು, ಮಣ್ಣಿನ ಮಾದರಿಗಳು ಮತ್ತು ವಾಯು ಗುಣಮಟ್ಟಮಾಪನ(AAQM)ದ ಮಾದರಿಗಳನ್ನು ಸಹ ಸಂಗ್ರಹಿಸಲಾಗುತ್ತದೆ. 17ನೇ ಪ್ರವರ್ಗದ ಕೈಗಾರಿಕೆಗಳಿಗೆ Online Continuous Effluent Monitoring System ಮತ್ತು Online Continuous Emission Monitoring Systemಅಳವಡಿಸಲಾಗಿರುತ್ತದೆ ಮತ್ತು ಇದನ್ನು ಕೇಂದ್ರ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿಯ ಪೋರ್ಟಲ್‌ಗೆ ಜೋಡಿಸಲಾಗಿರುತ್ತದೆ. ಪರಿವೀಕ್ಷಣೆ ಸಮಯದಲ್ಲಿ

		ಕಂಡುಬಂದ ನ್ಯೂನ್ಯತೆಗಳ ಆಧಾರದ ಮೇಲೆ ಜಲ (ನಿವಾರಣೆ ಮತ್ತು ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ) ಕಾಯ್ದೆ, 1974 ಮತ್ತು ವಾಯು(ನಿವಾರಣೆ ಮತ್ತು ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ) ಕಾಯ್ದೆ, 1981 ರ ಅಡಿಯಲ್ಲಿ ಕಾರಣ ಕೇಳುವ ನೋಟೀಸ್ / ಪ್ರಸ್ತಾವಿಕ ನಿರ್ದೇಶನ(Notice of Proposed Directions)ವನ್ನು ಜಾರಿ ಮಾಡಲಾಗುವುದು ಹಾಗೂ ಮುಂದುವರೆದ ನಿಯಮ ಉಲ್ಲಂಘನೆಯ ಆಧಾರದ ಮೇಲೆ ಮಂಡಳಿಯಲ್ಲಿ ಮೌಖಿಕ ವಿಚಾರಣೆ ನಡೆಸಿ, ಮುಚ್ಚುವ ಆದೇಶವನ್ನು ಜಾರಿಮಾಡಲಾಗುವುದು. ಮಂಡಳಿಯಿಂದ CFE & CFO ಪಡೆಯದೆ ಅಪಾಯಕಾರಿ ತ್ಯಾಜ್ಯ ನಿರ್ವಹಣೆ ಮಾಡುವ ಹಾಗೂ ಕಾರ್ಯಾಚರಣೆ ಮಾಡುವ ಕೈಗಾರಿಕೆಗಳನ್ನು ಮಂಡಳಿಯ ಅಧಿಕಾರಿಗಳು ಗುರುತಿಸಿ, ಸದರಿ ಕೈಗಾರಿಕೆಗಳಿಗೆ ಮುಚ್ಚುವ ಆದೇಶ ನೀಡಲು ವರದಿಯೊಂದಿಗೆ ಶಿಫಾರಸ್ಸು ಮಾಡುವ ಕೈಗಾರಿಕೆಗಳನ್ನು ಮಂಡಳಿಯು ರಾಜ್ಯ ಮಟ್ಟದ ಜಾರಿ ಸಮಿತಿ ಸಭೆಯಲ್ಲಿ ಚರ್ಚಿಸಿ, ಮುಚ್ಚುವ ಆದೇಶವನ್ನು ನೀಡಲಾಗುತ್ತದೆ. ನಿಯಮ ಉಲ್ಲಂಘನೆ ಮಾಡಿರುವ ಕೈಗಾರಿಕೆಗಳ ವಿರುದ್ಧ ಮಂಡಳಿಯು ತೆಗೆದು ಕೊಂಡಿರುವ ಕ್ರಮಗಳ ವಿವರವನ್ನು**ಅನುಬಂಧ -3ರಲ್ಲಿ**ಲಗತ್ತಿಸಿದೆ.
(ಈ)	ಕರ್ನಾಟಕ ರಾಜ್ಯ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿಯು CFE & CFO ಹಾಗೂ ಇತರ ಸಂಬಂದಿಸಿದ ಇಲಾಖೆಗಳ ಸಮನ್ವಯತೆ ಸಾಧಿಸಲು ಮಾರ್ಗಸೂಚಿ ಮತ್ತು SOP ಹೊರಡಿಸಿದೆಯೇ; ಹೊರಡಿಸಿದ್ದಲ್ಲಿ, ಅದರ ಸಂಪೂರ್ಣ ಮಾಹಿತಿ ನೀಡುವುದು, ಇಲ್ಲದಿದ್ದಲ್ಲಿ ಮಾರ್ಗಸೂಚಿ ಮತ್ತು SOP ಹೊರಡಿಸದಿರಲು ಕಾರಣಗಳೇನು?	ಕರ್ನಾಟಕ ಸರ್ಕಾರವು ದಿನಾಂಕ: 10.12.2021ರಂದು ಅಧಿಸೂಚನೆಯನ್ನು ಹೊರಡಿಸಿರುತ್ತದೆ. ಇದರನ್ವಯ ಕೆಂಪುವರ್ಗದ ಕೈಗಾರಿಕೆಗಳು ಜಲ ಮೂಲಗಳಿಂದ ಕನಿಷ್ಠ 500 ಮೀ. ದೂರದಲ್ಲಿ, ಕಿತ್ತಳೆ ವರ್ಗದ ತ್ಯಾಜ್ಯ ನೀರನ್ನು ಉತ್ಪತ್ತಿ ಮಾಡುವ ಕೈಗಾರಿಕೆಗಳು ಜಲ ಮೂಲಗಳಿಂದಕ ನಿಷ್ಠ 75 ಮೀ. ದೂರದಲ್ಲಿ, ಕಿತ್ತಳೆ ವರ್ಗದ ತ್ಯಾಜ್ಯ ನೀರನ್ನು ಉತ್ಪತ್ತಿ ಮಾಡದಿರುವ ಕೈಗಾರಿಕೆಗಳು ಜಲಮೂಲಗಳಿಂದಕನಿಷ್ಠ 30 ಮೀ. ದೂರದಲ್ಲಿ ಹಾಗೂ ಹಸಿರು ವರ್ಗದ ಕೈಗಾರಿಕೆಗಳು ಜಲ ಮೂಲಗಳಿಂದಕ ನಿಷ್ಠ 30 ಮೀ. ದೂರದಲ್ಲಿರುವುದನ್ನು ಮಂಡಳಿಯು ಖಚಿತಪಡಿಸಿ ಕೊಂಡು CFE & CFO ಪತ್ರವನ್ನು ನೀಡುತ್ತದೆ. ರಾಜ್ಯದಲ್ಲಿ ಅಪಾಯಕಾರಿ ತ್ಯಾಜ್ಯಗಳನ್ನು ನಿರ್ವಹಿಸುವ ಮರುಬಳಕೆ ಕೈಗಾರಿಕೆಗಳಿಗೆ ಕೇಂದ್ರ ಮಾಲಿನ್ಯ ನಿಯಂತ್ರಣ ಮಂಡಳಿಯು SOPಯನ್ನು ಹೊರಡಿಸಿರುತ್ತದೆ. 1. **Solvent Recovery units :** SOP on Utilization of Spent Solvent for Recovery of Solvent issued by CPCB on February, 2021 2. **Tyre Pyrolysis Units:**SOP on Recycling of waste Tyre scrap for recovery of Tyre Pyrolysis Oil, Pyrogas and Char in Tyre Pyrolysis units issued by CPCB on January 16th, 2024. 3. **Hazardous Waste Incinerators:**Guidelines for Common Hazardous Waste Incineration issued by CPCB on June, 2005.

		4. **Alternative Fuel and Raw Material Units (AFR units):**Guidelines for Pre-processing and Co-processing of Hazardous & Other Waste in cement plant issued by CPCB on July, 2017. 5. **Hazardous Waste Landfill sites (TSDF):** Criteria for Hazardous Waste Landfills issued by CPCB on February, 2001. 6. **Contaminated Empty Barrel Recycling units :** SOP on Utilization of Contaminated Barrels / containers / Drums containing hazardous waste / chemicals / oil and Lubricants issued by CPCB on February, 2021 & November -2024. 7. **Used / Waste Oil Recyclers:**SOP on Utilization of Used Oil and Off Specification Products (Shampoo, Detergent & Creams) for recycling issued by CPCB on December, 2021. 8. **Lead Battery Recyclers:**SOP on Recycling of Lead Scrap / used lead acid batteries issued by CPCB on January 4th, 2024. 9. **Lithium Ion Battery Recyclers:**SOP on Utilization of Black Mass (Generated by Lithium Ion Battery dismantlers / recyclers or E-waste dismantlers / recyclers) for recovery of carbon / graphite material and metal compounds issued by CPCB on January, 2025. SOP /Guidelinesಗಳ ಸಂಪೂರ್ಣ ವಿವರಗಳನ್ನು **ಅನುಬಂಧ - 4ರಲ್ಲಿ** ಲಗತ್ತಿಸಿದೆ.

ಅಪಜೀ 139 ಇಎನ್‌ಜಿ 2025.

(ಈಶ್ವರ ಬಿ. ಖಂಡ್ರೆ)
ಅರಣ್ಯ, ಜೀವಿಪರಿಸ್ಥಿತಿ ಮತ್ತು ಪರಿಸರ ಸಚಿವರು.

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List of Solvent Recovery Units				
Sl No.	Name of the Industry	Regional Office	District	Industrial Area
1	M/s. Associated Chemicals and Engineering Company, No.301, IVth Phase, Peenya Industrial Area, Bengaluru 560 058	Peenya	Bengaluru Urban	Peenya Industrial Area
2	M/s Manjunatha Chemicals, No-D-17, KSSIDC Industrial Estate, Kumbalgodu, Mysore Road, Bengaluru -560074	R R Nagar	Bengaluru Urban	KSSIDC Industrial Estate
3	M/s. Aldochem, Plot No.20/E, Sy.No. 37, Kumbalagodu Village, Kengeri Hobli, Bengaluru -560074	R R Nagar	Bengaluru Urban	Kumbalgudu Industrial Area
4	M/s Sathya Industries plot No. 142, Dr B. R. Ambedkar Industrial Estate Jigani Industrial Area 1st Phase, Bengaluru-562106	Anekal	Bengaluru Urban	B. R. Ambedkar Industrial Estate Jigani Industrial Area 1st Phase
5	M/s Shine Chemicals India, No. SP-165, Jigani Industrial Area, Anekal tq, Bangalore District.	Anekal	Bengaluru Urban	Jigani Industrial Area
6	M/s Gomti Research & Pharmachem Pvt Ltd. No.B-36/38, KSSIDC Indl Area, Kambalgodu, Bengaluru-5600743	R R Nagar	Bengaluru Urban	KSSIDC Industrial Area
7	M/s. Shalini Enterprises, No. A6 3rd Stage, Peenya Industrial Area, Bengaluru-5600058	Peenya	Bengaluru Urban	Peenya Industrial Area
8	M/s. Bhavana Agencies, No.58c-4, Hoskote Industrial Area, Hoskote Bangalore Dist.	Hoskote	Bengaluru Rural	Hoskote Industrial Area
9	M/s. Ind Pure Chem, Plot No. 8D, KIADB Indl Area, Hoskote Taluk, Bangalore Rural District	Hoskote	Bengaluru Rural	KIADB Indl Area
10	M/s Mayash Enterprises, Plot No.273 Kadecher, KIADB I.A, Yadagiri Tq & Dist	Yadgir	Yadgiri	KIADB Indl Area
11	M/s. Sai Enterprises Plot No. 182, KIADB Indl area, Kadachur village, Yadgir	Yadgir	Yadgiri	KIADB Indl Area
12	M/s S N P Pharmacutical plot No.266,KIADB I,A. Kadocher, Yadgiri	Yadgir	Yadgiri	KIADB Industrial Area

13	M/s. Sri Venkateshwara Pharmaceuticals, Plot No:88, KIADB Industrial Area, Kadechur, Saidapura Hobli, Yadagiri Taluk and District - 585221	Yadgir	Yadgiri	KIADB Industrial Area
14	M.s.Penta Chem, Plot No.47, 1st Phase, KIADB Harohalli Indl Area, Kanakapura Taluk, Ramanagar District -562112	Ramanagara	Ramanagara	KIADB Harohalli Industrial Area
15	M/s Panchamukhi pharma Plot no. 94& 97,1st Phase, Harohalli Industrial Area, Kanakapura Taluk, Ramanagara Dist	Ramanagara	Ramanagara	Harohalli Industrial Area,
16	M/s. Syngeyoi , Plot No. 267/8A & 267/8B, KIADB Industrial Area, 2nd Phase, Harohalli, Kanakapura Taluk, Ramanagara District	Ramanagara	Ramanagara	KIADB Industrial Area
17	M/s. Somesh Enterprises,Plot No.91 P, KIADB Industrial Area, Humnabad, Bidar.	Bidar	Bidar	KIADB Industrial Area
18	M/s Vijeta Industries plot No.11-A, H,No.19-1-116, Banker Colony Shivnagar South Bidar Industrial Area, Bidar-585402	Bidar	Bidar	Banker Colony Shivnagar South Bidar Industrial Area
19	M/s. Soumya Pharma ,PLOT No. 91-P, (PART-1), Sy No -145 KIADB, Humnabad Industrial Area, Humnabad Taluk, Bidar District. -585330	Bidar	Bidar	Humnabad Industrial Area
20	M/s. PJR Organics, Plot No. 16/1P, Sy. No. 131, KIADB Indsutrial Area, Humnabad Taluk, Bidar District - 585330	Bidar	Bidar	KIADB Industrial Area
21	M/S. SARVODAYA SOLVENTS PVT LTD, SY NO.352/1, 350/1, MARKUNDA VILLAGE TALUK & DISTRICT, BIDAR-585403.	Bidar	Bidar	Non Industrial Area
22	Kore Chemical Industries, Plot No. 92-P, Humnabad Industrial Area, Gadwanthi, Humnabad Taluk, Bidar District-585330	Bidar	Bidar	Humnabad Industrial Area
23	Eco Green Fuels Pvt. Ltd., Plot No. 252, Rd. #1, Sy. No. 21/P & 21, 2nd Phase, Vasanthanarasapura Industrial, Yalladadlu-572128, Tumkur District	Tumkur	Tumakuru	Vasanthanarasapura Industrial Area

24	M/s. Khemical India, Plot No.680, Sy. No.43/3 and 44, 21 J Road, 2nd Phase, Tumkuru	Tumkur	Tumkur	Antharasanahalli Industrial Area
25	M/s. Bhagavathi Enterprises, Plot No.553-P-6, 2nd Phase, KIADB, Vasanthanarasapura Industrial Area, Tumkauru Taluk & District	Tumkur	Tumkur	Vasanthanarasapura Industrial Area
26	Banashankari Industries, Plot No.197, KIADB I,A. Malur 3rd Phase, Kolar Dist	Kolar	Kolar	KIADB Industrial Area
27	M/s. L.N. Chem, Plot No. 6-11 & 6-L, 4th Phase, KIADB Industrial Area, Malur, Kolar District	Kolar	Kolar	KIADB Industrial Area
28	Banashankari Chemicals Pv t. Ltd., plot No.200 -203, KIADB I,A. 3rd Phase, Malur, Kolar Dist	Kolar	Kolar	KIADB Industrial Area
29	M/s. Sonia Industries, Plot No. 11B, Part -10 Sy. No. 47, Kumbalgodu Village, KIADB Industrial Area, 1st Phase, Kumbalgodu, Kengeri Hobli, Bangalore South Taluk, Bangalore - 560074	R R Nagar	Bengaluru Urban	KIADB Industrial Area
30	M/s. Banashankari Chemicals Pvt. Ltd., Plot No. 101-A (P) & 102 -A(P), Pharma SEZ Ind. Area, Kowshika Village, Hassan -573201	Hassan	Hassan	SEZ Ind. Area
31	M/s. Jwala Mala SDP Plant, Plot No. 127-C, Adakanahally Industrial Area, Nanajangud Taluk, Mysuru District - 571301	Mysuru-2	Mysuru	Adakanahally Industrial Area
32	M\s. Sri Sai Industries, Plot No. 12-B, KIADB Indl. Area, Somanahalli, Maddur Taluk, Mandya Dist.	Mandya	Mandya	KIADB Indl. Area
33	M/s. Black God Chemical Industries Opc Pvt Ltd., Plot No.34, Plot No.34, Baikampady Industrial Area, Mangaluru-575011	Mangaluru	Mangaluru	Baikampady Industrial Area
34	Sai Enterprises, Plot No.182, Kadechuru Industrial Area, Yadgiri Taluk and District.	Yadgir	Yadgiri	Kadechuru Industrial Area
35	M/s. Sri Durga Life Science LLP Plot No.104/2, Badanaguppe-Kellamballi KIADB Industrial Area Chamarajanagar	Chamarajanagar	Chamarajanagar	KIADB Industrial Area

List of Tyre Pyrolysis Units

Sl.No.	Name & Address of the TPO unit	Regional Office	District	Industrial Area
1	Pioneer Industries, Plot No 80 KIADB Industrial Area, Humnabad Taluk, Bidar	Bidar	Bidar	KIADB Industrial Area
2	Mahagaonvi Polymer Energy ,Plot No. 135, I1,& I2,Kolhar Industrial Area,Bidar	Bidar	Bidar	Kolhar Industrial Area,Bidar
3	Ahmed Industries.,Plot No 130/B, Kolhar Industrial Area, Bidar	Bidar	Bidar	Kolhar Industrial Area,Bidar
4	Premier Plast,Plot No 204, Kolhar KIADB Industrial Area, Bidar	Bidar	Bidar	Kolhar KIADB Industrial Area
5	6 H Industries,Sy No 133 Gadavanti, Plot No 122 D KIADB Indl Area Humnabad Tq Bidar	Bidar	Bidar	KIADB Industrial Area
6	Star Polymers,Plot No 177A, 177B 178 178 -P, Kolhar Ind. Area, Bidar	Bidar	Bidar	Kolhar Industrial Area,Bidar
7	New Himalaya Plastic Industries (Pyrolysis Plant) Plot No 25 KIADB Industrial Area Humnabad Taluk Bidar	Bidar	Bidar	KIADB Industrial Area
8	KGN Industries,Plot NO 100 P 1 Part KIADB Industrial Area Humnabad Taluk Bidar	Bidar	Bidar	KIADB Industrial Area
9	Eesha Kishan Eco Energies Pvt Ltd.181,182&182 (P), Kolhar Industrial Area, Bidar	Bidar	Bidar	KIADB Industrial Area
10	Mehanaj Industries,Plot No 365-P6 KIADB Industrial Area, Bidar	Bidar	Bidar	KIADB Industrial Area
11	Aditya Unit - 1 Eurealm Eco Pvt Ltd.,No.47, Opp ANZ factory, Sompura Industrial Area, 1st Phase, Dobbspet, Nelamangala Taluk	Nelamangala	Bengaluru Rural	Sompura Industrial Area

12	Aditya Eco Fuels Unit -2,No. 489 & 456, Sy. No. 20,21,105/2, 24 & 25,Beeragondanahalli Villag ,KIADB, Sompura 2nd stage, Thyamagondlu Hobli,Nelamangala	Nelamangala	Bengaluru Rural	Sompura Industrial Area
13	Sri Shivashakti Rubbers, Plot No.84-P4, 1st Phase, Jigani Industrial Area, Jigani Hobii, Anekal Taluk, Bangalore.	Anekal	Bengaluru Urban	Jigani Industrial Area
14	Raksha Industries , Plot. No. 112 & No. 113 ,Gowribidanur 2nd phase,Industrial Area, Chikkaballapur	Chikkaballapur a	Chikkaballap ura	Gowribidanur 2nd Phase,Industrial Area
15	Lakshmi Industries,Plot No. 110 and 111 ,Gowribidanur, 2nd phase Industrial, Chikkaballapur	Chikkaballapur a	Chikkaballap ura	Gowribidanur 2nd Phase,Industrial Area
16	M/s Vten Group, Plot No. 180/P2, Nandur Industrial Area, Kalaburagi	Kalaburagi	Kalaburagi	Nandur Industrial Area
17	M/s Mangalam Industries, Sy.No.339/2, Kamalapur Village, Kalaburagi	Kalaburagi	Kalaburagi	Non Industrial Area
18	M/s Sana Industries, Sy.No.59, Plot No.297 & 298, Nandur Kesartgi Industrial Area, Kalaburagi	Kalaburagi	Kalaburagi	Nandur Kesartgi Industrial Area
19	M/s Sahara Fuels Energy, Sy.No.39,93 Plot No.71/B, Nandur Kesartgi Industrial Area, Kalaburagi	Kalaburagi	Kalaburagi	Nandur Kesartgi Industrial Area,

List of Incinerator Facilities

Sl No.	Name of the Industry	Regional Office	District	Industrial Area
1	M/S. Haat Incinerators India Pvt Ltd., Plot No.35 B & C, Jigani Industrial Area, Jigani Hobli, Anekal Taluk, Bengaluru Urban District-560105	Anekal	Bengaluru Urban	Jigani Industrial Area
2	M/s. Gomti Incinco, No.3, B-2, 1st Phase, KIADB Industrial Area, Kumbalagodu, Bengaluru.	RRNagar	Bengaluru Urban	KIADB Industrial Area
3	M/s. Century Refineries Pvt. Ltd. No.17A & B, KIADB Indl Area, Hoskote, Bengaluru.	Hoskote	Bengaluru Rural	KIADB Industrial Area
4	M/s. Karnataka Waste Management Projects {A Division of Re-sustainability Ltd., (Formerly Ramky Enviro Engineers)} Sy. No.75 to 85 of Pemmanahalli and Sy.No.7 & 9 of himmanayakanahalli, Dabaspet, Nelamangala Tq. Bangalore.	Nelamanagala	Bengaluru Rural	KIADB Industrial Area

5	M/s. Kalyana Karnataka Waste Management Project Pvt Ltd., Plot No.158-164, KIADB Kadechur Industrial Area, Saidapura Hobli, Yadgir Taluk & District	Yadgiri	Yadgiri	Kadechur Industrial Area
6	M/S. Bangalore Incinerators Pvt Ltd., Plot No.28, KIADB Industrial Area, Anchepalya, Kunigal Taluk, Tumakuru District	Tumakuru	Tumakuru	KIADB Industrial Area
7	Re-sustainability Ltd., (Formerly M/s Century Eco Solutions Pvt. Ltd. Plot NO. 161B & C, 1st Phase, Vasanthapura, KIADB Industrial Area, Kora village, TumkurTaluk& District.	Tumakuru	Tumakuru	KIADB Industrial Area
8	M/s. E Nano Incintech, Plot No.342-B, of Harohalli Industrial Area, 2nd Phase, 2nd Sector, Ramanagar District.	Ramanagara	Ramanagara	Harohalli Industrial Area

LIST OF AFR UNITS

Sl No.	Name of the Industry	Regional Office	District	Industrial Area
1	M/s. Indian Eco Solution Private Limited , Plot No.462, Vasanthanarasapura Industrial Area, 2nd Phase, Tumakuru Taluk & District	Tumkur	Tumkuru	Vasanthanarasapura Industrial Area
2	M/s. Century eco solutions India Pvt Ltd. Plot no. 161B & C ,1st phase Vasanthanarasapura ,KIAD Indl Area,Kora village & hobli Tumakuru Tq & Dist	Tumkur	Tumkuru	Vasanthanarasapura ,KIAD Indl Area
3	M/s. Kalyana Karnataka Waste Management Project Pvt Ltd., Plot No.158-164, KIADB Kadechur Industrial Area, Saidapura Hobli, Yadgir Taluk & District	Yadagir	Yadgiri	KIADB Kadechur Industrial Area
4	M/s Advance Eco Resource Management, Plot No. 87/1 Helalige Chandrapura, Hosur main Road, Bangalore-560008	Sarjapura	Bengaluru Urban	Non Industrial Area
5	M/s Century Refineries Pvt Ltd No.17 A&B KIADB I.A, Chekkahalli village Hosakote Taluk, Bangalore rural dist	Hoskote	Bengaluru Rural	KIADB Industrial Area
6	E-Nano Incin tech, Plot No.342-B,Harohalli Industrial Area, KIADB , Phase-II, Kanakapura Taluk & Ramanagara District	Ramanagar	Ramanagra	Harohalli Industrial Area
7	M/s. Gomti Incinco, No.3, B-2, 1st Phase, KIADB Industrial Area, Kumbalgodu, Mysuru Road, Bengaluru-560074	R R Nagar	Bengaluru Urban	KIADB Industrial Area
8	Green Fuel Waste Management, Sy no 6/*/4, Injepalli Village, Adakki Hobli, Sedum Taluk, Gulbarga District– 585222	Gulbarga	Gulbarga	Non Industrial Area
9	M/s. SVD Eco Services, Plot No.179, KIADB, Kolhar Industrial Area, Bidar Taluk & District	Bidar	Bidar	Kolhar Industrial Area
10	M/s. Klean Kiln Fuels, No.36/2, Adur Village, Harohalli Main Road, Anekal Taluk, Bengaluru Urban District	Anekal	Bengaluru	Non Industrial Area
11	M/s. A T Enterprises, Plot No.70,71 & 72, Masthenahalli Industrial Area, KIADB, 1st Phase, Masthenahalli, Chinthamani Taluk, Chikkaballapura Dist	Chikkaballapura		Masthenahalli Industrial Area,

List of TSDF Units				
Sl No.	Name of the Industry	Regional Office	District	Industrial Area
1	M/s. Kalyana Karnataka Waste Management Project Pvt Ltd., Plot No.158-164, KIADB Kadechur Industrial Area, Saidapura Hobli, Yadgir Taluk & District	Yadgiri	Yadgiri	Kadechur Industrial Area
2	M/s. Karnataka Waste Management Projects {A Division of Re-sustainability Ltd., (Formerly Ramky Enviro Engineers)} Sy. No.75 to 85 of Pemmanahalli and Sy.No.7 & 9 of himmanayakanahalli, Dabaspet, Nelamangala Tq. Bangalore.	Nelamangala	Bengaluru Rural	DabaspetIndustrial Area

List of Barrel Recyclers				
Sl.No.	Name & Address of unit	Regional Office	District	Industrial Area
1	M/s. Archana Enterprises, Shed No. C-9 KSSIDC Industrial estate ,Veerasanadra 2nd stage Huskur Road 0# : Hosur road Anekal Taluk ,Bengaluru -560100	Sarjapura	Bengaluru Urban	KSSIDC Industrial estate
2	M/s. New Kannimar Enterprises , plot no.15b, 1st phase, Jigani Industrial Area Bengaluru562106	Anekal	Bengaluru Urban	Jigani Industrial Area
3	M/s. Hindustan barrels, No.3 Narayanagouda, Indl Estate, Kareemsab layout, Hegganahalli, Near Peenya 2nd stage, Bengaluru Urban.	Peenya	Bengaluru Urban	Narayanagouda, Indl Estate
4	M/s. Roshan Enterprises ,Plot No. 87F(P),1st phase Jigani indl area ,Anekal taluk,Bangalore urban dist-560102	Anekal	Bengaluru Urban	Jigani indl area
5	M/s Sannidhi Enterprises plot No.13/1, Kachalli Hobli, Bengaluru North	Dasarahalli	Bengaluru Urban	Kachohalli Industrial Area
6	M/s. Sree Mahalakshmi Enterprises No.2 Behind Raghavendra Indl Estate, Karihobanahalli Road, Near peenya ,2nd stage Bengalur-560074	Dasarahalli	Bengaluru Urban	Behind Raghavendra Industrial Estate
7	M/s. Sri Gajanana Industries, Shed No.1A plot No.42, Jigani Industrial Area, Bengaluru-560105	Anekal	Bengaluru Urban	Jigani Industrial Area
8	M/S. Ishvarya Traders, Plot No.3-D1, Bommasandra I & II Phase Industrial Area, Hosur Road, Attibele Hobli, Anekal Taluk, Bengaluru-560099	Anekal	Bengaluru Urban	Bommasandra I & II Phase Industrial Area
9	M/s. 3R Innovation and Research India Private Limited- Unit-III, Plot No.06, Sy. No.24/3A, Lakshmipura Post, Kachohalli Industrial Area, Dasanapura Hobli, Bengaluru-562162.	Dasarahalli	Bengaluru Urban	Kachohalli Industrial Area
10	M/s. Shalini Enterprises, No. A6 3rd Stage, Peenya Industrial Area, Bengaluru-5600058	Peenya	Bengaluru Urban	Peenya Industrial Area
11	M/s. SBM Enterprises, Plot No.326, Sy. No.5, 6 and 199, Nidavanda Village, Somapura 1st Stage Industrial Area, Nelamangala Taluk, Bengaluru Rural District-562132	Nelamangala	Bengaluru Rural	Somapura 1st Stage Industrial Area

12	M/s Shobith Industry , B-4,KSSIDC Indl Area ,Nanjanagudu Tq, Mysore.	Mysuru -1	Mysuru	KSSIDC Indl. Area
13	M/s. SMZ Industries, Shed No.C-202 KSSIDC Indl Area, Hebbal, Mysore.	Mysore -1	Mysuru	KSSIDC Indl Area
14	M/s. H.R.F Trading Sy.No. 143/2, Bannur road Hancheya Village , Kasaba hobli, Mysuru-570019	Mysore -1	Mysuru	Non Industrial area
15	M/s S A Enterprises No-163, Industrial Estate Yadavagiri Mysuru	Mysore -1	Mysuru	yadavagiri industrial estate
16	M/s M M Enterprises plot No. 12/A Bannimantapa Industrial Layout, Devaraja Mohalla, Mysuru	Mysuru -1	Mysuru	Bannimantapa Industrial Layout
17	M/s. New Royal Traders Unit-III, No.1/E, Bannimantapa Industrial Area, C.V. Road, Mysuru-570015	Mysuru -1	Mysuru	Bannimantapa Industrial Area
18	M/s.Moogambigai metal refineries(unit-2) (Plastic division) PlotNo. 124-A Baikampady Industrial area,Mangaluru	Mangalore	Mangaluru	Baikampady Industrial area
19	M/s. Karnataka Traders, Plot No.23/A, Kamad Industrial Area, Mulki, Mangalore.	Mangalore	Mangaluru	Karnad Industrial Area
20	M/s Falcon imper corporation plot No.9A/10A, Baikampady Industriai Area Mangalore-575011	Mangalore	Mangaluru	Baikampady Industrial Area
21	M/s. S S Metals & Industries, 6-64/3, Plot No.277 & 278, Baikampady Industrial Estate, Mangalore- 570045	Mangalore	Mangaluru	Baikampady Industrial Estate
22	M/s. Shariff Enterprises, Plot No. 141 C Industrial Area, Baikampady, Mangaluru, D.K. District -575011	Mangalore	Mangaluru	Baikampady Industrial Area,
23	M/s. Black God Chemical Industries Opc Pvt Ltd., Plot No.34, Plot No.34, Baikampady Industrial Area, Mangaluru-575011	Mangalore	Mangaluru	Baikampady Industrial Area,
24	Mother Nature Waste Management and Recycling Industry, Plot No. 259, D. No. 6-314, Baikampady Industrial Area, KIADB Road, Mangaluru, D.K.District- 575011	Mangalore	Mangaluru	Baikampady Industrial Area
25	M/s. Moogambigai Metal Refineries(Unit-2) (Plastic Division), Plot No.124 A & B, Baikampady Industrial Area, Mangalore	Mangalore	Mangaluru	Baikampady Industrial Area

26	M/s. R.T Enterprises plot no. A.21 1st phase Antharasanehalli Indl area Tumukur tq & dist	Tumkur	Tumkuru	Antharasanehalli Indl area
27	M/s Century Enterprises plot No.95p &96-p 1st phase Vasanthanarasapura Tumkur tq &dist	Tumkur	Tumkuru	Vasanthanarasapura Industrial Area
28	M/s. Alpha Eco Industries Plot No,131,2nd Phase Antharasanhalli Indl area ,Antharsanhalli,Tumkur tq & dist	Tumkur	Tumkuru	Antharasanhalli Indl area
29	M/s. MD Craft Industries, Plot No.118, Sy. No.42, Vasanthanarasapura, 1st Phase Industrial Area, Thimmaraj, Thimmarajanahalli - 572128	Tumkur	Tumkuru	Vasanthanarasapura, 1st Phase Industrial Area
30	M/s.Hajira Enterprises, Plot No.324 -T, 2nd phase KIADB Industrial area, Harohalli, Kanakapura Taluk, Ramanagara District	Ramanagara	Ramanagara	KIADB Industrial area
31	M/s. K.H Enterprises Plot No.310 -F2 ,KIADB Indl area ,Harohalli Kanakapura Taluk & Ramangar District	Ramanagara	Ramanagara	KIADB Indl area
32	M/s S.A Traders, Plot No-325-L II Phase KIADB Industrial Area Harohalli, Kanakapura Taluk, Ramanagara District	Ramanagara	Ramanagara	KIADB Industrial Area
33	M/s. Indian Enterprises Plot No.13 1st Cross, KIADB Indl area, Tubinakere, Mandya Tq & Dist	Mandya	Mandya	KIADB Indl area,
34	M/s.Y J Rao Industries Plot No. 20 p ,KIDBIndl area Machenahalli Nidige Hobli Shivamogga -577222	Shivamogga	Shivamogga	KIADBIndl area
35	M/s Simnani Enterprises plot No.14, KIADB I,A. Harihara, Davanagere	Davanagere	Davangere	KIADB Industrial Area
36	M/s. Sai Enterprises the plastic reprocessing unit @ Plot No. D/S-11, 7th Cross, 2nd Stage, Industrial Estate KSSIDC, Harihara Tq, Davangere Dist-577601	Davanagere	Davangere	Industrial Estate KSSIDC
37	M/s. King Enterprises Plot No. 68, 6th Main Road, Belur Industrial area, Dharawad	Dharwad	Dharwad	Belur Industrial area
38	M/s. S. N. Baddi Eco Safe Recycling Industries, Sy. No. 612(B), Belur Industrial Area, Belur - 580011, Dharwad District	Dharwad	Dharwad	Belur Industrial Area

39	M/s, Sahara Enterprises, Plot No.505(B), Sy.No.340, Belur Indl Area, Belur-580011, Dharwad-Tq & District	Dharwad	Dharwad	Belur Indl Area,
40	M/s S.K. Pipes Industries Sy No. 218/A, Ujjani road Kudligi Taluk, Vijayanagara District	Vijayanagara	Vijayanagara	Non Industrial area
41	M/s. Rishiyanth Incorp proposed to establish the units located at Plot No.31 P1, KIADB Industrial Area, Vemgal Hobli, Kolar Taluk & District.	Kolar	Kolar	KIADB Industrial Area

List of Used Oil Recyclers				
Sl No.	**Name of the Industry**	**Regional Office**	**District**	**Industrial Area**
1	M/s Ganapathy Refineries Pvt Ltd , Plot No.9&10, DR.Ambedkar Industrial Estate 1st phase Jigani Anekal tq, Bangalore - 560105	Anekal	Bengaluru Urban	DR.Ambedkar Industrial Estate 1st phase Jigani Anekal tq
2	M/s. Arun Industries No.B-64,3rd stage Peenya Indl area Bangalore	Peenya	Bengaluru Urban	Peenya Indl area
3	M/s. Ganapathy Refineries, Plot No.B-121, Nelamangala Industrial Estate, KSSIDC, Kasaba Hobli, Nelamangala	Nelamangala	Bengaluru Rural	Nelamangala Industrial Estate, KSSIDC,
4	M/s. Nakoda petrochemicals, Plot No.8 KIADBI Indl Area, Sathyamangala, Tumkur-572104	Tumkur	Tumkuru	KIADBI Indl Area
5	M/s. Shanthadurga Petrochemicals, No 701 Shedegalli Manturga Post, Khanapur Belgaum	Belagaum	Belagaum	Non Indutrial Area
6	M/s. H.N Petrochemicals Industries, Plot No. Sy.No. 29/2, Taj Sultanpur Taluk, Kalaburagi District -585103	Kalaburgi	Kalaburagi	Non Indutrial Area
7	M/s Balaji Industries Plot No.20/A, KIADB Industrial Area Machenahalli Shivamogga	Shivamogga	Shivamogga	KIADB Industrial Area
8	M/s. Evolve Oil Refining Industry, No. 410-413/2, Hebbal Industrial Area, Mysuru - 570016	Mysore -1	Mysuru	Hebbal Industrial Area

List of Waste Oil Recyclers				
Sl No.	**Name of the Industry**	**Regional Office**	**District**	**Industrial Area**
1	M/s. Jonas Petro Products Plot No. 277, Baikanapally Industrial Area Mangalore, D.K District	Mangalore	Managaluru	Baikanapally Industrial Area
2	M/s. Merlyn Hydrocarbons Pvt Ltd., Plot No.366, KIADB Indl Area, Hassan Taluk & Dist	Hassan	Hassan	KIADB Indl Area

List of Used Oil & Waste Oil Recyclers				
Sl No.	Name of the Industry	Regional Office	District	Industrial Area
1	M/s Kar Recycle centre LLP No. 114/C, 1st cross, 5th main Yeshwantapura Industrial Area opposite Peenya Metro Station, Tumkur Road, Bengaluru-002	Bengaluru City West	Bengaluru Urban	Yeshwantapura Industrial Area
2	M/s Bharath Lubricants plot No.36, KSSIDC Industrial Area Veerasandra, Hosur Road Anekal Taluk,Bengaluru	Sarjapura	Bengaluru Urban	KSSIDC Industrial Area
3	M/s. Lube Tech Petro Chemicals, No. C-76, KSSIDC Indl Area, Veerasandra, Attibele, Amehal Taluk, Bengaluru Urban	Sarjapura	Bengaluru Urban	KSSIDC Indl Area
4	M/s Balaji Refineries B-5 B-6 Veerasandra Industrial Estate Bengaluru-560100	Sarjapura	Bengaluru Urban	Veerasandra Industrial Estate
5	M/s Century refineries Pvt ltd. Plot no. 17-1 & J, KIADB Indl Area, Hosakote Taluk, Bangalore Rural District	Hoskote	Bengaluru Rural	KIADB Industrial Area
6	M/s Sampath Refineries Pvt Ltd, plot No.64A-65D, KIADB Industrial Area Tubinakere Mandya	Mandya	Mandya	KIADB Industrial Area
7	M/s. Mandya Refineries, Plot No.59 Part - II A, KIADB Indl Area, Tubinakere, Mandya Tq & Dist	Mandya	Mandya	KIADB Indl Area
8	M/s. S M Enterprises, No.4911, M C Road, Beside Fire Station, Mandya Tq & Dt	Mandya	Mandya	Tubinakere Industrial Area
9	M/s. F.A. Refineries,Plot No.92-B KIADB Industrial Area, Ist Phase, Vasanthanarasapura, Tumkur.	Tumkur	Tumkuru	KIADB Industrial Area
10	M/s M-tech petroleum Pvt Ltd plot No. 192 Vasanthanarsapura Industrial Area tumkur	Tumkur	Tumkuru	Vasanthanarsapura Industrial Area tumkur
11	M/s. VBS Petrochemicals Plot No. 29P2 Hirehalli ,Indl area ,Hirehalli, Tumukur	Tumkur	Tumkuru	Hirehalli ,Indl area
12	M/s. SMI Industries, Plot No. 195-D, 1st Phase, Vasanthanarasapura Indl. Area, Tumakuru Tq. & District	Tumkur	Tumkuru	Vasanthanarasapura Indl. Area
13	M/s. R.V.P Refineries (Previously A.S Refineries), Plot no.97-B, Vasanthanarasapura Indl Area Nagenahalli Village, Kora Hobli, Tumkur Tq & Dist	Tumkur	Tumkuru	Vasanthanarasapura Indl Area
14	M/s. Mahalakshmi Industries, Plot No.218, KIADB Indl Area, Vasanthanagara, Tumkur -572128	Tumkur	Tumkuru	KIADB Indl Area
15	M/s. Alfa refineries, Plot No. 310H, II Phase, Harohalli Indl Area, Harohalli Hobli, Kanakapura Taluk, Ramanagara District	Ramanagara	Ramanagara	Harohalli Indl Area
16	M/s. Bharani Refinaries 324-P KIADB Industrial area 2nd phase ,Kanakapura Taluk Ramanagara District	Ramanagara	Ramanagara	KIADB Industrial area

17	M/s. Jai Sai Lubricants, Plot No.57 & 58, Harohalli Industrial Area, 1st Phase, Kanakapura Taluk, Ramanagara	Ramanagara	Ramanagara	Harohalli Industrial Area
18	M/s Merlyn hydrocarbon plot No.367, KIADB I.A, H N Pura Road Hassan	Hassan	Hassan	KIADB Industrial area
19	M/s Khwaja petroleum Pvt Ltd plot No.3, KIADB Industrial area , Bangarpet Taluk, Kolar Dist	Kolar	Kolar	KIADB Industrial area
20	M/s Sri Lakshmi Refineries Industries, No. IP-34, Kudumalakunte Village, KIADB Industrial Area, Gowribidanur, Chikkaballapura	Chikkaballapura	Chikkaballapura	KIADB Industrial Area
21	M/s. K.M Oils Pvt Ltd, Plot No.75 ,76 & 77 (Part-A) 2nd Phase, Kapnoor Indl Area, Kalburgi	Kalburgi	Kalaburagi	Kapnoor Indl Area
22	M/S. Sarvodaya Solvents Pvt Ltd, Sy No.352/1, 350/1, Markunda Village Taluk & District, Bidar-585403.	Bidar	Bidar	Non Industrial area

List of Lead Acid Battery/Lithium Ion Battery Recyclers				
Sl-No.	Name & Address of unit	Regional Office	District	Industrial Area
1	Hindustan Lead Alloys., No.132, Byraveshwara Industrial Estate, Near Shushruthi Bank, Andrahalli Main Road, Bangalore - 560091	Dasarahalli	Bengaluru Urban	Byraveshwara Industrial Estate
2	Sun Metals., Sy No.30/2, Surajakkanahalli Village, Kasaba Hobli, anekal Taluk, Bengaluru	Anekal	Bengaluru Urban	Non Industrial Area
3	R.P.N Industreis, Plot No.B2, KSSIDC Indl. Area, Kumbalgodu, Mysore Road, Bengaluru -560074	R R Nagar	Bengaluru Urban	KSSIDC Indl. Area
4	M/s. Sri Ponni Industries, Plot No. 24, 4th Phase Bommasandra Industrial Area, Anekal Taluk, Bengaluru Urban District -560099	Anekal	Bengaluru Urban	Bommasandra Industrial Area,
5	Evershine Smelting Alloy Pvt Ltd., Plot No.15C, Zone No.2, Attibele Industrial Area, Bengaluru-562107-volume 1	Sarjapura	Bengaluru Urban	Attibele Industrial Area
6	Hi-Tech Eco Green Plot No. 104/A, Sy.No. 7,8,9,10 Bharthipura village, Somapura Indl Area, Nelamagala	Nelamangala	Bengaluru Rural	Somapura Indl Area
7	M.H.Metals Recycling Industries., Plot No.440, sy No.23/1 & 35 of Lakshampura Village, Sompura 2nd stage Industrial area, Nelamangala Taluk, Bangalore Rural District	Nelamangala	Bengaluru Rural	Sompura 2nd stage Industrial area

8	HITECH ECO GREEN, 363A,SOMPURA INDUSTRIAL AREA, 1ST STAGE, TRMN BACK SIDE, DOBASPET, NELAMANGALA TQ. BANGALORE RURAL, Karnataka, 562111	Nelamangala	Bengaluru Rural	SOMPURA INDUSTRIAL AREA
9	Sri Shirdi Sai Baba Industries., Plot No.325V, KIADB Ind Area, Phase-II, Harohalli, Kanakapura Taluk & Ramangara District	Ramanagara	Ramanagara	KIADB Ind Area
10	Shiva Enterprises., Plot No.311-A, 2nd Phase, KIADB Industrial Area, Harohalli, Kanakapura Taluk, Ramanagara	Ramanagara	Ramanagara	KIADB Industrial Area
11	Shree Ponni Lead Alloys Pvt Ltd., Plot No.32-A, Harohalli Industrial area, 1st Phase Kanakapura Taluk, Ramangara-562112	Ramanagara	Ramanagara	Harohalli Industrial area
12	M/s. Surya Metal Mart., Plot No.395, Harohalli 3rd Phase, Harohalli Industrial Area, Kanakapura Taluk, Ramanagara District, Bangalore	Ramanagara	Ramanagara	Harohalli Industrial Area
13	Tharun Enterprises., Plot No.325R-1, KIADB Ind Area, Phase-II, Harohalli, Kanakapura Taluk, Ramanagar	Ramanagara	Ramanagara	KIADB Ind Area
14	Veeranarayana Metal Alloys Pvt Ltd.,Sy No.81/2, Bhadrapura, Lakkenahalli Village & Post,solur Hobli, Magadi Taluk, Ramanagara District-561101	Ramanagara	Ramanagara	Harohalli Industrial Area

15	M/s. Metastable Materials Pvt Ltd., Plot No.B-61, I Phase, Harohalli Industrial Area, Kanakapura Taluk, Ramanagara District	Ramanagara	Ramanagara	Harohalli Industrial Area
16	HS Metals (Unit-II), Plot No.99-P-2, 4th Phase, KIADB Induatrial Area, No.34, Rajendra Layout, Maruthi Extension, Malur Taluk, Kolar District	Kolar	Kolar	KIADB Induatrial Area
17	Jayvel Enterprises., Plot No.26A, KIADB Industrial Area, Malur, Kolar	Kolar	Kolar	KIADB Industrial Area
18	Shreenevasa Metal Corporation India Private Ltd., Plot No.81,3rd Cross, 2nd Stage, KIADB Industrial Area, Malur Kolar	Kolar	Kolar	KIADB Industrial Area
19	S.K. Accumulators., Plot No.31, Part-4, 4th Phase, KIADB Industrial Area, Malur, Kolar-563130	Kolar	Kolar	KIADB Industrial Area
20	OM Metals, Plot 293A & B, 3rd Phase, KIADB Indl Area, Malur, Kolar District-563130	Kolar	Kolar	KIADB Indl Area
21	Selvam Metals & Alloys.,Plot No.37, 2nd Cross, 2nd Phase, KIADB Industrial area, Malur Taluk, Kolar	Kolar	Kolar	KIADB Industrial area
22	Chloride Metals Limited., Sy No.60/1 & 2, Seethanayakanahalli Malur-Hosur Road, Lakkur Hobli, Malur Taluk, Kolar District	Kolar	Kolar	Non Industrial Area
23	Ace Enterprises., No.94 Part2, KIADB Industrial Area,4th Phase, Malur, Hoskote Village, Lakkur Hobli, Malur, Kolar District	Kolar	Kolar	KIADB Industrial Area

24	Sandeep Lead Alloys India Private Limited, Plot No.19, KIADB Industrial Area,1st Phase,Malur Taluk,Kolar District	Kolar	Kolar	KIADB Industrial Area
25	Kandan Alloys., Plot No.6-E, 4th Phase, KIADB Industrial Area, Malur Taluk, Kolar District	Kolar	Kolar	KIADB Industrial Area
26	SP Metal (OM Metal)., Plot No.78,1st Phase, KIADB Industrial Area,Malur, Kolar Taluk	Kolar	Kolar	KIADB Industrial Area
27	Enviro Green Alloys., Plot No.32, 1st Phase,KIADB Indl Area, Malur Taluk,Kolar District	Kolar	Kolar	KIADB Indl Area
28	Aryan Metal Industries, Plot No. 55, 4th Phase, KIADB Industrial Area, Malur Taluk, Kolar District	Kolar	Kolar	KIADB Indl Area
29	Lawraga Metals Pvt Ltd., P.NO.06T, 4th Phase, KIADB Indl Area, Malur, Kolar	Kolar	Kolar	KIADB Indl Area
30	M/s. Theos metals Trada Private LIMITED., Plot No.318-A & 318-B, 3rd Phase, KIADB Industrial Area, Malur Taluk, Kolar District	Kolar	Kolar	KIADB Industrial Area
31	M/s. Ganapathi Enterprises, Plot No. 11, 1st Phase, Malur Industrial Area, Malur Taluk,Kolar District, Malur - 563130	Kolar	Kolar	Malur Industrial Area
32	M/s Laxmi Metals., Plot No.26-B, Kurandanalli Road, 1st Phase, Malur, KIADB Industrial Area, Malur Taluk, Kolar District.	Kolar	Kolar	KIADB Industrial Area

33	M/s NIK Enterprises (Formerly M/s. Krish Auto Power India Private Limited.,), Sy. No.100, Choodagondanahalli Village, Hosur Main Road, Malur Taluk, Kolar District.	Kolar	Kolar	KIADB Industrial Area
34	M/s. LICO Materials Pvt Ltd , Plot No. 104, Sy. No. 43, 53 and 54, Vemgal KIADB Indl. Area, Kolar taluk and District.	Kolar	Kolar	Vemgal KIADB Indl. Area,
35	Bala Industries, 235 M, 3rd Phase, Bommasandra Industrial area, Hosur Road, Bengaluru (Bangalore) Urban, Kanataka, 560099	Kolar	Kolar	Bommasandra Industrial area
36	Fairoz Metal Mart P.No.190, Masthenahalli, 1st Phase indl area, Masthenehalli Kaiwara(H), Chinthamani (T), Chikkaballapura	Chikkaballapura	Chikkaballapura	Masthenahalli, 1st Phase indl area
37	Shri Lakshmi Venkateshwara enterprises., Plot No.216, Masthenahalli, 1st Phase Industrial Area, Chikkaballapura	Chikkaballapura	Chikkaballapura	Masthenahalli, 1st Phase Industrial Area
38	Trishulavel Eshan Pvt Ltd.,112, Masthenahalli Industrial Area, Masthenahalli 1st Phase, Chintamani (T), Chikkaballapura (D)	Chikkaballapura	Chikkaballapura	Masthenahalli Industrial Area,
39	Eswari Global Metal Industries Pvt Ltd.,Unit -1 No. 101A & B, Baikampady Industrial Area, Managluru-575011	Mangaluru	Mangaluru	Baikampady Industrial Area
40	Eswari Global Metal Industries Pvt Ltd., Unit -3 P.No.410 & 411, Baikampady Industrial Area, Managluru-575011	Mangaluru	Mangaluru	Baikampady Industrial Area

41	Anupama Industries Plot No.62-P, KIADB Indl Area, Machenahalli, Shivamogga Taluk and District.	Shivamogga	Shivamogga	KIADB Ind Area
42	Shivam Enterprises.,Plot No.22-A, KIADB Industrial Area, Vasanthasapura, Kora Hobli,Tumkur-572128	Tumkuru	Tumakuru	KIADB Industrial Area
43	E-pragathi Recycling Pvt Ltd., unit-3., Sy no. 18, plot No137B & 138, Vasanatharasapura indl area, Thimmrajanahalli Village, Bellavi Hobli, Tumkur & Rural District	Tumkuru	Tumakuru	Vasanatharasapura indl area
44	Chandana Industries, Plot no.174/B, KIADB Idustrial area, Vasanthanarasapura, Kora Hobli, Tumkur Dist	Tumkuru	Tumakuru	KIADB Idustrial area
45	Greens Recology Company, Ground Floor, Plot No. 415 Sy No. 3/14, KIADB, Vasanthanarasapura Industrial Area, Yaladadlu Village Kora Hobli, Tumakuru (Tumkur), Karnataka, 572138	Tumkur	Tumakuru	Vasanthanarasapura Industrial Area,
46	Minimines Cleantech Solutions Private Limited., Plot No. 22A, Vasanthanarasapura Industrial Area, Tumkur Industrial Area: Vasantha-Narasapura Ind Area, VASANTHANARASAPURA, Tumkuru	Tumkuru	Tumakuru	Vasanthanarasapura Industrial Area
47	King Scrap Materials Enterprises. P.No.87, Belur Industrial Area,Belur,Dharwad-580011	Dharwad	Dharwad	Belur Industrial Area
48	Spark Battery Industry., Plot No.1(P)1, Sanklapura Industrial Area, Hospet	Ballary	Bellary	Sanklapura Industrial Area

49	M/s. Eshwari Global Metal Industries Pvt. Ltd. (Unit - II) located at Plot No. 96 & 97, Industrial Area, Baikampady, Mangalore – 575011	Mangalore	Mangaluru	Baikampady Industrial Area
50	Eswari Global Metal Industries Private Limited, Unit 3 - Plot No. 415 & 416, Industrial Area, Baikampady, Mangalore	Dakshina Kannada	Mangaluru	Baikampady Industrial Area
51	Eswari Global Metal Industries Pvt Ltd., Plot No.96 & 97, Industrial Area, Baikampady, Mangalore-575011	Mangaluru	Mangaluru	Industrial Area, Baikampady
52	Moogambigai Metal Refineries, Plot No.132 A, Industrial Area, Baikampady, Mangaluru-575011	Mangaluru	Mangaluru	Baikampady Industrial Area
53	J B Carbon Etracts Private Limited, Plot No 158'C', Belur Industrial Estate	Dharwad	Dharwad	Belur Industrial Estate
54	M/s. Sri Chamundi Metal Works, Plot No.440-K, Sy. No.144, KIADB Industrial Area, Hebbal Kasaba Hobli, Mysuru-570016	Mysuru-1	Mysuru	KIADB Industrial Area
55	A R Industries, Plot No.3D, Sanklapura Industrial Area, Hospet Taluk, Vijayanagara District	Vijayanagara	Vijayanagara	Sanklapura Industrial Area

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(1)

Issue of Closure Order from 01.04.2025							
sl no	**File no**	**Industry name**	**Activity**	**RO**	**Under which Act**	**Date of isuue**	**Despatch no**
1	KSPCB/Enf-Cmp/178/2024-25	S K Enterprises, #130, Sy No. 89, Gidadapalya Road, Yalachaguppe Village, Tavarekere Hobli, Bengaluru	Lead smelting activity by dismantaling lead acid batteries	RR Nagar	Water Act & Air Act	15.05.2025	05 & 06
2	KSPCB/Enf-Cmp/46/2025-26	Illegal lead recycling unit by Sri. Sanjay located at Sy No. 133/3, Marasandra Village, Kasaba Hobli, Malur tq, Kolar Dist	lead recycling activity	Kolar	Water Act & Air Act	08.09.2025	213 & 214
3	KSPCB/Enf-Cmp/47/2025-26	Illegal lead recycling unit in the premises of M/s. Ridhi Sidhi Enterprises located at Plot No. 49, 2nd Phase, Sy No. 76, Nosager Village, Kasaba Hobli, Malur tq, Kolar Dist	lead recycling activity	Kolar	Water Act & Air Act	08.09.2025	215 & 216

4	KSPCB/Enf-Cmp/49/2025-26	Illegal lead recycling unit by Sri. Hafeez Khan (Proprietor of M/s. MNS Traders) located at Sy No. 274, Narayana Keri Main Road, Behind brick factory, near BESCOM Junction, Lakkuru Village & Hobli, Malur tq, Kolar Dist	lead recycling activity	Kolar	Water Act & Air Act	09.09.2025	219 & 220
5	KSPCB/Enf-Cmp/48/2025-26	Illegal lead recycling unit of M/s. J K Metals located at Sy No. 134, Marasandra Village, Kasaba Hobli, Malur tq, Kolar Dist	lead recycling activity	Kolar	Water Act & Air Act	09.09.2025	217 & 218

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List of Notice of Proposed Directions issued by the Board

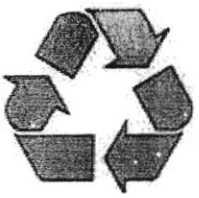
Sl.No	Industry Name and Complete address	Activity	NPD Issued by	NPD Issued Date	WPC/APC/EP Act
1	M/s.Sai Enterprises, Plot No.182,Kadechur Industrial Area, Yadgir Taluk & District	Solvent Recycling	WMC-2	12.06.2025	EP Act
2	M/s. Mayash Enterprises, Plot No.273, KIADB Indl Area, Kadechur,Yadgir Taluk & District	Solvent Recycling	WMC-2	11.06.2025	EP Act
3	M/s. SNP Pharmaceuticals, Plot No.266, KIADB Indl Area, Kadechur, Yadgir Taluk & District	Solvent Recycling	WMC-2	11.06.2025	EP Act
4	M/s. Kalyana Karnataka Waste Management Project Pvt Ltd, Plot No.158-164, KIADB Industrial Area, Kadechur, Yadgir Taluk & District	TSDF	WMC-2	11.06.2025	EP Act
5	M/s. Mohanam Industries, Sy No.339/2, Kamalapur Village, Humnabad Road, Taluk & District, Kalaburagi	Tyre Pyrolysis	RSEO Kalaburagi	01.10.2024	Water Act and the Air Act
6	M/s. Ahmed Industries, Plot No. 130/B, KIADB, Kolhar Industrial Area, Bidar – 585403.	Tyre Pyrolysis	RSEO Kalaburagi	22.07.2025	Water Act and the Air Act
7	M/s. Mehanaj Industries, Plot No. 365 – P-6, Kolhar Industrial Area, Bidar District.	Tyre Pyrolysis	RSEO Kalaburagi	22.07.2025	Water Act and the Air Act

ಅನುಬಂಧ-4

Standard Operating Procedure and Checklist of Minimal Requisite Facilities for utilization of hazardous waste under Rule 9 of the Hazardous and Other Wastes (Management and Transboundary movement) Rules, 2016

Utilization of Spent Solvent for recovery of solvent

(Revised)



February, 2021

Central Pollution Control Board

(Ministry of Environment, Forest & Climate Change, Government of India)

Parivesh Bhawan, East Arjun Nagar,

Shahdara, Delhi – 110032

Procedure for grant of authorization by SPCBs/PCCs for utilization of Hazardous waste

(i) While granting authorisation for utilization of hazardous wastes, SPCBs/PCCs shall ensure that authorisation is given only to those wastes for which SoPs on utilisation have been circulated by CPCB ensuring the following:

a. The waste (intended for utilization) should have similar source of generation as specified in SoPs.

b. The utilization process should be similar to the process of utilization described in SoPs.

c. End-use / product produced form the waste shall be same as specified in SoPs.

d. Authorisation shall be granted only after verification of minimum requisite facilities installed and after verification of utilization process as given in SoPs.

e. Issuance of passbooks (similar to the passbooks issued for recycling of use oils, waste oil, non-ferrous scraps, etc.) for maintaining records of receipt of hazardous wastes for utilization.

(ii) After issuance of authorization, SPCB shall verify the utilization process, checklist and SOPs, quarterly during the initial 02 years of operation followed by random checks in subsequent year's at least once in every year.

In-case of lack of requisite infrastructures with the SPCBs/PCCs, SPCBs/PCCs may engage 3rd party institutions and EPA/NABL/ISO17025 accredited laboratories for monitoring and analysis of prescribed parameters of the SoPs for verification purpose. Such labs shall have accreditation (EPA/NABL/ISO17025) for the parameters specified in SoP.

(iii) SPCB shall provide half yearly up-dated list of units permitted for utilization of hazardous waste to CPCB and also periodically update the same on SPCB website Such updated list shall be sent for January-June and July-December of every year and reach to CPCB by July and January respectively of every year.

(iv) Authorisation for utilisation shall not be given to the units located in the State/UT where there is no Common TSDF, unless the unit ensures authorised captive disposal of the hazardous waste or its complete utilisation or arrangement of sharing with any other authorised disposal facility,

(v) In case of the utilization proposal is not similar with respect to source of generation, utilization process and end-use as outlined in this SoP, the same may be referred to CPCB for clarification / conducting trial utilization studies and developing SoPs.

(vi) The source and work zone standards suggested in the SoPs are based on the E(P)A notified and OSHA standards respectively, however, SPCB/PCC may impose more stringent standards based on the location or process specific conditions.

1.0 Source of Waste

Spent Solvent is generated during use of solvent to dissolve or dilute other substances or materials or as chemical intermediates in various industrial processes. These spent solvents are hazardous wastes and are required to be disposed, when not utilized as resource recovery, in authorized disposal facility in accordance with authorization condition stipulated by the concerned SPCB/PCC.

This SoP is applicable only for utilization (including captive utilization) of spent solvent to recover solvent as below:

Type of HW	Source of generation	Recovery/Product
Spent Solvent (Hazardous waste categories 20.2; 21.2; 26.4; 28.6 and 29.4 of Schedule I of HOWM Rules, 2016)	Industrial uses of solvents; Production or industrial use of paints, pigments, lacquers, varnishes and inks; Production or industrial use of synthetic dyes, dye-intermediates and pigments; Production/formulation of drugs/pharmaceutical and health care product, and; Production and formulation of pesticides including stock-piles.	Recovered solvent or mixture of solvent containing; Acetone, Toluene, Benzene, Xylene, Cyclohexane, Methyl Iso Butyl Ketone, Methanol, Iso Propyl Alcohol, Methylene Dichloride, Tetra Hydro Furan, Ethyl Acetate, Dimethyl formamide, Butyl acetate, Methyl Acetate, Butanol, Ethanol, Methyl Ethyl Ketone and Iso Propyl Ether

1.1 Utilization Process

The recovery of solvent shall involve fractional distillation of spent solvent followed by single or two stages cooling in primary and secondary condenser, depending upon boiling point of the spent solvent.

Water shall be used as cooling medium for condenser for recovery of spent solvents having boiling point of 100°C and above wl ereas for solvents with low boiling point (i.e. <100°C), the unit shall provide secondary condenser with chilled water/brine as cooling medium.

1.2 Product Usage / Utilization

The solvent recovered from Spent Solvent generated from pesticides industry shall preferably be sent to the generator itself or other pesticides manufacturing units. However, such recovered solvent shall not be used in the process of production of pharma, food, and cattle feed.

The packaging of product (i.e. recovered solvent) shall be labelled as "This product has been recovered from Spent Solvent generated from Pesticides/Dye and Dye intermediated industries/Drugs/etc. (as the case may be) manufacturing process".

1.3 Standard Operating Procedure for utilization

This SoP is applicable only for the utilization of Spent Solvent for recovery of solvent.

(1) The Spent Solvents containing Toluene, Xylene, Cyclohexane, Acetone, Methyl isobutyl ketone, Methanol, Isopropyl alcohol, Methylene Dichloride, Tetra Hydro Furan, Ethyl Acetate, Iso Propyl Ether, Dimethyl formamide, Butyl acetate, Methyl Acetate, Butanol, Benzene, Ethanol and Methyl Ethyl Ketone shall be procured only in tankers/drums.

(2) The Spent Solvents shall be transferred from tankers/drums to the raw material storage tank and to distillation column by solvent transfer pump.

(3) Transportation of Spent solvents shall be carried out by sender or receiver (utilizer) only after obtaining authorisation from the concerned SPCB under the Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016.

(4) It shall be ensured that the aforesaid hazardous waste is procured from the industries who have valid authorization for the same from the concerned State Pollution Control Board as required under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

(5) During loading and unloading of Spent Solvents/Recovered Solvent from Tanker to Storage Tank or Storage Tank to Tanker, vent (of both Storage Tank/Tanker) shall be connected to each other so as to minimize VOC emissions.

(6) Vent of all storage tasks (i.e. Spent Solvent and Recovered Solvent) shall be connected through condenser.

(7) All the Vehicles entering the utilization premises shall be fitted with the spark arrestor.

(8) The vent of the condenser shall be at least 06 meters above the roof top or at height prescribed by SPCB/PCC, whichever is higher.

(9) The vent of condenser shall be passed through VOC absorption media like activated carbon and shall comply with the prescribed standards.

(10) The unit shall maintain proper ventilation in the work zone and process areas. All personnel involved in the plant operation shall wear proper personal protective equipment such as hard hats, goggles, face shield, steel toed shoes, gloves, aprons, respirators etc.

(11) The unit shall provide laboratory facility for analysis of solvent.

(12) The unit shall provide suitable fire safety arrangements and spark/flame proof electrical installation/ fittings.

(13) The unit shall obtain license from Petroleum and Explosive Safety Organization of Govt. of India.

(14) The Spent solvent generated from Pesticides industry shall not be mixed with any other spent solvent and be distilled separately in separate batch.

The solvent recovered from Spent Solvent generated from pesticides industries shall preferably be sent to the generator itself or other pesticides manufacturing units. However, such recovered solvent shall not be used in the process of production of pharma, food, and cattle feed.

(15) The packaging of product i.e. recovered solvent shall be labelled as "This product has been recovered from Spent Solvent generated from Pesticides/Dye and Dye intermediate industries/Drugs/etc. (as the case may be) manufacturing process".

(16) Residue generated from the distillation unit shall be packaged and temporarily

stored in a dedicated hazardous waste storage area within the unit. The same shall be disposed in Common Hazardous Waste Treatment, Storage and Disposal Facility (CHWTSDF) or sent to cement kilns for co processing/utilization at facility, as authorised by the concerned SPCB/PCC.

(17) The unit shall ensure that all the discarded/used drums/barrels are either sent back to the unit from where the Spent Solvent is procured or to the facility who has authorisation for utilization of used drums/barrels or to CHWTSDF for disposal, as authorized by the SPCB/PCC.

(18) The condensate water from distillation and effluent generated from cooling tower shall be managed as per the conditions stipulated by the concerned SPCB/PCC under the Water (Prevention and Control of Pollution) Act, 1974.

(19) Transportation of the residues generated during the utilisation process shall be carried out by sender or receiver (TSDF operator) as per the authorization issued by the concerned SPCB in accordance with provisions under the Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016.

(20) In case of environmental damages arising due to improper handling of hazardous wastes including accidental spillage during generation, storage, processing, transportation and disposal, the unit shall be liable to implement immediate response measures, environmental site assessment and remediation of contaminated soil/groundwater/sediment etc. as per the "*Guidelines on implementing Liabilities for Environmental Damages due to Handling & Disposal of Hazardous Wastes and Penalty*" published by CPCB.

(21) During the process of utilization and handling of hazardous waste, the unit shall comply with the requirements in accordance with the Public Liability Insurance Act, 1991 as amended, wherever applicable.

1.4 Record/Returns Filing

(1) The unit shall submit quarterly and annual information on the said hazardous wastes (i.e. spent Solvent) consumed, its source, products generated and resources conserved (specifying the details like type and quantity of resources conserved) to the concerned SPCB/PCC.

(2) The unit shall maintain a passbook issued by concerned SPCB wherein the following details of each procurement of Spent Solvent shall be entered:

- Address of the sender
- Date of dispatch
- Quantity procured with percentage content of moisture and solvent in the same
- Seal and signature of the sender
- Date of receipt in the premises

(3) A log book shall be maintained with information on source and date of procurement of Spent Solvent, quantity, percentage content of solvent and

moisture in the same, date wise utilization of the same, hazardous waste generation and its disposal, etc.

(4) The unit shall maintain record of hazardous waste utilised, hazardous waste generated and disposed as per Form 3 & shall file annual returns in Form 4 as per Rule 20 (1) and (2) of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, to concerned SPCB/PCC.

1.5 Standards

(1) During recovery of solvent from spent solvents, the unit shall comply with the following work zone standards:

S. No.	Substance	CAS No.	TWA* PPM
1	Toluene	108-88-3	100
2	Xylenes (o-,m ,p- isomers) m-Xylene alpha,	1330-20-7	100
3	Cyclohexane	110-82-7	300
4	Acetone	67-64-1	1000
5	Methyl isobutyl ketone	108-10-1	100
6	Methanol	67-56- 1	200
7	Isopropyl alcohol	67-63-0	400
8	Methylene Dichloride	75-09-2	25
9	Tetra Hydro Furan	109-99-9	200
10	Ethyl Acetate	141-78-6	400
11	Iso Propyl Ether	108-20-3	500
12	Dimethyl formamide	68-12-2	10
13	Butyl acetate	123-86-4	150
14	Methyl Acetate	79-20-9	200
15	Butanol	71-36-3	100
16	Benzene	71-43 2	1
17	Ethanol	64-17-5	1000
18	Methyl Ethyl Ketone	78-93-3	200

**time-weighted average (TWA), the PELs are 8-hour TWAs*

(2) The vent of condenser shall be passed through VOC absorption media like activated carbon and shall comply with Process vent emission Standard of Total Organic Carbon (TOC) ≤ 20 ppm.

(3) Monitoring of the specified parameters for source emission shall be carried out quarterly for the first year followed by atleast annually in the subsequent year of utilization. Fugitive emission for specified parameters shall be carried out quarterly. The monitoring shall be carried out by NABL accredited or EPA approved laboratories and results shall be submitted to the concerned SPCB/PCC quarterly.

1.6 Siting of Industry

Facilities for utilization of Spent Solvent shall be located in a notified industrial area or industrial park/estate/cluster and in accordance with Consent to Establish issued by the concerned SPCB/PCC.

1.7 Size of Plant & Efficiency of utilisation

Output as recovered solvent depends upon content of solvent, moisture and impurities present in the spent solvent. It is expected that full quantity of solvent (present in the spent solvent) be recovered with negligible loss. Therefore, requisite facilities of adequate size of storage shed and other plant & machineries as given in para 1.9 below shall be installed accordingly.

1.8 On-line detectors / Alarms / Analysers

Regular VOC monitoring with portable VOC meter at primary and secondary vent condensers and online fixed VOC detector connected to data logger to be provided by the concerned unit. In case of continuous process online emission data be connected to server of the concerned SPCB/PCC.

1.9 Checklist of Minimal Requisite Facilities

S. No.	Particulars
1	Tankers/HDPE drums for receiving spent solvents
2	Connection of vent of the tanker with Spent solvent storage tanks during loading and unloading.
3	Solvent transfer pump (s) for transferring Spent Solvent from tanker/drums to storage tank.
4	Solvent transfer pump (s) for transferring Spent Solvent from storage tank and to distillation column.
5	Connection of vent of the tanker with Recovered solvent storage tanks during unloading
6	Vent of all the storage tanks (i.e. Spent solvent & recovered solvent) be connected to condenser.
7	Vehicles be fitted with the spark arrestor
8	Thermic fluid heater/ electric heating system
9	Distillation column
10	Water as cooling medium for condenser for recovery of Spent solvent with boiling point of 100°C and above
11	Cooling Tower
12	Secondary condenser with chilled water/brine as cooling medium for solvent with low boiling point (i.e. <100 C).
13	VOC absorption media connected to vent of condenser
14	Height of vent of condenser be least 06 meters above the roof top or at height prescribed by SPCB/PCC, whichever is higher
15	Dedicated hazardous waste storage area for res due generated from

	distillation column
16	fire safety arrangements and spark/flame proof electrical installation/ fitting
17	License from Petroleum and Explosive Safety Organization of Govt. of India
18	Regular VOC monitoring with portable VOC meter at primary and secondary vent condensers and online fixed VOC detector connected to data logger to be provided by the concerned unit. In case of continuous process online emission data be connected to server of the concerned SPCB/PCC.

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CP-22/139/2021-WM-III-HO-CPCB-HO

Standard Operating Procedure(SOP) for Recycling of Waste Tyre Scrap for the recovery of Tyre Pyrolysis Oil, Pyro Gas and Char in Tyre Pyrolysis Oil (TPO) Units

January 16, 2024

Central Pollution Control Board

(Ministry of Environment, Forest & Climate Change, Government of India)

Parivesh Bhawan, East Arjun Nagar, Shahdara, Delhi – 110032

CP-22/139/2021-WM-III HO-CPCB-HO

CPCB

STANDARD OPERATING PROCEDURE
for
Recycling of Waste Tyre Scrap for the recovery of
Tyre Pyrolysis Oil, Pyro Gas and Char
in Tyre Pyrolysis Oil (TPO) Units

1.0 Background

In the matter of OA No. 400 of 2019 and in compliance of the Hon'ble NGT order dated 06-01-2020, seven (07) Tyre Pyrolysis Oil (TPO) Units comprising of three (03) advance batch automated tyre pyrolysis plants, three (03) existing batch units and one (01) continuous tyre pyrolysis plants were studied under the guidance of experts from NEERI and IIT Delhi. Further study of 70 TPO units were carried out with the help of SPCBs. As per the study advanced batch automated process (ABAP) and continuous tyre pyrolysis process had demonstrated compliance with regard to work zone limits and no significant impact on ambient air quality.

The study further observed that existing batch TPO Units need additional features such as PLC based control arrangement, bypass arrangement for pyro gas from reactor door to primary condenser, installation of gas sensors, pressure, temperature gauges at reactor & storage tank, gas /fire alarm system, flaring of entire pyro gas during emergency, arrangement for re-circulation of pyro gas for reactor's heating, provision for flaring of pyro gas, suction hoods over the gate of reactor and char bagging area, water sprinkler system and mechanized arrangement for removal of char and steel scrap and arrangement of Nitrogen gas (N_2) purging to address environmental and safety concerns.

In the same matter, the Hon'ble NGT vide its order dated 25.10.2021 directed to issue appropriate SoP covering siting criteria, threshold limit of a plant, carrying capacity, standards for effluents, emissions and hazardous or other waste, safety aspects to prevent accidents and for protection of public health. Accordingly, in consultation with expert members from NEERI & IIT-Delhi, the existing SoP was revised w.r.t Recycling of Waste Tyre Scrap for the recovery of Tyre Pyrolysis Oil, Pyro Gas and Char in Tyre Pyrolysis Oil (TPO) Unit.

1.1 Pyrolysis process

Pyrolysis is a thermal degradation process carried out in the absence of oxygen /air in a vessel or a chamber, so that the combustion of material does not take place. It is a process in which organic materials are thermally decomposed into simpler compounds in the temperature range of 400 – 500 °C in an oxygen-free environment. Fig. 1 shows the

schematic diagram of waste scrap tyre pyrolysis process. Since the products of thermal decomposition are released at different temperature having varying molecular structure, the products are in all phases i.e. solid, liquid and gas. Pyrolysis of tyres and rubber products produce pyrolysis oils, pyrolysis gas (pyro-gas), char and steel. The products generated in tyre pyrolysis are as follows:

A) **Pyro Gas**: 20 to 35 percent of a tyre's energy content is typically converted into a combustible gas (Pyro Gas) that is used to fuel the pyrolysis process or is combusted in a flare before it is released. Typically, the components of pyro gas are H_2, H_2S, CO, CO_2, CH_4, C_2H_4, C_3H_6 and other light hydrocarbons.
B) **Pyro Oil**: 35 to 50 percent of the output from the process is transformed into a liquid product that varies in quality from saleable fuel oil to lower-value oil blend stock.
C) **Char**: The residual solid product (referred as char constitutes 25 to 40 percent of the output and contains a mixture of carbon, silica, titanium dioxide, zinc, steel etc.
D) **Steel**: The thin wire, which is used for reinforcement of tyre is extracted out during pyrolysis and is collected at the end, sold in the market as scrap steel.

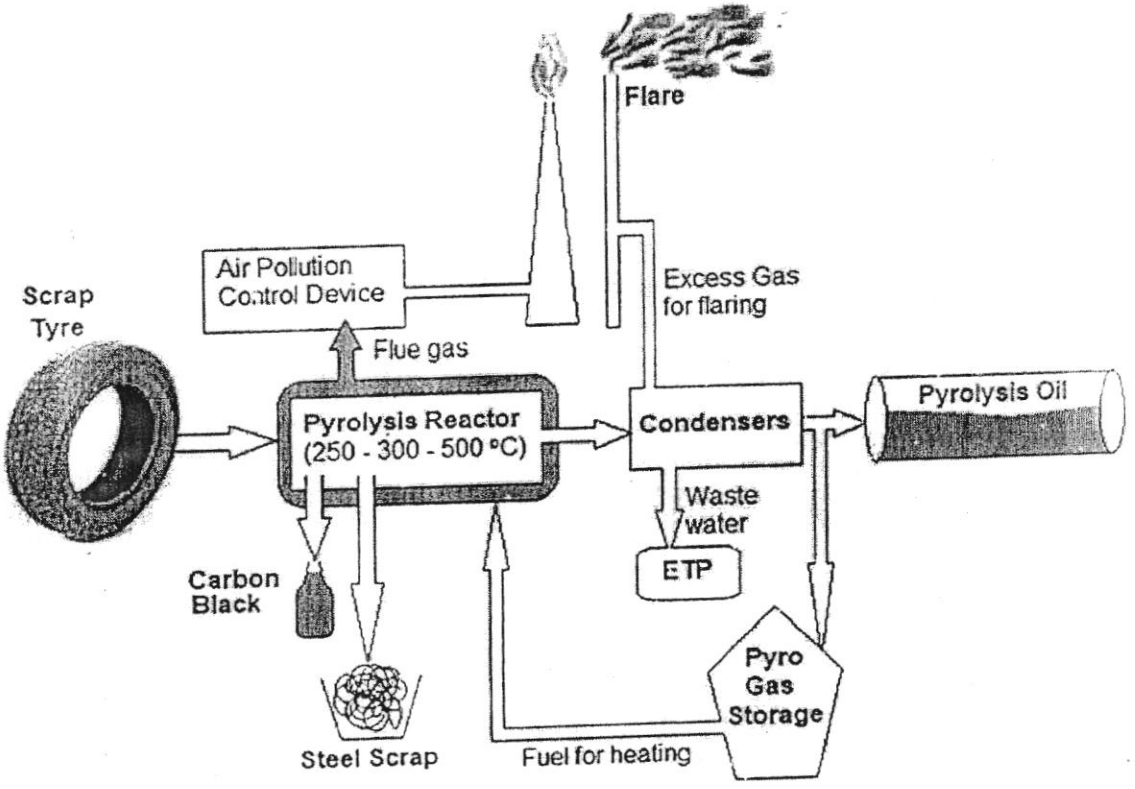

Fig. 1: Schematic diagram of waste tyre pyrolysis process

The quantity and quality of each product depends on many process variables, including temperature, pressure, and residence time. A preferred quality trye pyrolysis oil would have molecular weight little above its boiling temperature under normal temperature and pressure. This would help in efficient combustion, and less of soot formation. Waste tyre pyrolysis plant operators are expected to have a control on rate of heating and condensation so as to produce high-quality oils with high calorific values comparable with diesel and gasoline type fuels.

Two types of Pyrolysis process are in operation in India. Batch Type and Continuous Pyrolysis process. In both type of pyrolysis processes, the final product remains the same. Most of the tyre pyrolysis units in the country are based on batch processes technology having different types of process control, safety mechanism, raw material, finish product and waste handling facilities. There is a need to standardize the operations and facilities at Tyre Pyrolysis Oil (TPO) Units to achieve environmentally sound and safe operation of these units.

From the study carried out, it was observed that Advanced Batch Automated Process (ABAP) and continuous tyre pyrolysis process have no significant impact on ambient air quality. Therefore, for standardizing the batch type pyrolysis operations, Advanced Batch Automated Process (ABAP) type TPO Unit shall only be allowed.

2.0 Siting Criteria, Carrying Capacity and Standard Operating Procedures (SoP) for Advanced Batch Automated Process (ABAP) type TPO unit

2.1 Siting Criteria for ABAP type TPO Units

The siting criteria is applicable only to new /proposed units. New ABAP type TPO unit shall be allowed only in the industrial areas/land.

(I) Siting criteria for ABAP type TPO Units:

The criteria for siting of ABAP type TPO units depends on the following facts:

i) There are no organized continuous process emissions in tyre pyrolysis process.

ii) The air pollutant emission in ABAP type TPO unit is from burning of fuel for heating purpose and intermittent flaring of excess pyro gas or its emergency release;

iii) The plot area of the TPO Unit carries more weightage as the emission from TPO unit does not affect far away community, instead it is the immediate neighbourhood that is affected. Char, being large size particle if spilled in the plant premises during its handling cannot travel to larger distance under the influence of wind;

iv) The environmental concern from TPO Unit is spillage of Char in the work zone while removing it from the reactor and its subsequent packing into the

bags. The influence zone due to this spillage is limited within the premise of the unit;

v) The odour from TPO Unit are localized and confined to premises and adjacent areas.

Followings are the criteria for site consideration for new units:

i) New ABAP type TPO Unit having individual reactor capacity of 10 tonnes to 20 tonnes should only be allowed;

ii) Considering the possible impacts in neighbourhood, TPO Unit having cumulative maximum batch capacity up to 60 tonnes per day (TPD) only be allowed within a premises and this is applicable for new ABAP type Units /expansion in existing batch type TPO Unit.

iii) Beyond cumulative batch capacity of 60 TPD, only continuous process type TPO unit be allowed in case of setting up of new ABAP type units or expansion in existing TPO Unit in a single premises.

iv) For new ABAP type TPO Unit the minimum plot area shall be 3000 square meters for a single reactor of 10 to 12 tonnes capacity and the area will increase by 750 square meters for every additional reactor of capacity 10 to 12 tonnes and will increase up to 6000 square meters.

v) For new proposed ABAP type TPO unit the minimum plot area shall be 4000 square meters for a single batch reactor of 20 tonnes capacity and the area will increase by 1000 square meter for every additional reactor and will increase up to 6000 square meters.

vi) For new proposed continuous TPO unit the minimum plot area should be 7000 square meters irrespective of number of reactors.

(II) Green Belt Requirement

The green belt should be as per consent conditions or as per the guidelines of Central and State Government and in no case less than 5% of the total area of the plot.

(III) Movement of Fire-Tenders

Paved road to be provided for movement of the fire-tenders. No material is allowed to be stored (no obstruction) on this paved road. SPCBs /PCCs to ensure this requirement, while issuing new CTE/CTO.

2.2 Carrying Capacity of the area for siting of ABAP type Tyre Pyrolysis Oil (TPO) Units

The committee constituted by the Hon'ble NGT in the is of the view that carrying capacity may not be required in case of individual Tyre Pyrolysis Units of capacity 10 - 60 TPD, since these are small pyrolytic operations with no process emissions and there are only flue gas emissions due to combustion of fuels for reactors or in flare stacks.

In order to minimize impact on adjacent areas, the minimum plot area as stipulated in section 2.1 is required by the unit.

2.3 Threshold Limits for Tyre Pyrolysis Oil (TPO) Units (New TPO Units and expansions in Existing TPO units)

The threshold limit is applicable to new /proposed units or expansion in the existing units. Followings are the threshold limits for the TPO units:

i) New ABAP type TPO units or expansion in existing units having cumulative batch capacity up to 60 TPD only shall be allowed.
ii) Beyond cumulative batch capacity of 60 TPD for new units or expansion in existing units, only continuous type TPO unit shall be allowed.

2.4 Standard Operating Procedure (SoP) of ABAP type TPO Units

A) Minimum Requirement for Environmentally Sound Operation:

2.4.1	Unit should have a valid Consent to Establish (CTE), Consent to Operate (CTO) under Water and Air Act and Authorization under the Hazardous and Other Waste (M & TM) Rules, 2016 issued by SPCB / PCC & Fire Safety Certificate issued by the concerned department.
2.4.2	Unit to comply with emission & effluents standards as prescribed by the concerned SPCBs/ PCCs in consent to operate (CTO) under Air and Water Act. Further the management of Hazardous waste generated has to be done as per the conditions prescribed in the authorization issued by the SPCBs / PCCs under the Hazardous and Other Waste (M & TM) Rules, 2016.
2.4.3	The feed to ABAP type reactor has to be in the form of used tyre scrap – whole tyres /cut tyres / chips / shred /mulch /granules etc.
2.4.4	Initial heating of the reactor has to be done either by using pyro gas stored during previous cycle or by use of pyro water / purge water (oil mix water) / oil water emulsion, or by tyre pyrolysis oil or any other fuel approved by concerned SPCBs /PCCs. After generation of pyro gas, the same is to be used for the purpose of heating reactor. The flue gas should be vented out to the environment through an alkaline scrubber with mist eliminator attached to a chimney of at least 30 meters height. Plants to install adequate air pollution control devices (APCDs) for controlling flue gas emissions.

2.4.5	A compressor / air blower has to be installed for mixing of air with pyro water for ensuring proper burning while using pyro water/purge water during initial heating.
2.4.6	In order to control fugitive emissions from the reactor shell during operation, its proper sealing should be ensured.
2.4.7	ABAP type TPO units to construct or install a sufficient capacity suction hood / industrial dust collector attached to a bag filter at feeding door and same should must be operational at the time of removal of steel scrap wire and char from the reactor.
2.4.8	Suction hoods also to be installed at all the transfer points across the work zone such as at char bagging area etc. to control fugitive emissions. All suction hood to be connected to a common manifold leading to alkaline scrubber with mist eliminator attached with stack of 30 m height (installed for venting out flue gas emissions).
2.4.9	Unit to ensure no spillage of char during removal/ unloading of steel scrap from the reactor. The flooring should be paved/ concretized along with proper slope and drains for movement of steel scrap. This operation to be made cleaner by use of vacuum cleaner after each batch operation.
2.4.10	Unit to install water sprinkling system for prevention of fugitive emission at the all transfer points for arresting fugitives.
2.4.11	The removal of char should be through a mechanized system. The unloading of char from the reactor is to be done under controlled conditions in such a manner that the material inside the reactor is not open to the atmosphere at any point of time. The char shall be bagged in the HDPE bags with proper sealing. It should be ensured that no spillage take place during the collection of the char in the bags. The removal of char should be started only after Nitrogen purging.
2.4.12	A permanent arrangement should be made for Nitrogen purging. Pre-filled nitrogen gas cylinders will not be allowed to use for purging. All units to have PLC based Nitrogen generator as per the following requirement:

Number of Reactors	Nitrogen Generator capacity (Nm^3/h)	Storage Tank Capacity (Liters)
1	3	1000
2	5	1500
3	7	2000
4	10	3000
> 4	12	4000

2.4.13	Excess pyro gas if any should be flared through properly designed flaring system of adequate capacity considering the emergency situation

	in which the entire gas may have to be flared. The flaring should be done at a minimum height of 30 meter.
2.4.14	Unit to install Programme Logic Controller (PLC) based system for control of temperature and pressure inside the reactor.
2.4.15	Unit to install Programme Logic Controller (PLC) based auto activation for stopping of gas supply to the burner and for switching off the burners in case of increase of pressure and temperature inside the reactor.
2.4.16	Unit to install PLC based auto activation of bypass arrangements for bypassing the pyro gas from reactor to first separator tank in case of blocking /chocking of outlet vent inside the reactor or direct bypass for flaring
2.4.17	Unit to install PLC based carbon monoxide (CO) gas sensors connected with sirens (hooters) in case of release of CO.
2.4.18	The collection of the oil from the condensers should be in closed vessel and storage also should be in closed metallic tanks. (Oil / Liquid is stored at atmospheric pressure in metallic tank. Since this is not pressureized tank, there is no need of vent. The presence of vent releases low molecular weight HC into the air and creates odour, which is objected by the neighbourhood.) There should be no manual handling of oil. Transfer of oil should be carried out through pumps.
2.4.19	Unit to connect first separator tank with the oil storage tank for storing heavy oil fraction. There should not be any release valve at the first separator tank.
2.4.20	At the end of the pyrolysis process the reactor has to be cooled before the removal of char. During cooling process, the reactor should be purged with Nitrogen gas.
2.4.21	The removal of char should be started after the reactor temperature comes down to below 50 °C or first separator tank temperature comes down to 40 °C.
2.4.22	The inside temperature of the reactor should not exceed 500 °C and the first separator tank temperature should not exceed 450 °C during the entire batch operation.
2.4.23	Waste water (Pyro water/Purge water/Oil mixed water/oil water emulsion) generated during the process should not be discharged anywhere and:

i)	Should be treated in suitable ETP of sufficient capacity. Oily sludge should be disposed through TSDF or can used to make char briquettes, for subsequent transfer /sale to the cement manufacturing plants or other such industries having authorization for co – processing or;

a. ETP discharge may be used for briquettes manufacturing. The briquettes so manufactured shall be disposed through processing in cement kiln

b. ETP sludge may be used for briquettes manufacturing. The briquettes so manufactured shall be disposed through processing in cement kiln.

ii)	Pyro water/Purge water /Oil mixed water/oil water emulsion may be used for briquettes manufacturing in a briquetting plant by mixing it with sawdust and char in suitable proportions. These briquettes so manufactured using the pyro water/purge water/oil mixed water/oil water emulsion and char are to be utilized only in processes where temperature is 1000 ^{0}C or more to avoid emissions of obnoxious gases; or
iii)	Pyro water/Purge water/ oil mix water/oil water emulsion should be used for Initial heating of the reactor.

2.4.24	Unit to ensure that treated water be re-used in unit itself & there is zero effluent discharge.
2.4.25	Unit to have a covered /closed separate storage tank for storage of pyro water /purge water /oil mix water/ oil water emulsion. The pyro water be transferred from final storage tank to pyro water / purge water / oil mix water / oil water emulsion storage tank in closed loop through pumps.
2.4.26	Unit should carry out stack and ambient air quality monitoring for SO_2, PM and CO at least once in six months from a recognized laboratory at identified monitoring location. The unit shall maintain a log book for recording the plant, operation, monitoring of the stack emissions and ambient air quality, generation & utilization of wastewater & sale of various products and by-products.
2.4.27	The transportation of Char should be done in bags (small or jumbo) in closed vehicles to ensure that there is no spillage of char during their transportation.
2.4.28	The transportation of Tyre Pyrolysis Oil (TPO) should strictly be done in closed tankers to ensure that there is no spillage of TPO during their transportation.
2.4.29	The char generated in the process shall be utilized either in co-processing in the cement industry or its quality be upgraded to Recovered Carbon Black (RCB). RCB may be used as raw material for manufacture of new tyre and other processes.
2.4.30	The Tyre Pyrolysis Oil and char shall be stored in areas separate / distinct from the processing area (shed where the reactors are installed). Tyres shall be stored in earmarked area / open area on a paved platform.

B. Safety Measure to be adopted

2.4.31	Automatic control systems such as Programmed Logic Control (PLC) shall be adopted for measurement and control of temperature and pressure along with safety inter-locks in case of increase of temperature or pressure to cut off heating of the reactor should be provided. It should be ensured that the reactor is under positive pressure at all the time.
2.4.32	A sensor for CO gas to be installed in the working area to ensure that concentration of CO in the working area does not exceed the prescribed limits for occupational safety and health as per Factory Act 1948. It will also be coupled with a warning /alarm system so that the plant operator can take adequate steps to rectify the situation.
2.4.33	Sensors along with alarm system should be provided at all the transfer points throughout the plant to detect any ieakage of flammable vapours from the system.
2.4.34	Fire detectors, sprinklers and fire hydrant with necessary pumping system and water storage should be provided in the process area, product and raw material storage area.
2.4.35	Unit to install fire hydrant system connected directly to the water tank and DG set for direct electric supply. Unit should also have ABC type fire extinguisher cylinders & fire buckets filled with sand and water.
2.4.36	The safety instruction for safe operation of plant will be displayed at the gate, plant working area and other critical places. Further, training will be imparted to the workers for safe operation of these plants.
2.4.37	On site emergency plan, as per the requirements under the Factories Act, 1948, will be made and implemented to handle any accident, fire/ leakage or any other emergency situation. All such measures shall include raw material storage, product storage and handling thereof.
2.4.38	The plant will be operated under the continuous supervision of a qualified person having experience of running such units.
2.4.39	All the persons /workers in the premises should wear an air filter mask to avoid inhaling of the fine char particles.
2.4.40	Unit will maintain good house-keeping and will ensure that no raw material products and wastes get spilled inside or outside the plant.
2.4.41	Unit to carry out annual health check-up of all the employees working in the unit & submit its report to concerned SPCBs/PCCs on annual basis.
2.4.42	Workers should be trained to handle fire. Workers should be given mock drill exercise for fire hazard incident. Assuming fire at the hatch door due to leakage of pyro-gas, what action, the workers should do? Training to use CO_2 type fire extingushers. Regular visit and inspection to check the training to workers.

2.5 Continuous Process (New & Existing):

A. Minimum Requirement for Environmentally Sound Operation:

2.5.1	Unit should have a valid Consent to Establish (CTE) and Consent to Operate (CTO) under Water and Air Act and Authorization under the Hazardous & Other Waste (M&TM) Rules, 2016 issued by SPCB /PCC & Fire Safety Certificate issued by the concerned department.
2.5.2	Unit to comply with emission & effluents standards as prescribed by the concerned SPCB/PCC in consent to operate (CTO) under Water and Air Act. Further the management of Hazardous Waste generated to be done as per the conditions prescribed in the authorization issued by the SPCB/PCC under the Hazardous Waste (M&TM) Rules, 2016.
2.5.3	The feeding system should be provided with an air-lock arrangement so that no air enters the reactor during feeding.
2.5.4	Initial heating of the reactor to be done either by using pyro gas stored during previous cycle itself or by use of purge water (oil mix water)/oil water emulsion, or by tyre pyrolysis oil or any other fuel approved by concerned SPCBs/PCCs. After generation of pyro gas, the same is to be used for the purpose of heating reactor. The flue gas should be vented out into the environment through alkaline scrubber with mist eliminator attached with a chimney of at least 30 meters height. Plants to install adequate air pollution control devices (APCDs) for controlling flue gas emissions.
2.5.5	A compressor or any other suitable arrangement has to be made /installed for mixing of air with pyro water for ensuring proper burning while using pyro water/purge water during initial heating.
2.5.6	In order to control fugitive emissions from the reactor during operation, proper sealing should be ensured.
2.5.7	Excess pyro gas if any should be flared through properly designed flaring system of adequate capacity considering the emergency situation in which the entire gas may have to be flared. The flaring should be done at a minimum height of 30 m.
2.5.8	The collection of the oil from the condensers should be in a closed vessel and storage also should be in closed tanks with suitable vents. There should be no manual handling of oil. Transfer of oil should be through pumps.
2.5.9	The removal of char should be through a mechanized system. The unloading of char from the reactor is to be done under controlled conditions through a pneumatic /screw conveyor system in such a manner that the contents of the reactor are not open to the atmosphere at any point of time. The end of the conveyor system shall be attached to a bagging plant where all the char will be bagged in the HDPE bags with proper sealing. It should be ensured that no spillage taken place during the collection of the char in the bags. Moreover, an air-lock should be provided to ensure no entry of air into the reactor.

2.5.10	Water sprinklers to be installed at the transfer points for arresting fugitives.
2.5.11	The char generated in the process shall be utilized either in co-processing in the cement industry or its quality be upgraded to Recovered Carbon Black (RCB). RCB may be used as raw material for manufacture of new tyre and other processes.
2.5.12	Waste water (Pyro water/Purge water/Oil mixed water/oil water emulsion) generated during the process should not be discharged anywhere and:

i)	Should be treated in suitable ETP of sufficient capacity. Oily sludge should be disposed through TSDF or can used to make char briquettes, for subsequent transfer /sale to the cement manufacturing plants or other such industries having authorization for co – processing or;

a. ETP discharge may be used for briquettes manufacturing. The briquettes so manufactured shall be disposed through processing in cement kiln
b. ETP sludge may be used for briquettes manufacturing. The briquettes so manufactured shall be disposed through processing in cement kiln.

ii)	Pyro water/Purge water /Oil mixed water/oil water emulsion may be used for briquettes manufacturing in a briquetting plant by mixing it with sawdust and char in suitable proportions. These briquettes so manufactured using the pyro water/purge water/oil mixed water/oil water emulsion and char are to be utilized only in processes where temperature is 1000 ^{0}C or more to avoid emissions of obnoxious gases; or
iii)	Pyro water/Purge water/ oil mix water/oil water emulsion should be used for Initial heating of the reactor.

2.5.13	TPO Units to ensure that treated water be re-used in the unit itself & there is zero effluent discharge.
2.5.14	The transportation of Char and Tyre Pyrolysis Oil (TPO) should strictly be done in closed vehicles to ensure that there is no spillage of char or oil during their transportation.
2.5.15	The generation, transportation and disposal of char to the cement manufacturing plants shall be recorded
2.5.16	The Tyre Pyrolysis Oil (Product) and char shall be stored in areas separate / distinct from the processing area (shed where the reactors are installed). Tyres shall be stored in earmarked sheds/open area on a raised cement concrete platform.

2.5.17	The unit should carry out stack and ambient air quality monitoring for SO2, PM, and CO at least once in six months from a recognized laboratory at identified monitoring location. The unit will maintain a log book for recording the plant operation, monitoring of the stack emissions and ambient air quality, generation & utilization of wastewater & sale of products and wastes.

B. Safety Measure to be adopted

2.5.18	Automatic control systems such as Programmed Logic Control (PLC) shall be adopted for measurement and control of temperature and pressure along with safety interlocks in case of increase of temperature or pressure to cut off heating of the reactor should be provide.
2.5.19	A sensor for CO gas to be installed in the working area to ensure that concentration of CO in the working area does not exceed the prescribed limits for occupational safety and health as per Factory Act 1948. It will also be coupled with a warning/alarm system so that the plant operator can take adequate steps to rectify the situation.
2.5.20	Sensors along with alarm system should be provided at all the transfer points throughout the plant to detect any leakage of flammable vapors from the system.
2.5.21	Excess pyro gas if any should be flared through properly designed flaring system of adequate capacity considering the emergency situation in which the entire gas may have to be flared. The flaring should be done at a minimum height of 30 meters.
2.5.22	Fire detectors, sprinklers and fire hydrant with necessary pumping system and water storage should be provided in the process area, product and raw material storage area.
2.5.23	The TPO unit shall possess fire clearance certificates issued by concerned departments.
2.5.24	The safety instruction for safe operation of plant will be displayed at the gate, plant working area and other critical places. Further, training will be imparted to the workers for safe operation of these plants. On site emergency plan, as per the requirements under the Factories Act, 1948, will be made and implemented to handle any accident, fire/ leakage or any other emergency situation. All such measures shall include raw material storage, product storage and handling thereof.
2.5.25	The plant will be operated under the continuous supervision of a qualified person having experience of running such units. All the persons/workers in the premises should wear an air filter mask to avoid inhaling of the fine char particles.
2.5.26	Units will maintain good house-keeping and will ensure that no raw material products and wastes get spilled inside or outside the plant.

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2.5.27	Units tc carry out annual health check-up of all the employees working in the unit & submit its report to concerned SPCBs /PCCs on annual basis.
2.5.28	Units operators shall have insurance cover for workers, plant & machinery and materials.
2.5.29	Workers should be given mock drill exercise for fire hazard incident.

C. General conditions applicable to all plants (Batch & Continuous):

2.5.30	The Tyre Pyrolysis Units (Continuous and Advanced Batch Automated Pyrolysis) are categorized into Orange category. Unit to register on the Waste Tyre EPR Portal of CPCB.
2.5.31	The Tyre Pyrolysis Oil unit to fulfill fuel quality as specified by Ministry of Petroleum and Natural Gas / Bureau of Indian Standards as and when the same gets notified.
2.5.32	In line with the policy adopted by MoEF&CC, Unit shall not to import waste tyres for the purpose of TPO production. Unit to use only indigenous generated waste tyre (i.e. Waste tyre generated in India only). Also unit to sell its products to Actual Users only.
2.5.33	Unit to maintain record on consumption of waste tyre along with details of its procurement source, Details & quantity of products, details of actual users to whom products have been sold.
2.5.34	Unit to submit its annual report on the EPR Portal and also to the concerned SPCB providing details on annual production of TPO, Char, Steel & other products including details of sources of purchasing waste tyre and also details of actual users to whom products have been sold within the time frame as prescribed on the Portal. The annual report to be supported with electricity bills of the financial year for which annual return has been submitted.
2.5.35	Units have to report daily waste generation, disposal data on National Hazardous Waste Tracking system as and when such system gets implemented by CPCB.

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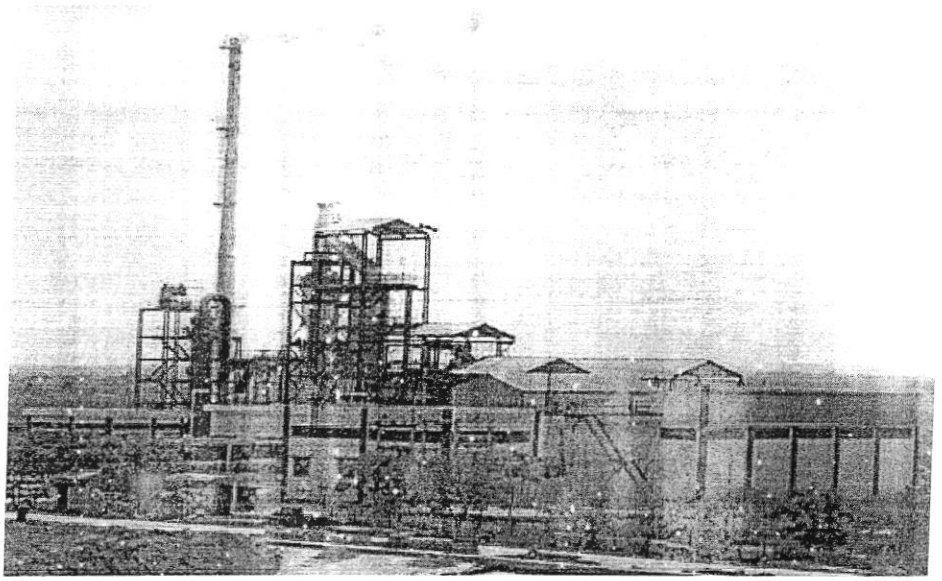
Hazardous Waste Management Series
HAZWAMS/30/2005-06

GUIDELINES
FOR
COMMON HAZARDOUS WASTE INCINERATION



Central Pollution Control Board
Ministry of Environment & Forests
e.mail: cpcb@alpha.nic.in Website: www.cpcb.nic.in

June, 2005

Dr. V. Rajagopalan
Chairman

Foreword

Hazardous wastes generated by the industries are required to be managed as per the Hazardous Waste (Management & Handling) Rules, 1989, as amended. About 4.4% of hazardous waste generated in the country is of the nature, which has to be incinerated. Besides, segregated organic residues, highly concentrated effluents such as mother liquors and toxic effluents not feasible for physico-chemical, biological treatment also require proper disposal through incineration.

Hierarchy of options in hazardous waste management, in sequence, is to switchover to cleaner technologies, cleaner production options and exploring the potential for re-using, recycling, recovering, renovation before sending to incineration and secured land filling.

Common incineration facilities are now in operation in the country. Incineration of hazardous waste from many industries is a task that requires comprehensive knowledge & skill in respect of chemistry, thermal engineering and environmental engineering. Therefore, the Central Pollution Control Board studied the common incineration facilities and formulated guidelines for proper design, operation and to meet the standards. While framing the guidelines, CPCB considered the preliminary draft prepared by the Committee constituted by the Chairman, CPCB, technology & operation of indigenous incineration facilities and experiences of European incineration facilities. I take this opportunity to register the sincere efforts made by Er. N.K. Verma and Er. N. Sateesh Babu in bringing out the guidelines with the association of GTZ-ASEM experts, in particular, Prof. Thomas Kolb, Karlsruhe University, Germany.

I understand this publication will be highly useful for the existing common incineration facilities, for those planning to set-up new facilities, regulatory officers and all others concerned to the pollution control and hazardous waste management in the country.

(V. Rajagopalan)

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1.0 PREAMBLE

Thermal oxidation through incinerator is one of the proven technologies for destruction of hazardous waste in all the forms i.e. solid / semi solid / liquid and gaseous, based on the feeding system, so as to render them innocuous in the form of non-toxic and non-hazardous residues. Though it is a solution for destruction of complex hazardous waste, requires knowledge to judge the compatibility of various wastes for the purpose of homogenization of feeding waste, to operate and maintain thermal processes, pollution control devices, which demands skill & experience, in order to comply with the environmental regulations for common hazardous waste incineration facilities (**ANNEXURE - I**).

The Common incineration facilities are, in principle, expected to handle the hazardous waste in solid and liquid forms having high degree of variation in respect of characteristics due to different nature of member industries, which will have direct bearing on efficiency of combustion system and pollution control devices. Therefore, experience in other parts of the world, particularly in case of handling hazardous waste in solid form, drive us to adopt rotary kilns followed by secondary combustion chambers as a set-up for combustion part of the incineration system, unless other combinations demonstrate equally in delivering required efficiency. As such, in India, existing three common incineration facilities do have the same combination; therefore the guidelines presented in this document cover such set-up.

2.0 COMMON INCINERATION FACILITIES

Common hazardous waste incineration facilities are those facilities, which handle hazardous waste from more than one industry either installed as an integral part or located elsewhere.

Various concerned components of common incineration facility include proper transportation, storage, analytical laboratory facilities, feeding mechanism, incineration system (rotary kiln & post combustion chamber), gas cleaning system, tail gas monitoring facilities with automatic on-line monitoring & control facilities, ash/slag management, bleed/scrubber liquor management and measures for health protection of workers. Guidelines for maintaining each of these components in order to comply with the prescribed standards are given in the subsequent chapters.

3.0 TRANSPORTATION OF HAZARDOUS WASTE

All the provisions corresponding to transportation of hazardous wastes under various Acts including the Hazardous Wastes (Management & Handling) Rules & subsequent amendments and Motor Vehicle Act, shall be duly complied with, in all respects (coding, containers, manifest system *etc.*). Guidelines for transportation of hazardous waste include, but not limited, to the following:

Generators responsibilities:

a. Generator of the hazardous waste shall ensure that wastes are packaged in a manner suitable for safe handling, storage and transportation. Labeling on packaging is readily visible and material used for packaging shall withstand physical and climatic conditions.

b. Generator shall ensure that information regarding characteristics of wastes particularly in terms of being Corrosive, Reactive, Ignitable or Toxic is provided on the label.

c. All hazardous waste containers shall be provided with a general label as given in Form 8 in Hazardous Waste (Management & Handling) Rules, 1989, as amended.

d. Transporter shall not accept hazardous wastes from an occupier (generator) unless six-copy (with colour codes) of the manifest (Form 9) is provided by the generator. The transporter shall give a copy of the manifest signed and dated to the generator and retain the remaining four copies to be used for further necessary action prescribed in the Hazardous Wastes (Management & Handling) Rules, 1989, as under:

Copy 1	(White)	Forwarded to the Pollution Control Board by the occupier
Copy 2	(Light Yellow)	Signed by the transporter and retained by the occupier
Copy 3	(Pink)	Retained by the operator of a facility
Copy 4	(Orange)	Returned to the transporter by the operator of facility after accepting waste
Copy 5	(Green)	Forward to Pollution Control Board by the operator of facility after disposal.
Copy 6	(Blue)	Returned to the occupier by the operator of the facility after disposal.

e. Generator shall provide the transporter with relevant information in Form 10 i.e. Transport Emergency (TREM) Card regarding the hazardous nature of the waste and measures to be taken in case of an emergency.

Transporters responsibilities:

a. Obtaining permission from SPCB for transport of hazardous waste [in addition to any other permissions that may be required under the Motor Vehicles (Amendment) Act of 1988].
b. The transport vehicles shall be designed suitably to handle and transport the hazardous wastes of various characteristics.

c. Maintaining the manifest system as required.

d. Transporting the wastes in closed containers at all times

e. Delivering the wastes at designated points

f. Informing SPCB and other regulatory authorities immediately in case of spillage, leakage or other accidents during transportation

g. Cleanup in case of contam nation.

4.0 STORAGE OF HAZARDOUS WASTE

a. Separate area should be earmarked for storing the waste and storage area may consist of different cells for storing different kinds of hazardous wastes.

b. Ignitable, reactive and non-compatible wastes shall be stored separately.

c. Adequate storage capacity shall be provided in the premises

d. No open storage is permissible and the designated hazardous waste storage area shall have proper enclosures, including safety requirements.

e. In order to have appropriate measures to prevent percolation of spills, leaks etc. to the soil and ground water, the storage area may be provided with concrete pavement and / or welded iron sheet depending on the characteristics of the waste handled.

f. Storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.

g. Proper stacking of drums with wooden frames shall be practised.

h. Incase of spills / leaks, cotton shall be used for cleaning instead of water.

i. Signboards showing precautionary measures to be taken, in case of normal and emergency situations shall be displayed at appropriate locations.

j. To the extent possible, manual operations with in storage area are to be avoided. Incase of personnel use, proper precautions need to be taken, particularly during loading / unloading of liquid hazardous. Waste in drums

k. A system for inspection of storage area to check the conditions of the containers, spillages, leakages etc. shall be established and proper records shall be maintained.

5.0 ANALYTICAL LABORATORY FACILITIES

a. Generators sending hazardous waste to the incineration facility are required to provide necessary test report of hazardous waste to the operator along with the information on the process(s) of its generation.

b. The tests to be conducted at incineration facility shall be with an objective to study i) Storage & feeding requirements; ii) operating conditions of the furnaces; iii) Feed concentration within the efficiency levels of air pollution control devices to comply with flue gas standards. The activity specific relevant parameters are indicated below:

- **Storage & feeding requirements:** Physical form of waste, pH, hazardous waste properties such as inflammability, reactivity, compatibility with other wastes *etc.* for segregating the waste and to store accordingly, in order to suit feeding mechanism.

- **Operating conditions of the furnaces:** viscosity, moisture content, total organic carbon, calorific value, volatility of the waste, special incompatible wastes, inorganic salts, metals etc.

- **Air pollution control devices**: chlorides & other halogens, sulphur, nitrates, mercury & other heavy metals etc.

Therefore, relevant parameters may be analyzed while accepting the waste.

c. The laboratory facilities shall give clear directions to the operators, two days in advance as far as possible, regarding type of waste to be incinerated in a particular date and its properties.

d. Therefore, the laboratory at the incineration facilities shall be capable of monitoring all the above parameters.

6.0 WASTE FEEDING MECHANISMS

a. Maintaining designed heat capacity of the combustion chambers under varying feed calorific values demands skill. In absence of proper hands on training and adequate knowledge, the minimum negative pressure could not be maintained at all the times leading to diffused emissions / sudden puffing of emissions into the secondary combustion chambers constraining the retention time resulting in poor efficiency. Besides, these temperature fluctuations will have negative bearing on refractory and insulation material.

b. Therefore, continuous feeding of homogeneous waste having same / similar calorific value to the combustion chambers is the desired choice. However, often maintaining homogeneous feed of waste is not feasible due to incompatibility of different wastes for mixing.

Conventionally, hazardous wastes in solid form are fed through a hydraulic system, which will have automatic two gates i.e. once the outside plate is closed, inner side plate is opened and solid waste mass is hydraulically pushed inside the Kiln and once the inner side plate is closed, outer plate is opened for next batch of solid waste. This system, besides negative pressure in the combustion chambers is required to ensure safety and to prevent workmen exposure to thermal radiation.

c. Thus, waste-feeding mechanism plays an important role to achieve desired combustion efficiencies. For example, the variety of wastes received from the member Industries can be classified into following for better control of combustion:

Waste in solid form

Property	Options
High calorific value containing waste (organic residues)	Quantity of solid mass feeding may be reduced in each charging to contain temperature shoot-ups. Besides, following are used in specific cases: Low calorific value liquid waste may be parallelly injected; and/or Steam may be parallelly injected
Reactive waste, which can not be mixed with others	Sealed drums, as such, may be charged into the kilns. Depending on calorific value, size of the drum / container may be specified to the member industry for such waste.
Other mixable solid waste having moderate calorific value	May be homogenized to the extent possible and charged to the kilns at desired quantity of packets and frequency.
Specific materials which melts on heating	Here the possibility would be to ask the member industry to store in required capacity of the container, which can be directly injected with out heating; or to provide a system by which such drums can be heated-up and can be charged through closed-loop pressurized nitrogen.

Waste in semi solid form

Property	Options
Very high solids concentration	Fully shelled (to prevent diffused emissions) screw pumps may be a choice
Relatively low conc. of solids / low viscosity	Pumps similar to the one used for cement concrete charging may be used.

Waste in semi solid form

Property	Options
Highly reactive / inflammable liquids	May be directly injected into combustion chambers without mixing with other wastes. The charging from the containers may be through closed loop nitrogen pressure purging.
Liquids having high calorific value (ex. contaminated solvents)	Can replace auxiliary fuel requirement, once the combustion chambers reaches to its designed temperatures.
Liquids having properties similar to that of auxiliary fuel	Once it is established, these liquids can be used for raising the initial temperature of the combustion chambers. However, specific tests in support of such claims be produced by a recognized credible third party.
Liquids having low calorific values	These may be injected in to kilns to suppress the temperature shoot-ups due to high calorific solid/ other special liquid waste feeds.

d. Depending on type of wastes received, the scheme shall be established by the common incineration facility and the member industry shall place the corresponding code number/ sticker and it is to be verified by analytical laboratory of common incineration facility to ensure appropriate feeding by operator of the facility.

e. While charging the liquid hazardous waste, filtering the liquids may be required to avoid chocking of pumps.

f. Non-easily pumpable wastes (ex. High viscous, having high solids content etc.) may require pressurized nitrogen purging for charging the liquid to the combustion chambers.

g. Incase of emptying liquid waste containing drums by inserting suction pumps & induced draft (hoods and ducts), set-up above such drum emptying area for collection of volatile organic compounds (VOCs) must be ensured. These collected diffused emissions must be controlled / routed to the combustion chambers.

h. Feeding pipeline and equipment are to be cleaned before a new type of waste is fed to the combustion system to avoid undesired reactions.

7.0 COMBUSTION CHAMBERS (Rotary Kiln and Secondary Combustion Chamber)

a. Incineration plants shall be designed, equipped, built and operated in such a way that the gas resulting from the process is raised, after the last injection of combustion air, in a controlled and homogenous fashion.

b. Incineration plant shall be equipped with at least one auxiliary burner. This burner must be switched on automatically with the temperature of the combustion gases after the last injection of combustion air falls below specified temperature. It shall also be used during plant start-up and shut-down operations in order to ensure that the minimum specified temperature is maintained at all times during these operations and as long as unburnt waste is in the combustion chamber.

c. During the start-up and shut-down or when the temperature of the combustion gas falls below specified minimum temperature, the auxiliary burner shall not be fed with fuels, which can cause higher emissions than those resulting from burning of gas oil /liquefied gas / natural gas.

d. The burners may be pressure-atomized type with approved certification from the Bureau of Indian Standards or equivalent.

e. In case of low calorific value liquid fuels are proposed to be injected into kiln, then double fuel injection burners may carry auxiliary fuel or equivalent liquid waste in one injection tube and low calorific value waste feed in other.

f. Kiln and secondary combustion chamber of the incinerator may be made of mild steel conforming to IS: 2062 and of suitable thickness lined with high-grade refractory and insulation, so as not to buckle in or bulge out.

g. Combustion chambers (Kiln & secondary combustion chamber) shall be supplied with excessive air to ensure complete burning of wastes. The blower shall have the capability to provide appropriate supply of combustion air.

h. An inventory of fuel oil for 5days continuous operation of the incineration facility may be kept in reserve.

i. Incinerator facility shall have a window fitted with safety view glass to view the kiln (axially) and flame in secondary combustion chambers.

j. As the common incineration systems will be handling wastes having varying heat value, and while ensuring TOC and LOI requirements in the ash/slag, there are possibilities for sudden rise of temperatures in the kiln. Therefore, the facilities may like to have thermal refractory bricks and insulation capable of withstanding a minimum temperature of 1,300°C (typically, corundum / chromium bricks).

k. Needful safety arrangement must be provided in case of high-pressure development in the furnace.

l. Interlocking arrangements for CO and temperature controls (in primary and secondary chamber) with feeding devices shall also be provided.

m. All the burners are to be equipped with flame control system (if no flame is detected, fuel injection has to be stopped, automatically – use of fast-stop-va ve).

n. Whenever the pressure in the combustion chambers becomes positive, immediately the feeding of waste shall be stopped and needful measures be taken to restore negative pressure.

o. Exit doors shall be provided at suitable place, one each on the primary kiln and the secondary chamber of the incinerator for ease in inspection and maintenance.

7.1 Rotary Kiln

a. To maintain designed heat capacity of the kiln, quantity of the solid waste injection package (kg/single injection) shall be adjusted w.r.t. calorific value of the waste feed.

b. When a high calorific value possessing solid waste is injected in packets, the size of each injection may be reduced, such that the peak CO concentration in the Kiln does not exceed too high in the initial stage, creating shooting of emissions to the secondary chamber, thereby crisis in ensuring the required retention time.

c. Appropriate slope (in general, 3 degrees), rotation rates (around 10/hr) and solid waste residence time (1-10 hrs) may be adjusted for the kilns, in order to achieve total organic carbon (TOC) and loss on ignition (LOI) requirements in the ash/slag.

d. To ensure life of refractory and insulation bricks, it is a practice to feed silica and glass in appropriate ratios to the kilns to form a cover over the refractory lining, as and when the thickness of the layer reduces.

e. It has been reported that reduction of out-side surface temperature of the rotary kiln enhances the life of refractory bricks and lining. Thus may be explored, where feasible.

f. In the rotary kiln, the temperature shall be maintained at 800+°C in order to ensure complete burning of solid waste. Controlled flow of air shall be maintained for complete volatilization of solid waste.

7.2 Secondary Combustion Chamber

a. Minimum temperature requirement In the secondary combustion chamber is 1100°C. This may be ensured by averaging the temperature measurement of three detectors (not exactly positioned in the burner flame) at the same time with in the combustion chamber.

b. The design and operating conditions shall demonstrate a minimum of 2 seconds residence time in the secondary combustion chambers, under critical feed conditions, so as to bring complete combustion of volatile matter evolved from the primary combustion chamber.

c. Incase, the consistent compliance with standards based on continuous monitoring results over a period of two weeks, under critical feed conditions, is successfully demonstrated. then State Pollution Control Board / Pollution Control Committee, can recommend the proposal made by the incineration facility for relaxation in temperature and residence time, but in any case not less than 950 °C and 1.5 seconds, for the consideration and approval of the Central Board.

8.0 POLLUTION CONTROL DEVICES

a. Pollution control devices are required to comply with prescribed standards for particulate matter, HCl, SO_2, CO, Total Organic Carbon, HF, NO_x (NO and NO_2 expressed as NO_2), Hydrocarbons, Dioxins/Furans, Cd +Th (and its compounds), Hg (and its compounds), Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V (and their compounds). Besides above, the State Board / Pollution Control Committee can prescribe additional parameters, as deem fit, in consultation with the Central Pollution Control Board.

b. Incineration facility shall explore, to the extent possible, for heat recovery.

c. There are many combinations of treatment units installed for gas cleaning and removal of air pollutants, to comply with the standards. Designed treatment scheme shall comprise of following equipment, in combination, with adequate efficiencies to meet the emission standards:

Dioxins: Keeping De-novo synthesis in the backdrop, steps must be taken to prevent reformation of dioxins by rapidly lowering the flue

gas temperatures, particularly from 500°C to less than 200°C by adopting rapid quench / catalyst / adsorption by activated carbon etc.

Particulate matter: Fine particulates in the flue gases requires specific dust separation technologies such as bag filters, electro static precipitator etc. in order to meet flue gas standard. In case of electro static precipitators, special care is required to avoid electric sparks due to the dust to avoid reformation of dioxins and adsorption to the fine dust.

Mercury: If the feeding waste contains mercury and its compounds, there is an every chance of these emissions to get air borne. Therefore, requires specific treatment for control of these emissions. (Ex. activated carbon, conversion into mercuric chloride and then to mercuric sulphide etc.)

SO_2: Sulphur in the feeding waste upon thermal oxidation forms sulphur dioxide, which requires control measures to meet the standard. Conventional method followed is scrubbing by alkali (alkali dry / wet scrubber with hydrated lime or sodium hydroxide injection)

HCl & HF: In order to control halogen emissions to the desired level, in particular chlorides and fluorides, conventionally water/alkali scrubbers are in use.

Mist: Often there is a need to eliminate the mist in the stack emissions, therefore, where necessary de-mister may be provided.

Stack height:

- Stack height shall not be less than 30 meters, in any case.
- Stack height requirement based on sulphur dioxide emissions by using the equation - stack height = 14 $(Q)^{0.3}$ [where, Q is the emission rate of SO_2 in kg/hr]
- By using simple Gaussian plume model to maintain ambient air quality requirements for all concerned parameters, in the receiving environment.

The required stack height shall be the maximum of the above three considerations.

9.0 MONITORING AND ON-LINE DISPLAY REQUIREMENTS

a. Sampling platform shall be provided as per CPCB norms to collect stack samples from the chimney for monitoring the air pollutants, as and when required. Holes need to be provided on chimney as per standard CPCB norms, following diametric calculations.

b. Frequency of monitoring for various parameters is given below:

S.No.	Parameter	Location	Frequency
1	Temperature	Secondary combustion chamber, stack emissions	Continuous monitoring
2	Carbon monoxide	Stack emissions	Continuous
3	Excess oxygen	Secondary combustion chamber, stack emissions	Continuous
4	Pressure	Combustion chambers	Continuous
5	Total particulate matter	Stack emissions	Continuous
6	HCl	Stack emissions	Continuous
7	HF	Stack emissions	Once in every month, initially for first year. If the correlation with HCL scrubbing efficiency is established, the frequency may be relaxed by the State Boards/ Pollution Control Committees appropriately
8	SO_2	Stack emissions	Continuous
9	NOx	Stack emissions	Continuous
10	TOC	Stack emissions	Continuous
		Residues from the combustion processes (slag / ash)	Once in every week (pooled sample), initially for first year. If there is consistency in meeting the standard, may be relaxed to once in a month (pooled sample)
11	Loss on ignition (LOI)	Residues from the combustion processes (slag/ash)	-do-
12	Mercury	Stack emissions	Twice a year, under critical operating conditions
13	Heavy metals	Stack emissions,	Twice a year, under critical operating conditions
14	Dioxins and furans	Stack emissions, ash/dust, scrubber liquors, quench liquor	Twice a year under critical operating conditions

c. Access shall be provided, online, to see the continuous monitoring data by the local regulatory Board/ Committee and annual environmental report giving complete details of operation &

compliance with regulatory requirements need to be published and made available to the public.

d. Formula to calculate the emission concentration at standard percentage of oxygen concentration

$$Es = \frac{(21 - Os)\ (Em)}{(21 - Om)}$$

Where,
Es = Calculated emission conc. at the std. Percentage oxygen concentration
Em = Measured emission concentration
Os = Standard oxygen concentration
Om = Measured oxygen concentration

The above correction to the measured concentrations is to be done only when the measured % oxygen conc. is higher than the standard % oxygen conc. (i.e. 11%)

e. Dibenzo-p-dioxins and dibenzofurans: Analysis of dioxins and furans as well as reference measurement methods to calibrate automated measurement systems shall be carried out as given by CEN-standards. If CEN-standards are not available, ISO standards, National or International Standards, which will ensure the provision of data of an equivalent scientific quality, shall apply.

The total concentration of dioxins and furans is to be calculated by multiplying mass concentrations of following Dibenzo-p-dioxins and dibenzofurans with their toxic equivalence factors, before summing:

Name of congener		Toxic equivalence factor
2,3,7,8	Tetrachlorodibenzodioxin	1.0
1,2,3,7,8	Pentachlorodibenzodioxin	0.5
1,2,3,4,7,8	Hexachlorodibenzodioxin	0.1
1,2,3,6,7,8	Hexachlorodibenzodioxin	0.1
1,2,3,7,8,9	Hexachlorodibenzodioxin	0.1
1,2,3,4,6,7,8	Heptachlorodibenzodioxin	0.01
	Octachlorodibenzodioxin	0.001
2,3,7,8	Tetrachlorodibenzofuran	0.1
2,3,4,7,8	Pentachlorodibenzofuran	0.5
1,2,3,7,8	Pentachlorodibenzofuran	0.05
1,2,3,4,7,8	Hexachlorodibenzofuran	0.1
1,2,3,6,7,8	Hexachlorodibenzofuran	0.1
1,2,3,7,8,9	Hexachlorodibenzofuran	0.1
2,3,4,6,7,8	Hexachlorodibenzofuran	0.1

1,2,3,4,6,7,8	Heptachlorodibenzofuran	0.01
1,2,3,4,7,8,9	Heptachlorodibenzofuran	0.01
	Octachlorodibenzofuran	0.001

10.0 ASH / SLAG MANAGEMENT

a. Water locking arrangement shall be provided for removal of ash/slag from the combustion chambers.

b. Where appropriate, options may be explored for recycling of ash/slag either with in the facility or outside. Depending on the soluble fraction of the slag, as approved by concerned authority, slag can be used for utilization of metals, as road construction material etc.

c. Dry slag and ash (residues from combustion processes, boiler dust, residues from treatment of combustion gases etc.) shall be placed in closed bags, containers etc. to prevent diffused emissions

11.0 QUENCH / SCRUBBER LIQUOR MANAGEMENT

a. Appropriate treatment to the wastewaters from the cleaning of exhaust gases be provided.

b. The treated wastewater shall conform to the disposal specific effluent standards.

c. If forced evaporation is considered as a treatment option for quench/ scrubber liquor, the organic emissions, if any, shall be collected and returned to incinerator.

d. Re-feeding of these liquors into the system may enhance the concentration levels therefore, adequate sink capacity shall be ensured.

12.0 ORGANISATIONAL STRUCTURE

The Chief executive Officer of the facility is responsible for all the activities at the incineration facility. He can establish an appropriate organizational structure and suitably allocate the responsibilities. This organizational structure shall be made available on-site to regulatory officials. A typical organizational structure for reference is shown in Figure-I.

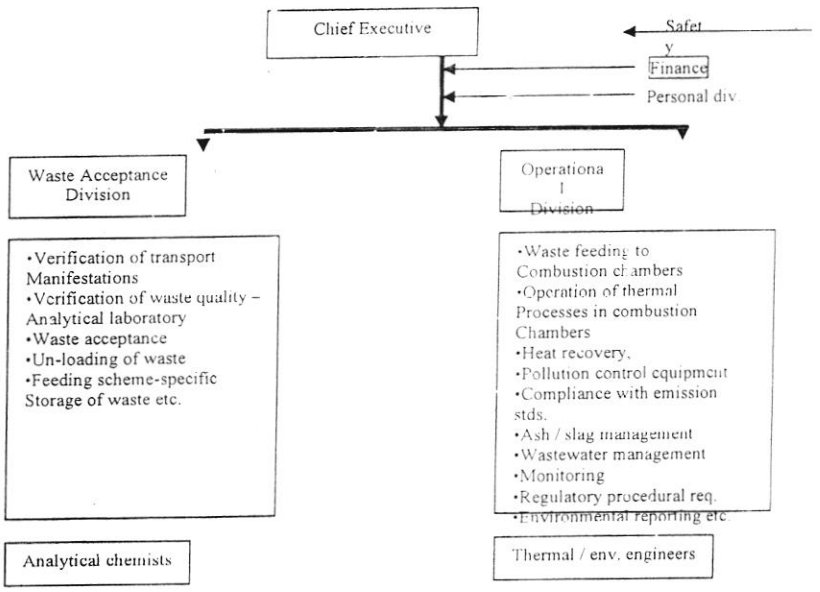

Figure 1: A Typical Organizational Structure

13.0 OTHER REQUIREMENTS

a. Proper sign boards shall be placed at all concerned areas

b. Incase of emergency, protocol to be followed shall be established and all operating staff shall be trained, accordingly. Inter-locking systems and alarm systems shall be provided at all reasonably possible areas

c. Abnormal operations and emergency situations should immediately be brought into the notice of the local regulatory Board / Committee.

d. While handling odourous wastes, care shall be taken (sealed containers, vapour balancing, nitrogen blanketing etc.) to avoid smell nuisance.

e. Efforts must be made to provide diffused emissions collection and control / routing to combustion chambers

f. Medical camps/ health check-ups of all the workmen of the incineration facility shall be conducted quarterly by registered medical practitioners.

g. Adequately qualified and trained staff shall be deputed for the operations, being sensitive in nature. No adhoc appointments be made or no un-skilled personnel shall be engaged for operation of the incinerators. All the personnel involved in handling of hazardous waste and incineration shall be on pay roll.

h. The incinerator shall incorporate all safety measures so as to provide complete protection to the operator and the unit against all possible operational/machinery failures.

i. Dedicated back-up power facility shall be provided with arrangement to automatically start functioning immediately, incase of power failures.

j. The whole equipment, not necessarily kiln, may be painted with two coats of heat resistant (aluminium) paint.

ANNEXURE - I

EMISSION STANDARDS FOR COMMON HAZARDOUS WASTE INCINERATORS

A. Flue Gas Emission Standards

Treated flue gas emissions discharge through stack to atmosphere shall always be less than or equal to the following parameter-specific emission standards:

Parameter	Emission standard	
Particulates	50 mg/Nm^3	Standard refers to half hourly average value
HCl	50 mg/Nm^3	Standard refers to half hourly average value
SO_2	200 mg/Nm^3	Standard refers to half hourly average value
CO	100 mg/Nm^3	Standard refers to half hourly average value
	50 mg/Nm3	Standard refers to daily average value
Total Organic Carbon	20 mg/Nm^3	Standard refers to half hourly average value
HF	4 mg/Nm^3	Standard refers to half hourly average value
NO_x (NO and NO_2 expressed as NO_2)	400 mg/Nm^3	Standard refers to half hourly average value
Total dioxins and furans	0.1 ng TEQ/Nm^3	Standard refers to 6-8 hours sampling. Please refer guidelines for 17 concerned congeners for toxic equivalence values to arrive at total toxic equivalence.
Cd + Th + their compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Hg and its compounds	0.05 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.
Sb + As + Pb + Cr + Co + Cu + Mn + Ni + V + their compounds	0.5 mg/Nm^3	Standard refers to sampling time anywhere between 30 minutes and 8 hours.

Note: All values corrected to 11% oxygen on a dry basis.

B. Operating Standards:

I. All the facilities shall be designed to achieve a minimum temperature of 1100°C in secondary combustion chamber and with a gas residence time in secondary combustion chamber not less than 2 (two) seconds.

II. The incineration facilities after initial operation of minimum one year, as per the guidelines and standards, can submit a proposal for relaxation in temperature and retention time requirement if it can be demonstrated that the flue gas standards and operation standards can be complied with at lower temperatures and residence times. The State Pollution Control Board / Pollution Control Committee, upon successful demonstration of compliance with flue gas standards by the facility, can recommend the proposal made by the incineration facility for relaxation in temperature and residence time, but in any case not less than 950 °C and 1.5 seconds, for the consideration and approval of the Central Board.

III. Incineration plants shall be operated (combustion chambers) with such temperature, retention time and turbulence, so as to achieve Total Organic Carbon (TOC) content in the slag and bottom ashes less than 3%, or their loss on ignition is less than 5% of the dry weight of the material.

IV. Guidelines published by the Central Board from time to time for common incineration facilities shall be referred for implementation.

V. All the project proposals submitted for establishment of the common incineration facilities shall be examined and cleared by the Task Force constituted by the Central Board.

VI. Notification of compliance: The operator of the incinerator shall undertake comprehensive performance test. Within 90 days of completion of comprehensive performance test, the operator shall issue a notification of compliance documenting compliance or non-compliance, as the case may be, for public information / notice.

Central Pollution Control Board
PARIVESH BHAWAN
East Arjun Nagar, Delhi – 110 032

No. B- 33014/7/IPC-II/2017-18/ July 07, 2017

OFFICE MEMORANDUM

Draft Guidelines for Pre-processing / Co-processing of Hazardous and Other Wastes had been prepared in Feb. 2017 and circulated among the SPCBs / PCCs and other Stake-holders for information/comments. Suggestions were received and have been incorporated wherever feasible. Accordingly, Final Guidelines have been prepared and are enclosed herewith for reference and further necessary action in the matter as deemed fit at the level of industries generating such wastes , SPCBs / PCCs , Pre-processors, Co-processors, TSDF and others concerned.

Reference of the Hazardous and Other Wastes (Management & Trans-boundary Movement) Rules, 2016 shall also be taken wherever necessary.

This is issued with the approval of the Competent Authority, Central Pollution Control Board.

[N.K. Gupta]
Divisional Head – IPC-II

Distribution :

- ✓ All the SPCBs / PCCs
- ✓ Cement Manufacturers Association, Noida [U.P.]
- ✓ Confederation of Indian Industries, New Delhi
- ✓ TSDFs

Guidelines for Pre-Processing and Co-Processing of Hazardous and Other Wastes in Cement Plant as per H&OW(M & TBM) Rules, 2016

cpcb

July, 2017

Central Pollution Control Board

(Ministry of Environment, Forest & Climate Change, Government of India)

Parivesh Bhawan, East Arjun Nagar,

Shahdara, Delhi – 110032

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1.0 Background:

The rules notified in the year 2016 on management of Hazardous and Other Wastes, outlines the hierarchy of wastes management, wherein, prevention, minimization, reuse, recycling, recovery, utilisation including pre-processing and co-processing was envisaged prior to considering the option of disposal through incineration or secured landfilling.

Substantial factions of the industrial, commercial, domestic and other wastes contain materials that have the potential for use as an alternative raw material or as a supplementary fuel for energy recovery. The current waste generation scenario in India is as follows.

- About 7.4 Million tonnes of hazardous wastes is annually generated in India, out of which around 3.98 Million tonnes is recyclable and can be used for resource or energy recovery.
- About 65 Million TPA of MSW is generated in the country which contains about 15-20 % of non-recyclable Segregated Combustible Fraction (SCF) which can be utilized for energy recovery.
- About 200 million tonnes of non-hazardous wastes of industrial origin also gets generated in the country such as fly-ash, pyro-metallurgical slags, sludge from WTPs, dried sewage sludge, Plastic & other packaging materials, date expired and off-specification FMCGs materials and food & kindred products, used pneumatic tyres, etc. having potential for resource or energy recovery.
- Large quantity of agro-wastes that do not have potential to be used as cattle feed etc.

Environmentally sound utilization of wastes for resource or energy recovery can be practiced in various industrial processes. However, utilization by co-processing in cement Kiln is considered as an effective and sustainable option. There is dual benefit in co-processing of wastes in cement kilns, in terms of utilizing the waste as a supplementary fuel as well as an alternative raw material

The production of cement in India is about 300 Million Tons per annum, for which estimated coal and raw material (Lime stone, Iron ore, Clay, Bauxite etc.) requirement are 50 Million Tons per annum and 450 Million Tons per annum, respectively. The country, therefore, has vast potential to utilize large quantum of wastes such as non-recyclable hazardous & other wastes, segregated combustible fractions from MSW or Municipal Solid Wastes (MSW) based Refuse Derived Fuel (RDF), non-hazardous industrial wastes, plastics wastes, tyre wastes, non-usable bio-mass etc. as an alternative fuel and raw material (AFR) in cement kilns. Such utilization would help in recovering energy and material value present in them thereby reducing the consumption of primary fossil fuels and raw materials. Utilising these materials as AFRs will also reduce large quantity of GHG emissions of the country which is in line with our commitment made in the Paris agreement.

Many trial runs for co-processing of different kind of hazardous and other wastes in cement kiln have been conducted as per the technical support provided by CPCB since the year 2005. These wastes have been permitted by CPCB and then authorized by SPCBs to implement regular co-processing in

various cement kilns under Rule 11 of the Hazardous Waste (Management, Handling and Transboundary Movement) Rules, 2008. CPCB has also published guidelines on co-processing of wastes in cement plants in the year 2010.

Subsequently, these rules have been superseded with re-notification vide GSR 395 (E) dated 04.04.2016 as the Hazardous and Other Wastes (Management and Trans-boundary Movement) Rules, 2016 (HOWM Rules 2016).

The Rule 9 of the HOWM Rules 2016 is reproduced below:

> *"**Utilisation of hazardous and other wastes.**-(1) The utilisation of hazardous and other wastes as a resource or after pre-processing either for co-processing or for any other use, including within the premises of the generator (if it is not part of process), shall be carried out only after obtaining authorization from the State Pollution Control Board in respect of waste on the basis of standard operating procedures or guidelines provided by the Central Pollution Control Board.*
>
> *(2) Where standard operating procedures or guidelines are not available for specific utilisation, the approval has to be sought from Central Pollution Control Board which shall be granting approval on the basis of trial runs and thereafter, standard operating procedures or guidelines shall be prepared by Central Pollution Control Board:*
>
> *Provided, if trial run has been conducted for particular waste with respect to particular utilization and compliance to the environmental standards has been demonstrated, authorization may be granted by the State Pollution Control Board with respect to the same waste and utilisation, without need of separate trial run by Central Pollution Control Board and such cases of successful trial run, Central Pollution Control Board shall intimate all the State Pollution Control Board regarding the same.*
>
> *(3) No trial runs shall be required for co-processing of waste in cement plants for which guidelines by the Central Pollution Control Board are already available; however, the actual users shall ensure compliance to the standards notified under the Environment (Protection) Act, 1986 (29 of 1986), for cement plant with respect to co-processing of waste:*
>
> *Provided that till the time the standards are notified, the procedure as applicable to other kind of utilisation of hazardous and other waste, as enumerated above shall be followed."*

The above provisions have prompted CPCB to bring out these revised guidelines to facilitate SPCBs/PCCs to grant authorisation for utilization of different kinds of wastes, including Hazardous & other wastes, as AFRs through co-processing in cement kilns in an environmentally sound manner.

2.0 Benefits of Co-processing:

Co-processing in cement kiln is considered as environmentally sustainable option for the management of different kinds of wastes including hazardous and other wastes. In co-processing, these wastes are not only destroyed at a higher temperature of up to 1450°C and long residence time during which its inorganic content gets fixed with the clinker and becomes part of cement apart from using the energy content of the wastes, thus no residues are left. While in case of incineration, the residual ash requires to be land filled as hazardous waste. Further the acidic gases, if any generated during co-processing gets neutralized in the large alkaline environment available within the kiln system. This phenomenon also reduces the non-renewable resources requirement such as coal and lime stone etc. Thus the utilization of wastes in cement kilns through co-processing provides a win–win option of waste disposal.

Co-processing of wastes in the cement plants would require a large scale management of Hazardous and other wastes. This would mean that a large quantum of waste will be received, stored, handled and pre-processed in the cement plants or TSDFs or stand-alone pre-processing facilities so as to make an homogenised mixture of wastes suitable for co-processing in the cement kilns. This waste mix would get prepared from different kinds of wastes such as the ones listed in HOWM Rules, 2016 and also those which are not listed like SCF, RDF, plastic & other packaging wastes, tyre chips, non-hazardous industrial wastes, biomasses, agro-wastes (which are not suitable for use as cattle feed), non recyclable materials from ware houses such as date expired or off-specification FMCG, food & kindred and other products, etc. Further it may require installation of different systems for feeding such homogenised mixtures into cement kilns. Fig 1 given in Annexure 1 provides an overview of the pre-processing of the waste in a facility and co-processing in cement kiln.

Hence, there is a need to define appropriate methodology with which, necessary authorization can be granted by SPCBs to cement plants or pre-processing facilities apart from TSDFs for collection, transportation, receipt, storage, handling & pre-processing of wastes and also for co-processing operation in cement kilns.

3.0 Authorization for pre-processing and/or co-processing:

As per HOWM Rules, 2016, utilisation of hazardous and other wastes for co-processing or for any other use shall be carried out only after obtaining authorization from the State Pollution Control Board in respect of waste on the basis of standard operating procedures or guidelines provided by the Central Pollution Control Board.

Further, no trial runs would be necessary for grant of authorisation for co-processing of wastes in cement kilns since Ministry of Environment, Forests and Climate Change has notified the Emission Standards for co-processing of wastes in cement kiln vide GSR No. 497 (E) dated 10.5.2016 under the Environment (Protection) Rules, 1986. Such co-processing shall be carried out as per the guidelines and SOPs outlined in this document

SPCBs may grant Authorisation to cement plants for co-processing of wastes listed in Schedule I, Schedule II and Schedule III of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. Authorisation for co-processing of commonly recyclable hazardous wastes

listed in Schedule-IV may be considered only if there are no recyclers for such wastes at reasonable distance as may be decided by SPCBs.

Further, SPCBs may also grant consent to the cement plants under Air (P&C) Act, 1981 for co-processing of any wastes not listed in HOWM Rules, 2016 like SCF, RDF, plastic & other packaging wastes, tyre chips, non-hazardous industrial wastes, biomasses, agro-wastes (which are not suitable for use as cattle feed) and date expired or off-specification FMCG and food & kindred other products which are not-recyclable. While co-processing all such wastes including hazardous & other wastes, cements plants shall comply with the emission standards prescribed for co-processing of wastes notified by MoEF&CC vide GSR No. 497 (E) dated 10.05.2016.

Use of wastes for co-processing in cement kilns does not warrant the requirement of EC as per MoEF&CC Notification No. S.O.3518 (E) dated 23.11.2016

As per HOWM Rules, 2016, every person who is engaged in generation, collection, transportation, receipt, storage, and handling of hazardous and other wastes for pre-processing and /or co-processing shall obtain an authorization or its renewal by applying in Form 1 from the State Pollution Control Board / Pollution Control Committee.

Accordingly, cement plants may co-process the pre-processed hazardous wastes received from TSDFs or stand-alone pre-processing facilities or their captive pre-processing facilities only after obtaining such authorization.

Every TSDF or standalone pre-processing facility or cement plant who is engaged in pre-processing of wastes for co-processing shall have minimal requisite infrastructure facilities & operational controls as mentioned below;

S.No	Type of operations	Check-list
i.	Type of packaging	May use liners, Bags Small / Jumbo, Drums, Containers, Bulkers, Tankers, etc. suitable for handling of hazardous wastes as per CPCB guidelines
ii.	Reception	Weighing bridge
iii.	Waste characterisation / qualification	Laboratory
iv.	Storage	Shall install covered sheds with Impervious flooring. Waste shall be stored in storage tanks/Containers/bins. Bulky wastes may be handled on impervious lined flooring under shed.
v.	Equipment for Size reduction	Shredder, Grinder, mixers, Cutter, Hammer, Jaw Crusher, Chipper, Hydro-pulper machines, etc.
vi.	Feed material preparation equipment	Impregnation, Drying, Screening, Crushing, Pelletisation, Granulation, Others
vii.	Moving machinery	Shall use machinery like trucks, Bob cat, Forklifts, loaders, dumpers, Arm handlers, Wheal loaders, Crawler loaders, Telescopic etc.
viii.	sorting equipment	Shall use equipment like Metal detectors, Electro-Magnetic separators, etc.
ix.	Screening material	Shall use equipment such as disc screen, Rotary screen, Trommel screen, Oscillating screens etc.

S.No	Type of operations	Check-list
x.	Conveyers to transport the material from one to another place	Shall use belt conveyors, Inclined Belt conveyors, Cleated belt conveyors, chain conveyors, bucket conveyors, closed conveyors, pipe conveyors etc
xi.	Feeding arrangements (applicable to cement plants alone)	Weigh feeders (Volumetric and Gravimetric feeding), Apron and Gottwald feeders etc. for liquid, solid and semi-solid waste feeding, including facilities for impregnation of wastes.
xii.	Safety equipment (applicable to cement plants alone)	Rotary Air Lock, Safety shut off gate, Double slide gates are utilized into the feeding mechanism to avoid any back fire due to any pressure build-up into the kiln.
xiii.	Fugitive Emission Control Systems	Fume extraction systems with vacuum ducts connected to Scrubbers / bag filters VOC emission control systems Biological treatment etc. ID fan and stack.
xiv.	Fire protection	Approved by fire safety auditor / fire department should be provided
xv.	Spillage/leachate collection / containment measures.	Shall install collection pits, impervious liners, segregation of storm water drainage systems
xvi.	Electrical fittings / Equipment	Systems shall be designed to handling flammable / explosive materials (If relevant)
xvii.	Odour control	The facility must have appropriate odor control facility to deal with the odor nuisance.
xviii.	Safety Equipment	There shall be provision of emergency showers and eye wash stations. Use of PPEs, ear-plug etc.
xix.	Facility has implemented a monitoring plan for checking the health of the operating personnel as per the statutory requirement	Medical surveillance of the operating personnel as per HOWM Rules 2016
xx.	Emergency Response Plan	Emergency Response Plan to deal with spills, fires and emergencies as per CPCB guidelines
xxi.	CEMS	Shall install CEMS for PM, NOx & SO_2 and connected to SPCB / CPCB for online data transmission (applicable to cement plants alone)

TSDFs, Stand alone Pre-processing Facilities & Cement plants shall undertake pre-processing of and co-processing of wastes as per the Standard Operating Procedures (SOPs) specified in these guidelines.

SPCBs shall grant authorisation to the waste generators to send their waste for management to any of the suitable pre-processing or co-processing facility that is approved by the SPCBs.

4.0 Trial Runs

Trial runs for co-processing of hazardous wastes would not be necessary except for few specific wastes such as Persistent Organic Compounds (PoPs), PCBs, obsolete and date expired pesticides, Ozone Depleting Substances

etc. listed for restrictions in international conventions, for which trial studies were not yet conducted. Kiln specific trial runs may be required for such wastes to study the destruction and removal efficiencies (as per the requirement of Stockholm convention) in the given kiln, compliance to emission standards, safe transport, storage and handling etc. prior to issuance of authorisation by SPCBs. In such cases, SPCBs may consult CPCB for conducting such kiln specific trial studies.

5.0 Standard Operating Procedures

5.1 Handling of Hazardous & other wastes:

The hazardous wastes need to be handled in an environmentally safe manner avoiding the possibilities of contaminating the environment and eliminate the chances of accidents leading to environmental damage. The requirements of handling, including labelling, packaging, transport and storage applicable to the hazardous & other wastes have been described in following sub-sections.

5.1 Responsibilities of occupier for handling of hazardous & other wastes

"Occupier" in relation to any factory or premises, means a person who has control over the affairs of the factory or the premises and includes in relation to any hazardous waste the person in possession of the hazardous waste.

The occupier shall take all adequate steps while handling hazardous wastes to:

(a) Contain contaminants and prevent accidents and limit their consequences on human beings and the environment; and

(b) Provide persons working on the site with the training, equipment and information necessary to ensure their safety.

5.2 Packaging of Hazardous & other wastes:

The containers utilized for storing and handling Hazardous and other wastes for the purpose of co-processing must be able to withstand normal handling and retain integrity for a minimum period of six months. In general, packaging of hazardous substances must meet the following requirements:

(i) All packaging materials including containers shall be of such strength, construction and type as not to break open or become defective during transportation.

(ii) All packaging materials including containers shall be so packed and sealed that spillages of hazardous wastes / substances are prevented during transportation due to jerks and vibrations caused by uneven road surface.

(iii) Re-packing materials including that used for fastening must not be affected by the contents or form a dangerous combination with them.

(iv) Packaging material should be such that there will be no significant chemical or galvanic action among any of the material in the package.

(v) Bulk transportation of hazardous wastes in trucks without suitable packaging or containers shall not be allowed.

(vi) The containers when used for packaging of the hazardous & other wastes shall meet the following requirements:

Container shall be of mild steel with suitable corrosion-resistant coating and roll-on roll-off cover, which may either be handled by articulated crane or by a hook lift system comfortably for a large variety of wastes. Other modes of packaging, like collection in 22-liter plastic or steel drums, PP and HDPE/LDPE containers, HDPE liner bags etc., also work for variety of waste. However, all such container should be amenable to mechanical handling.

- It should be leak proof.
- In general, the containers for liquid hazardous waste should be completely closed / sealed. There should be no gas generation due to any chemical reaction within the container, and thus should be devoid of air vents.
- Container should be covered with a solid lid or a canvas to avoid emissions of any sort including spillage, dust etc. and to minimize odour generation both at the point of loading as well as during transportation.
- Container used for transportation of waste should be able to withstand the shock loads due to vibration effect/undulations of pavements etc.
- Container should be easy to handle during transportation and emptying.
- As far as possible, manual handling of containers should be minimized. Appropriate material handling equipment is to be used to load, transport and unload the containers. Drums should not be rolled on or off vehicles. Preferably, equipment such as fork lift & pallets shall be used.
- Where a two-tier or three-tier storage is envisaged the frame should have adequate strength to hold the containers. Palletised drums may be stacked not more than 2 layers high in the transport vehicle.
- One-way containers (especially 16-liter drums) are also allowed. The multi-use container should be re-useable provided it should be cleaned and free from deterioration or defects.
- Loads are to be properly placed on vehicles. Hazardous & other waste containers are not to overhang, perch lean or be placed in other unstable base. Load should be secured with straps, clamps, braces or other measures to prevent movement and loss. Design of the container should be such that it can be safely accommodated on the transport vehicle.
- Non-compatible wastes shall not be collected in the same container. These wastes shall be segregated & packed separately. Non - compatible wastes shall not be transported together under any circumstance.

5.3 Labelling of Hazardous & other wastes

There are two types of labeling requirements:

(i) Labelling of individual transport containers (ranging from a pint-size to a tank); and

(ii) Labelling of transport vehicles.

All hazardous & other waste containers must be clearly marked with the contents. The marking must be irremovable, waterproof and firmly attached. Previous content labels shall be obliterated when the contents are different. Proper marking of containers is essential.

Containers that contain hazardous waste shall be labelled with the words "HAZARDOUS WASTE" in Vernacular language, Hindi / English. The information on the label must include the code number of the waste, the waste type, the origin (name, address, telephone number of generator), hazardous property (e.g. flammable), and the symbol for the hazardous property (e.g. the red square with flame symbol).

The label must withstand the effects of rain and sun. Labelling of containers is important for tracking the wastes from the point of generation up to the final point of disposal. The following are the requirements for labeling:

- The label should contain the name and address of the occupier and facility where it is being sent for pre-processing or co-processing i.e. labelling of container shall be provided with a general label as per Form 8 of the HOWM Rules, 2016.

- Emergency contact phone numbers shall be prominently displayed viz; the phone number of concerned officer of the sender and receiver, Regional Officer of the SPCB / PCC, Fire Station, Police Station and other agencies concerned.

Explanation: As a general rule, the label has to state the origin/ generator of the waste. He / she and only he / she – is responsible and shall know, in case of any accident / spillage etc. what kind of wastes it is, what hazard may occur and which measures should be taken. The second in the line is the collector / transporter / disposer /co-processor / pre-processor, who has to know the risk and what to do to minimize risks and hazards.

5.4 Collection and transportation of Hazardous & other wastes

The transportation of the Hazardous wastes has to be undertaken by the transporter who is engaged by either authorised sender or receiver. The responsibility of safe transportation of hazardous & other waste to the site for pre-processing or co-processing shall rest with either waste generator or the occupier of the pre-processing / co-processing facility that engages the transporter for the waste transportation. The detailed guidelines for collection and transportation of hazardous and other wastes have been provided at **Annexure-2**.

5.5 Storage of Hazardous & other wastes

The storage period of hazardous and other wastes shall be in accordance with the Rule 8 of the Hazardous & Other wastes (Management and Transboundary Movement) Rules 2016. The minimal requisite facilities for storage of hazardous and other wastes are given at **Annexure-3**.

5.5 Waste reception

Waste Characterization plays an important part in any treatment process of the waste which may be required before pre-processing and ultimately co-processing into the cement kilns. Upon receipt of the waste, it shall be weighed and property logged. It shall then undergo a visual inspection to confirm the physical appearance. A representative sample of the waste shall be collected and send to the onsite laboratory for finger printing analysis. Finger print analysis is performed to confirm that a particular waste stream belongs to an offsite waste generation source or not, based on its characteristics. The results of the finger printing analysis should be compared with the results of earlier analysis. Upon confirmation, this shall then be sent for pre-processing or co-processing.

The operator of the pre-processing facility of the cement plant shall perform following finger print analysis for each of the consignment of waste received for pre-processing or co-processing from generation site;

- Moisture content,
- Ash content,
- Net Calorific Value (NCV),
- Chloride and Sulphur content.
- Chemical compatibility
- Any other specific parameter, which may be decided on merit of each case keeping the clinker production process in focus.
- In case of liquid samples, viscosity, pH, suspended particle content etc shall also be performed.
- Heavy metal analysis, Reactive Sulphide, Reactive Cyanide or Halide analysis should be performed if sample comes from a sector which is suspected to have these in the waste material.

The results of this finger print analysis confirm that the waste belongs to already tested and verified waste stream which is suitable for co-processing into the kiln and do not have any side effects on clinker and cement quality parameters.

As the main product of the kiln is clinker, there must not be any side effect on its quality while utilizing the waste streams as AFRs. For pre-qualification for co-processing or pre-processing, a representative sample should be collected from the waste generator's site and analysed in a laboratory for above said parameter which shall form basis for comparing the finger print analysis of the waste consignments.

Quality Control - The quality of the pre-processed wastes (AFRs) largely depends on the quality control process followed during the quality assessment stage. Starting from sampling like collection of a representative sample, its storage in suitable container, avoiding any adulteration during transportation to lab, sample preparation in lab, performing test as per BIS standards for different quality parameters and carefully observing, recording and comparing

the results for specific waste streams is the key to define and confirm its suitability for pre-processing / co-processing in to the cement kiln.

Samples of wastes received at the pre-processing facility or the cement plant for pre-qualification must be preserved for one year for traceability considerations.

Samples of waste collected from regular consignments for finger print analysis must be preserved for one month for traceability consideration.

Samples that are beyond times as mentioned above must be sent to the TSDF or standalone pre-processing facility or to the cement plant for ensuring its disposal through co-processing.

5.6 Acceptance process for Hazardous & other wastes

Appropriate knowledge of the hazardous and other wastes is necessary to ensure that it will not adversely affect the process, safety or environment while handling it during pre-processing or co-processing. Hence, appropriate characterization of the waste for its acceptance and safe handling is an essential requirement.

Characterization of Hazardous and other waste for acceptance comprises two stages: pre-acceptance (or screening) and on-site acceptance. Pre-acceptance involves the provision of assessing the representative samples of the waste to allow operators to determine suitability of the infrastructure to handle the waste before receiving the same in the facility. The second stage concerns procedures when the waste arrives at the facility to confirm previously approved characteristics.

Failure to adequately screen waste samples prior to acceptance and a confirmation of its composition on arrival at the installation may lead to subsequent problems, inappropriate storage, mixing of incompatible substances, and accumulation of wastes could occur.

Hence, the pre-processing / co-processing facility must have appropriate laboratory facility for characterizing solid, liquid and sludge wastes with qualified analysts to ensure that proper waste acceptance process is practiced. This laboratory shall be equipped with facilities to test Moisture, Calorific value, Ash, Chorine, Fluorine, Carbon, Hydrogen, Sulphur, Nitrogen, Phosphorous, alkali and heavy metals, flash point, mixing compatibility, reactive sulphide, reactive Cyanide or halides etc.

In case the waste received at cement plant or standalone pre-processing facility does not meet the required criteria, in such case, the receiver should make arrangement for transfer of such waste to TSDF for final disposal by adopting necessary manifest system.

6.0 Pre-processing of wastes for co-processing:

Due to the heterogeneity of wastes, pre-processing is required to produce a relatively uniform waste stream for co-processing in cement kilns. This waste stream should comply with the technical and administrative requirements of cement manufacture and guarantee that emission standards and product quality are met. The proposal in this regard shall be submitted to SPCB by the cement plant or standalone pre-processing facility or TSDF. Waste mix having

uniform characteristics needs to be prepared from different waste streams for trouble free co-processing in a cement kiln.

The characteristics of the waste mix that need to be uniform pertain to particle size, chemical composition and heat content. For optimum operation, kilns require very uniform waste mix flows in terms of quality and quantity. Uniform quality of waste mix can be achieved by pre-processing different types of wastes by different physical processes in a pre-processing facility.

Pre-Processing is defined as pre-treatment of waste streams coming from different sectors and industries to make it suitable/homogenised for feeding into the kiln system to avoid process fluctuations. Pre-processing involves only physical transformations like size reduction (By Shredding and cutting), separation of foreign/undesirable materials (magnetic materials separation by Magnetic separator, use of metal detectors to remove metallic particles), impregnation (introducing and proper mixing of biomass/saw dust in semi solid streams to soak extra flowing liquids & maintaining good flow ability) and desired size selection (Size selection by screening operation, manual size selection by handpicking of large material size on very low speed Belt conveyors).

Pre-processing produces a homogenised Alternative Fuel mix from different incoming waste streams from various industrial sectors and reduces the possibilities of process fluctuations during Co-Processing the pre-processed fuels.

Various types of equipment are utilized during pre-processing operations like Shredder, Grinder, Cutter, Hammer, Jaw Crusher, Chipper and Hydro pulper machines for size reduction. Mixers for homogenizing the waste mix into large vessels/pits. Moving machinery like trucks, Bob cat, Forklifts, loaders, dumpers, Arm handlers, Wheel loaders, Crawler loaders, Telescopic handlers etc for material movement from one to another place and loading unloading of the material. Metal detectors, Electro-Magnetic separators, metal sorting equipments are utilized to remove small metallic traces which may be present into the incoming hazardous and other wastes from various sources. Different type of screens like Disc screen, Rotary screen, Trommel screen, Oscillating/ vibrating screens are used to separate the differently sized portions of the processed waste and choosing the right fraction for feeding into the system. Various types of Belt conveyors like flat belt conveyors, Inclined Belt conveyors, Cleated belt conveyors, chain conveyors, bucket conveyors, closed conveyors, pipe conveyors etc are utilised to transport the material from one to another place, usually pre-processed waste from the processing area to feeding area.

The pre-processing facility must have appropriate design to ensure that the waste homogenization operation is carried out in an environmentally sound manner and has equipment & facilities that are designed to handle the required hazardous wastes.

The rejects produced from the pre-processing facility, if any, may be sent to the TSDF, the authorisation for which may be obtained from concerned SPCB.

The pre-processing area must have impervious concrete floor and should be adequately covered to avoid exposure of rain to the material being stored and handled while pre-processing or co-processing.

Fume extraction systems with vacuum ducts and fume hoods should be installed at receiving pits/tanks, mixing units, blending units, shredders, transfer points, dryers, impregnation units, granulators, pelletizes, crushers, grinders, blenders etc. where there is source of such emissions. Such fume extraction systems should be connected to scrubbers / bag filters / VOC emission control through carbon adsorption, thermal or biological treatment etc. depending on type of emissions. The cleaned gases should be vented through ID fan and stack.

A fire protection system of approved design should be in place in the storage and pre-processing area.

The storage, handling and pre-processing facility should have appropriate spillage / leachate collection and storage system with impervious liners to avoid contamination of the ground water and soil.

The storm water and spillage / leachate drainage systems should be so designed that there should be no contamination of the storm water with the spillage or leachate from the storage, handling and pre-processing area.

The electrical and instrumentation fitting should be conforming to the standards.

The facility must have appropriate odor control facility to deal with the odor nuisance.

Emergency showers and eye wash stations should be provided within the storage, handling and pre-processing work area for immediate emergency use following exposure to the wastes.

Abatement techniques should be in place for control of noise to required levels.

7.0 Co-processing of wastes in Cement kiln:

Co-processing is defined as the use of waste as raw material, or as a source of energy, or both to replace natural mineral resources (material recycling) and fossil fuels such as coal, petroleum and gas (energy recovery) in industrial processes, mainly in energy intensive industries (EII) like cement production. In Co-processing, the combustible waste is utilized as fuel (Alternative Fuels) into the kiln system for maintaining the high temperature during clinker production. Some of the waste streams like biomass, small quantity waste streams, etc which have suitable quality parameters may be directly fed into the kiln system. However, majorly waste streams, especially when volumes are more, are fed after pre-processing which make it homogenized to reduce the process fluctuations.

Various equipment are utilized for feeding the pre-processed AFR into kiln system. Automated mechanical extraction machines such as walking Floor and various belt conveyors as mentioned above are utilized for transporting material from processing area to feeding point. Different kinds of volumetric and gravimetric dosing machinery are utilized for feeding the AFR material into the kiln in a controlled manner. Various safety equipments like Rotary Air Lock, Safety shut off valves & gates & Double slide gates are utilized into the

feeding mechanism to avoid any back fire due to pressure build-up inside the kiln. Bag filters are utilised at transfer points to avoid any dust emission into the atmosphere in case of feeding fine AFRs.

For optimal performance (co-processing without additional emissions), waste materials (pre-processed or as received) should be fed to the cement kiln through appropriate feed points, in adequate proportions and with proper waste quality and emission monitoring systems.

Different feed points can be used to feed the waste materials into the cement kiln for co-processing. The most common ones are:

- Main burner at the rotary kiln outlet end
- Rotary kiln inlet end
- Pre-calciner
- Mid kiln (for long dry and wet kilns)

Appropriate feed points have to be selected according to the physical, chemical and toxicological characteristics of the waste materials. Wastes of high calorific value have to be always fed into the high temperature combustion zones of the kiln system. Wastes containing stable toxic components and also wastes containing more than 1.5% chlorine should be fed to the main burner to ensure complete combustion in the high temperature and long retention time.

Alternative raw materials containing constituents that can be volatilized at operating temperatures in the pre-heater system have to be fed into the high temperature zones of the kiln system.

Coal feeding circuit and raw material feeding circuits of the cement plant must not be utilised to feed any type of wastes for co-processing unless a trial is performed to demonstrate the suitability of the same and specific approval from the SPCB is obtained along with the authorisation. SPCBs may consult CPCB in specific cases in this regard.

Feeding of alternative raw materials containing volatile (organic and inorganic) components to the kiln via the normal raw meal supply should be avoided unless it has been demonstrated by trial runs in the kiln that there is no VOC emission from the stack. Such trial runs should be carried out with permission from SPCBs. SPCB should consult CPCB if they feel that trial is needed in specific difficult cases.

Destruction of waste materials that are covered under the Stockholm convention and Montreal Protocol such as PCBs, Expired or obsolete pesticides, Ozone Depleting Substances etc. must however be undertaken in a given kiln only after obtaining specific approval from SPCB and other concerned organisations. For this, SPCB in consultation with CPCB will provide steps to be followed including implementing a trial as per a defined protocol.

7.1 Suitability of Substances for co-processing:

The decision on what type of substances can be used is based on the clinker production processes, the raw material and fuel compositions , the feeding points, the air pollution control devices and the given waste management

problems. The Accept - Refuse Chart in **Annexure-4** could be used by plant operators to help them in considering, which type of substance is suitable for co processing.

As a basic rule, waste accepted for co-processing must be safe enough to handle in the given facility and shall contribute to recovery of material or energy value present in it or provide its safe disposal.

Sometimes, some waste streams are not suitable in large volumes but can be co-processed in small volumes with controlled feed rate into the system.

The wastes listed below are normally not recommended till otherwise proved / evidenced for and hence need not be considered for pre and co-processing.

- Biomedical waste
- Asbestos containing waste.
- Electronic scrap.
- Entire batteries.
- Explosives.
- Corrosives.
- Mineral acid wastes.
- Radioactive Wastes.
- Unsorted municipal garbage.

7.2 Operating Conditions:

Cement plants shall ensure to prevent waste feed in following conditions;

i. at start up, until the temperature of 850°C in calciner or 1100°C at kiln inlet as the case may be.

ii. Whenever the temperature of 850°C or 1100°C as the case may be is not maintained.

iii. Whenever emission monitoring show that any emission limits value is exceeded due to disturbances or failures of air pollution control devices.

iv. In case of disturbed process condition in the kiln

The management of the pre and co-processing plant shall be in the hands of a skilled person, competent to manage the hazardous waste in an environmentally sound manner.

8.0 Emission standards:

The cement kilns undertaking co-processing of the different wastes as above must comply with the following notified emission standards notified vide GSR 497 (E) dated 10.5.2016;

"S. No.	Industry	Parameter	Standards		
(1)	(2)	(3)	(4)		
"10A.	Cement Plant with co-processing of wastes		A- Emission Standards		
			Rotary Kiln – with co-processing of Wastes		
			Date of Commissioning	Location	Concentration not to exceed, in mg/Nm^3
			(a)	(b)	(c)
		Particulate Matter (PM)*	on or after the date of notification (25.8.2014)	anywhere in the country	30
			before the date of notification (25.8.2014)	critically polluted area or urban centres with population above 1.0 lakh or within its periphery of 5.0 kilometer radius	30
				other than critically polluted area or urban centres	30
		SO_2*	irrespective of date of commissioning	anywhere in the country	100, 700 and 1000 when pyritic sulphur in the limestone is less than 0.25%, 0.25 to 0.5% and more than 0.5% respectively.
		NO_x*	After the date of notification (25.8.2014)	anywhere in the country	(1) 600
			Before the date of notification	anywhere in the country	(2) 800 for rotary kiln with In Line Calciner
			(25.8.2014)		(ILC) technology. (3) 1000 for rotary kiln using mixed stream of ILC, Separate Line Calciner (SLC) and suspension pre-heater technology or SLC technology alone or without calciner.
		HCl	10 mg/Nm^3		
		HF	1 mg/Nm^3		
		TOC	10 mg/Nm^3 **		
		Hg and its compounds	0.05 mg/Nm^3		
		Cd +Tl and their compounds	0.05 mg/Nm^3		
		Sb+As+Pb+Co+Cr+Cu+Mn+Ni+V and their compounds	0.5 mg/Nm^3		
		Dioxins and Furans	0.1 ngTEQ/ Nm^3		

Continuous Emission Monitoring System (CEMS) should be installed & functioning for the parameters PM, SO_2 and NO_x in the first phase and the data should be uplinked to CPCB and SPCB servers. Additional emission parameters for CEMS may be added in future as per the directions of CPCB or SPCBs form time to time.

Other parameters shall be monitored manually once in a year and data should be submitted to SPCBs/CPCB

SPCB / PCC shall monitor the emission from the cement plant to verify the compliance of notified emission standards. In case, SPCB/PCC does not have

the emission monitoring facilities, they can engage any EPA recognized / NABL accredited laboratory for the purpose.

9.0 Procedure for obtaining Authorisation

For co-processing of hazardous and other wastes, cement plants shall obtain Consent to Establish (CTE) and Consent to Operate (CTO) prior to obtaining authorisation under HOWM Rules, 2016.

The proposal for co-processing may include any kind of hazardous & other waste (as listed in the Schedules of HOWM rules, 2016) and non-hazardous wastes such as segregated combustible fractions from MSW, Refuse Derived Fuel (RDF) from MSW, Plastic wastes, Tyre chips, biomasses, food and other products, agro-wastes etc. with exceptions as described in section 7.1 of this guidelines.

The cement plants /standalone pre-processing facilities / TSDFs shall have valid authorisation for receiving, transporting, handling, storing, pre-processing or co-processing of hazardous and other wastes, for which they shall apply for authorisation as per Form 1 of HOWM Rules, 2016.

Application for authorisation shall provide details of the infrastructure available at their end to receive, characterize, transport, handle, store, pre-process and co-process wastes with minimum requisite facilities as specified in section 3.0 and 6.0 of these guidelines.

SPCB / PCC shall undertake physical inspection and verify the required equipment for pre-processing and co-processing of hazardous and other wastes. Format for verifying adequacy of the infrastructure for Pre-processing / Co-processing of waste materials is given below;

Format for verifying adequacy of the infrastructure for Pre-processing / Co-processing of waste materials

S.No	Type of operations	Check-list
i	Nature of the waste materials applied for	a. Solid b. Liquid c. Sludge d. Gas e. Hazardous f. Non-Hazardous g. Flammable h. Toxic i. Corrosive j. Explosive
ii	Type of packaging	a. Liners b. Bags Small / Jumbo c. Drums d. Containers

S.No	Type of operations	Check-list
		e. Bulkers f. Tankers g. Other (pl specify)
iii	Type of material handled	a. Solids b. Liquids c. Sludges d. Gases e. Flammable f. Toxic g. Corrosive
iv	Reception	Weighing bridge
v	Type packaging	Loose Bags Drums Containers Bulkers Tankers
vi	Laboratory for Waste characterisation	a. Yes b. No
vii	Storage	Covered sheds Impervious flooring Storage tanks/Containers/bins
viii	Equipment for Size reduction	Shredder, Grinder, mixers, Cutter, Hammer, Jaw Crusher, Chipper, Hydro-pulper machines others (pl. specify)
ix	Feed material preparation equipment	Impregnation Drying, Screening Crushing Pelletisation

S.No	Type of operations	Check-list
		Granulation Others
x	Moving machinery	like trucks, Bob cat, Forklifts, loaders, dumpers, Arm handlers, Wheal loaders, Crawler loaders, Telescopic
xi	sorting equipment	Metal detectors, Electro-Magnetic separators, etc.
xii	Screening material	Disc screen, Rotary screen, Trommel screen, Oscillating screens etc.
xiii	Conveyers to transport the material from one to another place	belt conveyors, Inclined Belt conveyors, Cleated belt conveyors, chain conveyors, bucket conveyors, closed conveyors, pipe conveyors etc
xiv	Feeding arrangements	Weigh feeders (Volumetric and Gravimetric feeding), Apron and Gottwald feeders etc. for liquid, solid and semi-solid waste feeding. Facilities for impregnation of wastes.
xv	Safety equipment	Rotary Air Lock, Safety shut off gate. Double slide gates are utilized into the feeding mechanism to avoid any back fire due to any pressure build-up into the kiln.
xvi	Fugitive Emission Control Systems	Fume extraction systems with vacuum ducts Scrubbers / bag filters / VOC emission control systems Biological treatment etc. ID fan and stack.
xvii	Fire protection Approved design should be provided	Yes No

S.No	Type of operations	Check-list
xviii	Spillage/leachate collection / containment measures. Collection pits, impervious liners, segregation of storm water drainage systems	Yes No
xix	Electrical fittings / Equipment / Systems are designed to handle flammable / explosive materials (If relevant)	Yes No
xx	Odour control The facility must have appropriate odor control facility to deal with the odor nuisance.	Yes No
xxi	Safety Equipment Provision of emergency showers and eye wash stations, PPEs, ear-plug etc.	Yes No Remarks:
xxii.	Facilities implemented at the location have been approved by the office of the Factory Inspector	Yes No
xxiii.	Facility has implemented a monitoring plan for checking the health of tne operating personnel as per the statutory requirement	Yes No
xxiv.	Facility has prepared an Emergency Response Plan	Yes No
xxv.	CEMS installed for PM, NOx& SO_2 and connected to SPCB / CPCB for	a. Yes b. No

S.No	Type of operations	Check-list
	online data transmission	

SPCBs shall attach the verified check-list to their inspection report. In case of refusal, SPCB shall communicate the reasons for the same.

SPCBs may also grant authorization for utilization of chemical gypsum, stabilized jarosite, other similar waste material having potential to be used as set retarder and other high volume low-effect wastes as specified under HOWM Rules, 2016 in cement mill, for which cement plant shall apply to SPCB in form 1. Cement plant shall provide details of the infrastructure available at their end to receive, characterize, transport, handle, store, pre-process and utilize wastes and illustrate their suitability to manage these wastes in an environmentally sound and safe manner with requisite facilities given in section 3.0 and 6.0 as applicable.

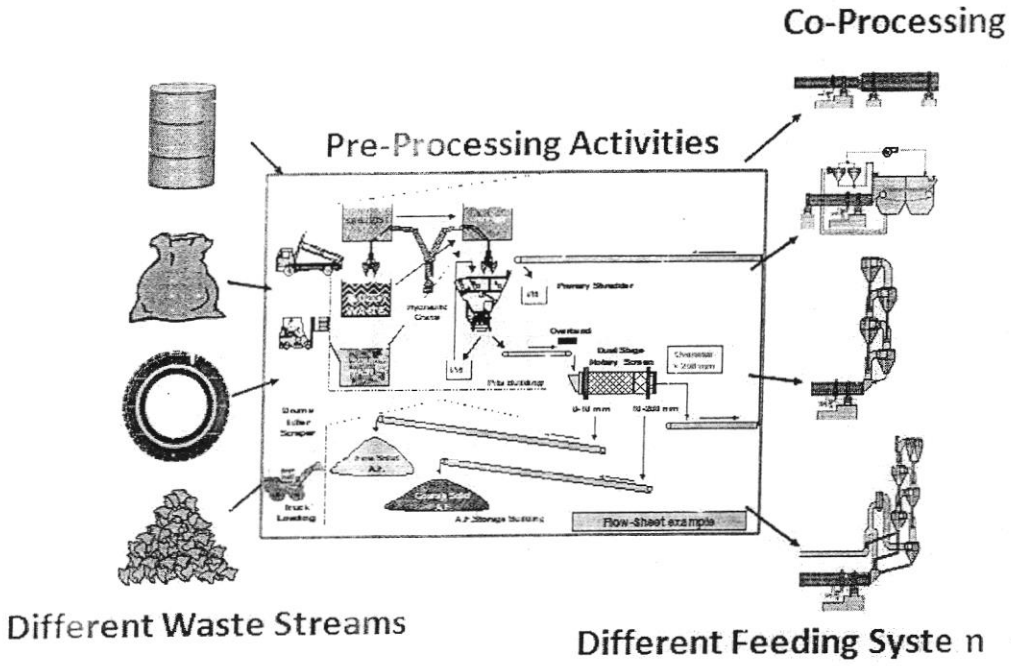
Waste generator shall also obtain authorisation for sending chemical gypsum, stabilized jarosite, and other high volume low-effect wastes as specified under HOWM Rules, 2016 for utilization in cement mill.

Before undertaking pre-processing or co-processing of a waste stream which were introduced for co-processing or pre-processing, the facility operator shall give intimation to SPCB / PCC as per the format given at Annexure - 5

****

Annexure 1

Schematic Representation of Pre and Co-Processing in Cement Kiln



Annexure-2

Collection & Transportation of Hazardous Wastes

The occupier of the hazardous waste shall ensure that wastes are packaged in a manner suitable for safe handling, storage and transport as specified in section 5.2 of these guidelines. Labeling on packaging is readily visible and material used for packaging shall withstand physical conditions and climatic factors as specified in Section 5.3.

In case of transportation of hazardous and other waste, the responsibility of the safe transport shall be either of the sender or the receiver whosoever arranges the transport and has the necessary authorization for the transport from the concerned State Pollution Control Board. The authorization for the transport shall be obtained either by the sender or the receiver on whose behalf the transport is being arranged. This responsibility should be clearly indicated in the manifest. Thus the occupier involved in transportation of hazardous wastes for co-processing or pre-processing shall comply with the following requirements;

(a) Ensure that information regarding characteristics of wastes particularly in terms of being corrosive, reactive, Ignitable or toxic is provided on the label.

(b) The transport of hazardous waste containers shall be in accordance with the provisions of the Hazardous and other Wastes (Management and Transboundary Movement) Rules, 2016, (herein after referred as HW (M & TBM) Rules) and the rules made by the Central Government under the Motor Vehicle Act, 1988 and other guidelines issued from time to time.

(c) Provide the relevant information in Form 9 to the transporter, regarding the hazardous nature of the waste and measures to be taken in case of an emergency and shall mark the hazardous wastes containers as per Form 8.

(d) All hazardous waste containers shall be provided with a general label as given in Form 8 of the HW (M& TBM) Rules.

(e) Intimate both the State Pollution Control Boards before handing over the waste to the transporter. In case of transportation of hazardous through a State other than the State of origin and destination, the sender shall give prior intimation to the concerned State Pollution Control Boardof the States of transit before handing over the hazardous wastes to the transporter.

(g) Manifest System shall be applicable for movement of wastes within the country only

h) The sender of the waste shall prepare seven copies of the Manifest in Form 10comprising of colour code indicated below and all seven copies shall be signed by the sender.

Copy number with colour code	Purpose
Copy 1 (White)	To be forwarded by the sender to the State Pollution Control Board or Committee after signing all the seven

	copies.
Copy 2 (Yellow)	To be retained by the sender after taking signature on it form the transporter and the rest of the five copies to be carried by the transporter.
Copy 3 (Pink)	To be retained by the receiver (actual user or treatment storage and disposal facility operator) after receiving the waste and the remaining four copies are to be duly signed by the receiver.
Copy 4 (Orange)	To be handed over to the transporter by the receiver after accepting waste.
Copy 5 (Green)	To be sent by the receiver to the State Pollution Control board/Committee.
Copy 6 (Blue)	To be sent by the receiver to the sender.
Copt 7 (Grey)	To be sent by the receiver to the State Pollution Control Board of the sender in case the sender is in another State.

Note:

i. The sender shall forward copy 1 (white) to the State Pollution Control Board, and in case of hazardous waste is likely to be transported through any transit State, the sender shall intimate State Pollution Control Boards of the transit States about the movement of the waste.

ii. No transporter shall accept waste from the sender for transport unless it is accompanied by signed copies 3 to 7 of the manifest.

iii. The transporter shall submit copies 3 to 7 of the manifest duly signed with date to the receiver along with the waste consignment.

iv. The receiver after acceptance of the waste shall hand over copy 4 (orange) to the transporter and send copy 5 (green) to his State Pollution Control Board and send copy 6 (blue) to the sender and the copy 3 (pink) shall be retained by the receiver.

v. The copy 7 (grey) shall only be sent to the State Pollution Control Board of the sender, if the sender in another State.

i) The transporter engaged for transportation of hazardous wastes for co-processing meets the following requirements;

i) Vehicle used for transportation shall be in accordance with the provisions under the Motor Vehicle Act, 1988, and rules made thereunder.

ii) Transporter shall possess requisite copies of the certificate (valid authorization obtained from the concerned SPCB/PCC for transportation of waste by the waste generator and operator of a facility) for transportation of hazardous waste.

iii) Transporter should have valid "Pollution under Control Certificate" (PUCC) during the transportation of hazardous waste and shall be properly displayed.

iv) Vehicle shall be painted preferably in blue colour with white strip of 15 to 30 cm width running centrally all over the body. This is to facilitate easy identification.

v) Vehicle should be fitted with mechanical handling equipment as may be required for safe handling and transportation of the wastes.

vi) The words "HAZARDOUS WASTE" shall be displayed on all sides of the vehicle in Vernacular Language, Hindi and English.

vii) Name of the facility operator or the transporter, as the case may be, shall be displayed.

viii) Emergency phone numbers and TREM Card in Form 9 of HW (M& TM) Rules, 2016.

ix) Vehicle shall be fitted with roli-on /roll-off covers if the individual containers do not possess the same.

x) Carrying of passengers is strictly prohibited and those associated with the waste haulers shall be permitted only in the cabin.

xi) Transporter shall carry documents of manifest for the wastes during transportation as required under Rule 19 of the HW (M & TBM) Rules.

xii) The trucks shall be dedicated for transportation of hazardous wastes and they shall not be used for any other purpose.

xiii) Each vehicle shall carry first-aid kit, spill control equipment and fire extinguisher.

xiv) Hazardous Waste transport vehicle shall run only at a speed specified under Motor Vehicle Act in order to avoid any eventuality during the transportation of hazardous waste.

xv) Educational qualification for the driver shall be minimum of 10^{th} pass (SSC). The driver of the transport vehicle shall have valid driving license of heavy vehicles from the State Road Transport Authority and shall have experience in transporting the chemicals.

xvi) Driver (s) shall be properly trained for handling the emergency situations and safety aspects involved in the transportation of hazardous wastes. He should aware of procedures outlined in Emergency Response Plan and trained on emergency spill control procedures.

xvii) The design of the trucks shall be such that there is no spillage during transportation.

Responsibilities of the hazardous waste Transporter

The sender or receiver whoever is involved in transportation of hazardous wastes shall be responsible for:

i) Obtaining requisite authorization from SPCB/PCC for transport of hazardous waste (in addition to any other permission that may be required under the Motor Vehicle (Amendment) Act of 1981).

ii) The transport vehicles shall be designed suitably to handle and transport the hazardous wastes of various characteristics.

iii) The transporting should follow all the Rules pertaining to transportation of hazardous waste as stipulated under HW (M& TM) Rules,2016.

iv) Transporting the wastes in closed container at all time.

v) Delivering the wastes at designated points only.

vi) Informing SPCB/PCC in Form 11 of the HW (M & TBM) Rules, or local authority, occupier / operator of a facility, and others concerned immediately in case of spillage, leakage or other accidents during transportation.

vii) The transporter shall train the driver with regard to the emergency response measures to be taken during the transportation of waste.

viii) Cleaning of vehicles shall be carried out at designated places as authorized by SPCB/PCC.

ix) Clean-up in case of contamination - Liable for taking up immediate emergency response measures in the event of spillage, improper disposal, fire or mishandling of hazardous waste. The main objective of the emergency response measures is to secure immediate human & environmental safety and contain/control further spillage or release of hazardous waste or release of fumes/gases. Each occupier, transporter, operator or cement plant responsible for transportation of hazardous waste shall develop Emergency Response Plan (ERP) as stipulated in "Guidelines on Implementing Liabilities for Environmental Damages due to Handling & Disposal of Hazardous Waste and Penalty" published by CPCB.

Letter of Intimation

The letter of intimation to SPCBs in case of sending wastes for co-processing from one State to another State is given below

Date : __ ____ 201_

To,

State Pollution Control Board / Pollution Control Committee
(Belonging to State in which waste generator is located)

_____

_____

Subject : Letter of intimation for sending our wastes for co-processing located in another state.

This is to inform you that we have finalized arrangement with ____ _____ (Name of the cement plant) to send our following hazardous & other wastes to them for undertaking co-processing. This cement plant is located in the State of _____.

1. _____ HW Category no. _____.
2. _____ HW Category no. _____.
3. _____ HW Category no. _____.

The route of the vehicle transporting these wastes will be passing through following states.

1.
2.
3.

We agree to maintain appropriate date wise & waste wise records of transport and receipt of the same at the receiving cement plant for your kind review as per the need.

Further, as mandated by the rules, we agree to file returns to you towards the co-processing of all the Hazardous Wastes carried out in our facility on an yearly basis.

Yours faithfully,
(Authorised Signatory)
Copy to SPCB / PCC (Receiving state)
Copy to SPCB / PCC (in between states)

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¶
Deleted: ¶

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Annexure - 3

Storage And Handling Requirements For Hazardous And Other Wastes

The minimum requirements for ensuring safe storage of hazardous and other wastes at TSDFs / Cement Plants / Standalone Pre-processing facilities shall be as below.

Storage Sheds

i. Flammable, ignitable, reactive and non-compatible wastes should be stored separately and never should be stored in the same storage shed.

ii. Storage area may consist of different sheds for storing different kinds of hazardous wastes and these sheds should be provided with suitable openings.

iii. Adequate storage capacity (i.e. 25% of the annual capacity of the hazardous waste utilization as a supplementary resource or for energy recovery, or after processing) should be provided in the premises.

iv. Storage area should be designed to withstand the load of material stocked and any damage from the material spillage.

v. Storage area should be provided with the flameproof electrical fittings and it should be strictly adhered to.

vi. Automatic smoke, heat detection system should be provided in the sheds. Adequate fire fighting systems should be provided for the storage area, along with the areas in the facility.

vii. There should be at least 15 m distance between the storage sheds.

viii. Loading and unloading of wastes in storage sheds should only be done under the supervision of the well trained and experienced staff.

ix. Fire break of at least 04 meter between two blocks of stacked drums should be provided in the storage shed. One block of drum should not exceed 300 MT of waste.

x. Minimum of 1 meter clear space should be left between two adjacent rows of pallets in pair for inspection.

xi. The storage and handling should have at least two routes to escape in the event of any fire in the area.

xii. Doors and approaches of the storage area should be of suitable sizes for entry of fork lift and fire fighting equipment;

xiii. The exhaust of the vehicles used for the purpose of handling, lifting and transportation within the facility such as forklifts or trucks should be fitted with the approved type of spark arrester.

xiv. In order to have appropriate measures to prevent percolation of spills, leaks etc. to the soil and ground water, the storage area should be provided with concrete floor or steel sheet depending on the

characteristics of waste handled and the floor must be structurally sound and chemically compatible with wastes.

xv. Measures should be taken to prevent entry of runoff into the storage area. The Storage area shall be designed in such a way that the floor level is at least 150 mm above the maximum flood level.

xvi. The storage area floor should be provided with secondary containment such as proper slopes as well as collection pit so as to collect wash water and the leakages/spills etc.

xvii. All the storage yards should be provided with proper peripheral drainage system connected with the sump so as to collect any accidental spills in roads or within the storage yards as well as accidental flow due to fire fighting.

Storage in Drums / Containers

i. The container shall be made or lined with the suitable material, which will not react with, or in other words compatible with the hazardous wastes proposed to be stored.

ii. The stacking of drums in the storage area should be restricted to three meters high on pallets (wooden frames). Necessary precautionary measures should be taken so as to avoid stack collapse. However, for waste having flash point less than 65.5°C, the drums should not be stacked more than one height.

iii. Stacking of drums may be done on specially rakes designed for holding pallets up to three rows, with height not exceeding 4.5 meters.

iv. No drums should be opened in the storage sheds for sampling etc. and such activity should be done in designated places outside the storage areas;

v. Drums containing wastes stored in the storage area should be labeled properly indicating mainly type, quantity, characteristics, source and date of storing etc.

Measures for Spillage/leakage control

i. The storage areas should be inspected daily for detecting any signs of leaks or deterioration if any. Leaking or deteriorated containers should be removed and ensured that such contents are transferred to a sound container.

ii. Incase of spills / leaks/dry adsorbents/cotton should be used for cleaning instead of water.

iii. Proper slope with collection pits be provided in the storage area so as to collect the spills/leakages.

iv. Storage areas should be provided with adequate number of spill kits at suitable locations. The spill kits should be provided with compatible sorbent material in adequate quantity.

Record Keeping and Maintenance:

Proper records with regard to the industry –wise type of waste received, characteristics as well as the location of the wastes that have been stored in the facility need to be maintained.

Miscellaneous

i) Smoking shall be prohibited in and around the storage areas;

ii) Good house-keeping need to be maintained around the storage areas.

iii) Signboards showing precautionary measures to be taken, in case of normal and emergency situations should be displayed at appropriate locations.

iv) To the extent possible, manual operations with in storage area should be avoided. In case of manual operation, proper precautions need to be taken, particularly during loading / unloading of liquid hazardous waste in drums.

v) A system for inspection of storage area to check the conditions of the containers, spillages, leakages etc. should be established and proper records should be maintained.

vi) The wastes containing volatile solvents or other low vapor pressure chemicals should be adequately protected from direct exposure to sunlight and adequate ventilation should be provided.

vii) Tanks for storage of liquids waste should be properly dyked and should be provided with adequate transfer systems.

viii) Storage sites should have adequate & prompt emergency response equipment systems for the hazardous waste stored on-site. This should include fire fighting arrangement based on the risk assessment, spill management, evacuation and first aid. For this purpose, on-site and off-site accident/emergency plan should be in place.

ix) Immediately on receipt of the hazardous waste, it should be analyzed and depending upon its characteristics its storage should be finalized.

x) Only persons authorized to enter and trained in hazardous waste handling procedures should have access to the storage site.

xi) Mock drill for onsite emergency should be conducted regularly and records maintained.

Storage Time

Normal storage of incinerable hazardous wastes at TSDFs / Cement Plants / Standalone Pre-processing facilitiesshould be restricted to maximum of 3 months. However State Pollution Control Board/Pollution Control Committee may extend the period upto 6 months in accordance with the Hazardous and other wastes (M & TM.) Rules, 2016.

Hazard Analysis and Safety Audit:

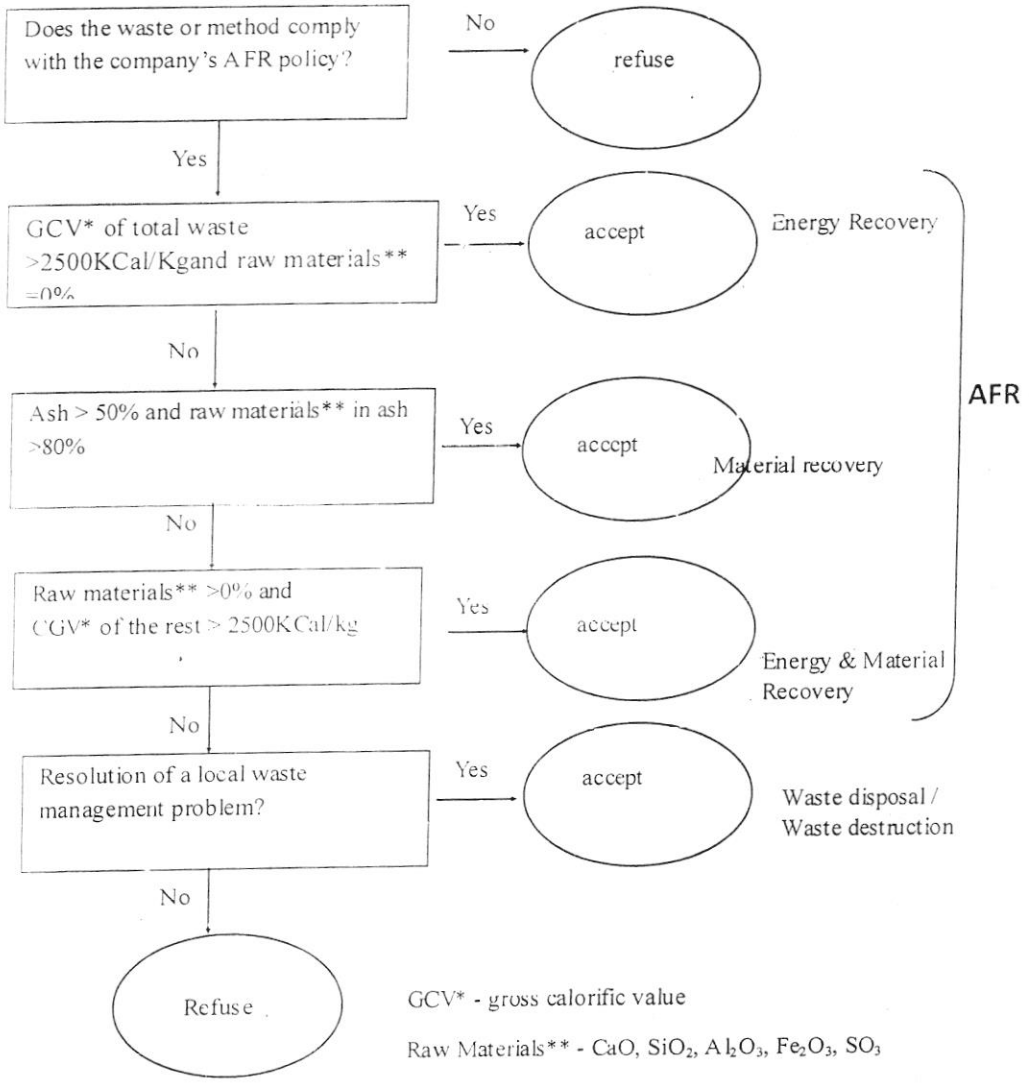
For every pre-processing and co-processing facility, a preliminary hazard analysis should be conducted. Safety Audit internally by the Operator every year & externally once in two years by a reputed expert agency should be carried out and same should be submitted to the SPCB/PCC. The code of practice and reporting shall comply to IS 14489.

Such conditions should be stipulated by SPCBs while granting authorization under the HW (M & TBM) Rules to the operators / pre-processing / co-processing facility.

***

Annexure -4

Acceptance / Refuse chart



GCV* - gross calorific value

Raw Materials** - CaO, SiO_2, Al_2O_3, Fe_2O_3, SO_3

Annexure-5

THE 'LETTER OF INTIMATION' TO SPCBs FOR UNDERTAKING CO-PROCESSING / PRE-PROCESSING OF WASTES

(to be applied when new wastes are introduced for co-processing, which were not enlioned in while seeking authorization)

Date : __ ____ 20__

To,

State Pollution Control Board / Pollution Control Committee

_____

_____

_____

Subject : Letter of intimation for undertaking pre-processing / co-processing of _____ from _____ in our pre-processing / co-processing facility

This is to inform you that we have finalized arrangement with _____ (Name of the industry / municipality / pre-processing agency) to undertake pre-processing / co-processing of following hazardous / non-hazardous waste being generated by them for pre-processing / co-processing in our facility.

1.
2.
3.
4.

We agree to maintain appropriate date wise & waste wise records of receipt, pre-processing, co-processing and stock of these wastes and agree to submit the same for scrutiny on demand.

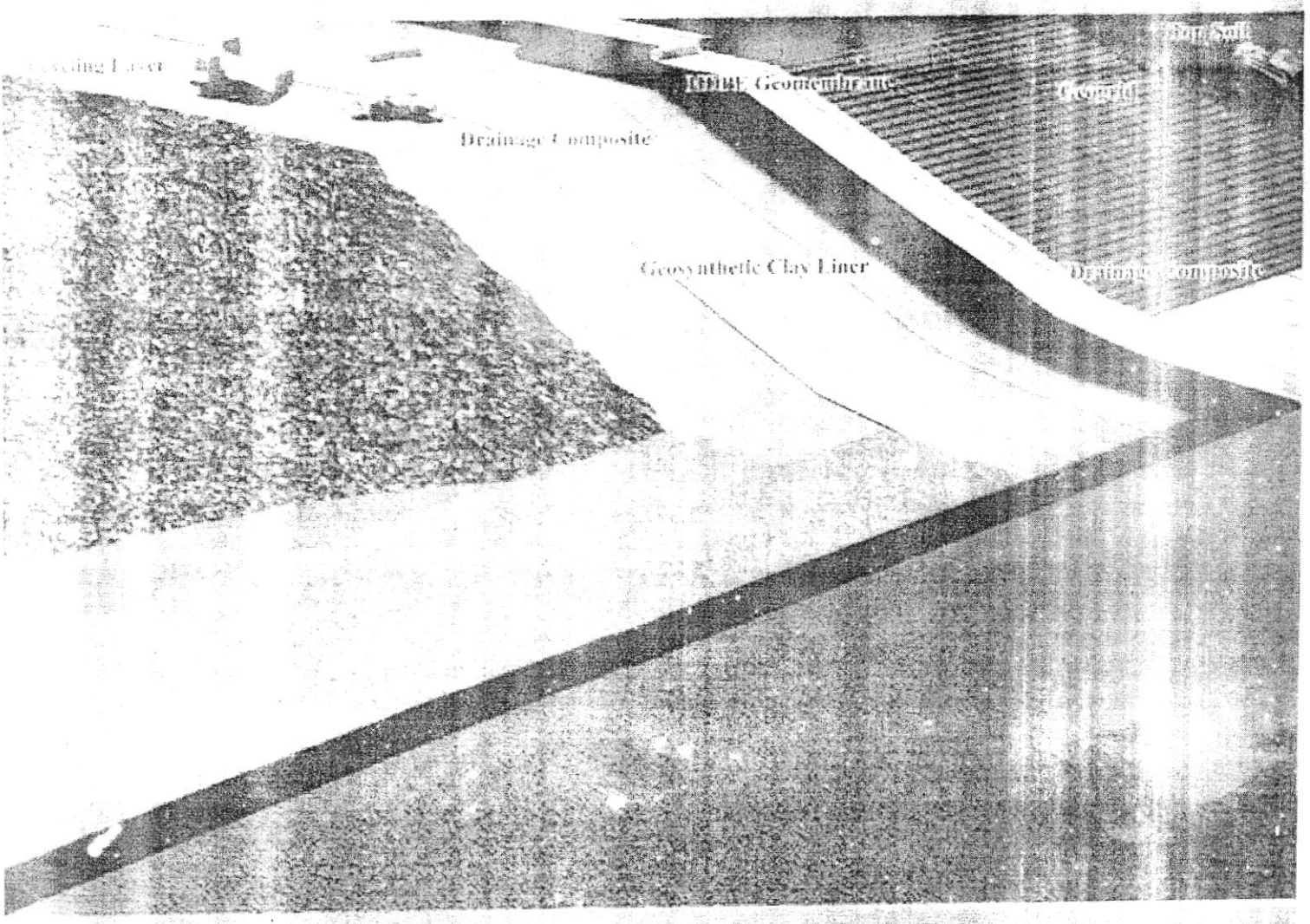
Further, as mandated by the rules, we agree to file returns to you towards the co-processing of all the Hazardous Wastes carried out in our facility on an yearly basis.

Yours faithfully,

(Authorised Signatory)

Hazardous Waste Management
Series : HAZWAMS/17/2000-01

CRITERIA FOR HAZARDOUS WASTE LANDFILLS



CENTRAL POLLUTION CONTROL BOARD
MINISTRY OF ENVIRONMENT & FORESTS
e-mail : cpcb@alpha.nic.in
Website : http//envfor.nic.in/cpcb
February, 2001

Hazardous Waste Management
Series : HAZWAMS/17/2000-01

CRITERIA FOR HAZARDOUS WASTE LANDFILLS

CENTRAL POLLUTION CONTROL BOARD
(Ministry of Environment & Forests, Govt. of India)
Parivesh Bhawan, East Arjun Nager
Delhi – 110 032

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केन्द्रीय प्रदूषण नियंत्रण बोर्ड
(भारत सरकार का संगठन)
पर्यावरण और वन मंत्रालय
Central Pollution Control Board
(A Govt. of India Organisation)
Ministry of Environment & Forests
Phone : 2204948

दिलीप विश्वास
अध्यक्ष

DILIP BISWAS
Chairman

FOREWORD

The Ministry of Environment & Forests, Government of India, has notified the Hazardous Waste (Management & Handling) Rules, in July 1989 under the Environment (Protection) Act, 1986. On 6th of January, 2000, major amendments to these rules with re-defined categories of hazardous wastes and harmonising them with the international laws, were notified. In order to facilitate implementation it is felt necessary to provide a set of guidelines on the Criteria for Hazardous Waste Landfills for the use of industries, implementing agencies and the general public.

The task of preparation of the guidelines was entrusted to a group comprising Prof. Manoj Datta, Indian Institute of Technology, New Delhi, Dr. D.B. Boralkar, Assistant Secretary, Central Pollution Control Board, Delhi and Ms. Sanchita Jindal, Joint Director (HSMD), Ministry of Environment & Forests, New Delhi. Useful criticism and suggestions were provided by National Productivity Council, New Delhi. The draft document was discussed and finalised by an Expert Committee under the Chairmanship of the Chairman, CPCB. The Expert Committee opined that secured disposal facilities need to be properly designed, constructed, commissioned and operated and that such facilities may not serve for the disposal of high-volume low-toxic waste. The present document provides guidance in respect of criteria for location, site selection and investigation, planning and design, waste acceptance, landfill liner system and cover, construction and operation, inspection, monitoring & record keeping, post-closure, financial assurance and contingency plan for emergencies.

This document on criteria for hazardous waste landfills has been brought out for use by implementing agencies, operators of landfills and others concerned.

(Dilip Biswas)

February, 2001

'Parivesh Bhawan', C.B.D. - cum - Office Complex, East Arjun Nagar, Delhi-110 032
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CRITERIA FOR HAZARDOUS WASTE LANDFILLS

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CRITERIA FOR HAZARDOUS WASTE LANDFILLS

1.0. APPLICABILITY

The criteria stated hereafter apply to owners and operators of facilities that dispose hazardous waste in landfills. The term 'hazardous waste landfill' (HW Landfill) is used to designate a waste disposal unit designed and constructed with the objective of minimum impact to the environment. This term encompasses other terms such as "secured landfill", "engineered landfill", "waste mounds", "waste piles" etc.

2.0. LOCATIONAL CRITERIA

HW Landfills shall not be located within a certain distance of the following : lakes, ponds, rivers, wetlands, flood plains, highways, habitation, critical habitat area, water supply wells, Airports, coastal zone. If it is absolutely essential to site a landfill within the restricted zone, then appropriate design measures are to be taken and prior permission from the SPCB/PCC should be obtained :

(a) Lake or Pond : No landfill shall normally be constructed within 200 m of any lake or pond. Because of concerns regarding runoff of waste contaminated water, a surface water monitoring network with approval of SPCB/PCC shall be established.

(b) River : No landfill shall be constructed within 100 m of a navigable river or stream.

(c) Flood Plain : No landfill shall be constructed within a 100 year flood plain. A landfill may be built within the flood plains of secondary streams if an embankment is built along the stream side to avoid flooding of the area. However, landfills must not be built within the flood plains of major rivers unless properly designed protection embankments are constructed around the landfills.

(d) Highway : No landfill shall be constructed within 500 m of the right of way of any state or national highway.

(e) Habitation : A landfill site shall be atleast 500 m from a notified habitated area. A zone of 500 m around a landfill boundary should be declared a no-development buffer zone after the landfill location is finalised.

(f) Public parks : No landfill shall be constructed within 500 m of a public park.

(g) Critical Habitat Area : No landfill shall be constructed within critical habitat areas including reserved forest areas. A critical habitat area is defined as the area in which one or more endangered species live. It is sometimes difficult to identify a critical habitat area. If there is any doubt then the SPCB/PCC shall be consulted for clarification.

(h) Wetlands : No landfill shall be constructed within wetlands. It is often difficult to identify a wetland area. Maps may be available for some wetlands, but in many cases such maps are absent or are incorrect. If there is any doubt, then the SPCB/PCC shall be consulted for clarification.

(i) Airports : No landfill shall be constructed within a zone around Airports as notified by the regulatory authority or the aviation authority.

(j) Water Supply Well : No landfill shall be constructed within 500 m of any water supply well.

(k) Coastal Regulation Zone : No landfill shall be sited in a coastal regulation zone.

(l) Ground water table level : No landfill shall be located in areas where the ground water table will be less than 2 m below the base of the landfill.

(m) Other criteria may be decided by the planners in consultation with SPCB/PCC commensurate with specific local requirements such as presence of monuments, religious structures etc.

3.0. SITE SELECTION

Hazardous waste landfills should preferably be located in areas of low population density, low alternative land use value, low ground water contamination potential and at sites having high clay content in the subsoil.

A HW landfill will be selected following the guidelines published by MoEF. The step by step procedure will be as follows :

(i) Earmarking a 'search area' taking into account the location of the waste generation units and a 'search radius' (typically 5 to 250 km). The search area will be so chosen that it minimises the number of HW landfills in any region or state.

(ii) Identification of a list of potential sites on the basis of
(a) availability of land
(b) collection of preliminary data
(c) restrictions listed in the locational criteria (section 2.0)

(iii) Collection of preliminary data as follows :

a) Topographic Maps : A topographic map will help find sites that are not on natural surface water drains or flood plains. Topographical maps may be procured from Survey of India.

b) Soil Maps : These maps, primarily meant for agricultural use, will show the types of soil near the surface. They are of limited use as they do not show types of soil a few metre below the surface. They may be procured from Indian Agricultural Research Institute.

c) Land Use Plans : These plans are useful in delineating areas with definite zoning restrictions. There may be restrictions on the use of agricultural land or on the use of forest land for landfill purposes. Such maps are available with the Town Planning Authority or the Municipality.

d) Transportation Maps : These maps, which indicate roads and railways and locations of airports, are used to determine the transportation needs in developing a site.

e) Water Use Plans : Such maps are usually not readily available. A plan indicating the following items should be developed : private and public tubewells indicating the capacity of each well, major and minor drinking water supply line(s), water intake wells located on surface water bodies, and open wells.

f) Flood Plain Maps : These maps are used to delineate areas that are within a 100 year flood plain. Landfill siting must be avoided within the flood plains of major rivers.

g) Geologic Maps : These maps will indicate geologic features and bedrock levels. A general idea about soil type can be developed from a geological map. Such maps can be procured from Geological Survey of India.

h) Aerial Photographs / Satellite Imagery : Aerial photographs or satellite imageries may not exist for the entire search area. However such information may prove to be extremely helpful. Surface features such as small lakes, intermittent stream beds and current land use, which may not have been identified in earlier map searches, can be easily identified using aerial photographs.

i) Ground Water Maps : Ground water contour maps are available in various regions which indicate the depth to ground water below the land surface as well as regional

ground water flow patterns. Such maps should be collected from Ground water Boards or Minor Irrigation Tubewell Corporations.

(j) Rainfall Data : The monthly rainfall data for the region should be collected from the Indian Meteorological Department.

(k) Wind Map : The predominant wind direction and velocities should be collected from the Indian Meteorological Department.

(l) Seismic Data : The seismic activity of a region is an important input in the design of landfills. Seismic coefficients are earmarked for various seismic zones and these can be obtained from the relevant BIS code or from the Indian Meteorological Department.

(m) Site Walk Over and Establishment of Ground Truths : A site reconnaissance will be conducted by a site walk-over as a part of the preliminary data collection. All features observed in various maps will be confirmed. Additional information pertaining to the following will be ascertained from nearby inhabitants : (a) flooding during monsoons, (b) soil type; (c) depth to G.W. table (as observed in open wells or tube wells); (d) quality of groundwater and (e) depth to bedrock.

(n) Preliminary Boreholes and Geophysical Investigation : At each site, as a part of preliminary data collection one to two boreholes will be drilled and samples collected at every 1.5m interval to a depth of 20m below the ground surface. The following information will be obtained : (i) soil type and stratification; (ii) permeability of each strata; (iii) strength and compressibility parameters (optional); (iv) ground water level and quality and (v) depth to bedrock. In addition to preliminary boreholes, geophysical investigations (electrical resistivity/seismic refraction/others) may be undertaken to assess the quality of bedrock at different sites.

(iv) Selection of two best ranked sites from amongst the list of potential sites on the basis of the ranking system stipulated by MoEF (1991).

(v) Environmental Impact Assessment for the two sites for the following parameters

(a) ground water quality, (b) surface water quality, (c) air quality - gases, dust, litter, odour; (d) land use alteration, (e) drainage alteration; (f) soil erosion; (g) ecological

impacts (h) noise; (i) aesthetics - visual, vermin, flies; (j) traffic alteration; and (k) others.

(vi) Assessment of public perception for the two sites.

(vii) Selection of final site.

(viii) The above site selection procedure shall not be applicable for location of facility within industrial areas of State Industrial Development Agencies. However EIA requirement will apply.

4.0 SITE INVESTIGATION CRITERIA

The data collected during site selection is not sufficient for landfill design. To be able to undertake detailed design of a landfill at a selected site, it is essential to characterise the landfill site and evaluate the parameters required for design. It is necessary that all data listed in Section 3.0 (iii) on "preliminary data" be collected for site characterisation. If some data has not be collected the same should be obtained before site investigations are undertaken for site characterisation. The following additional data will be collected through a detailed site investigation programme at the chosen site.

A detailed site investigation programme will comprise of subsoil investigation, ground water/hydrogeological investigation, hydrological investigation, topographical investigation and geological investigation. The output expected from each investigation is listed below :

(a) Subsoil Investigation : A detailed investigation plan may be drawn up in consultation with a geotechnical engineer. The output from such an investigation should yield the following :

(i) Stratification of subsoil - type of soil and depth

(ii) Depth to ground water table and bedrock (if located within 15m of base of landfill)

(iii) Permeability of various strata beneath the landfill.

(iv) Strength and compressibility properties of subsoil

(v) Extent of availability of liner material, drainage material, top soil and protective soil in adjacent borrow areas.

(vi) Subsoil properties along approach road.

A minimum of 3 boreholes per hectare of landfill area upto 15m beneath the base of the landfill shall be drilled and insitu tests as well as laboratory tests shall be performed for permeability, strength, compressibility and classification of soils. In addition, test pits and boreholes should be drilled at borrow area for liner and cover materials as well as along approach road.

(b) Ground Water / Hydrogeological Investigation. A detailed investigation plan may be drawn up in consultation with a ground water specialist or a hydrogeologist. The output from such an investigation should yield the following :

(i) Depth to groundwater table and its seasonal variations.

(ii) Ground water flow direction.

(iii) Baseline ground water quality parameters - all drinking water quality parameters.

(c) Topographical Investigation. Construction of a landfill involves a large quantity of earthwork. It is essential to have an accurate topographical map of the landfill site to compute earthwork qauntities precisely. A map of 0.3m contour interval is considered desirable.

(d) Hydrological Investigation. The objective of a hydrological investigation is to estimate the quantity of surface runoff that may be generated within the landfill to enable appropriate design of drainage facilities. If additional run off from areas external to the landfill is likely to enter the landfill, this quantity should also be estimated to design interception ditches and diversion channels. Such an investigation shall yield estimates of peak flows. If seasonal rivers or streams run close to the site, hydrological investigation should indicate the possibility of flooding of the site under one in 100 year flood flows. Surface water samples for water quality analysis may be collected from during hydrological studies.

(e) Geological Investigation and Seismic Investigation. Geological investigations shall delineate the bedrock profile beneath the landfill base, if not confirmed by subsoil investigations. Geophysical surveys may be designed in consultation with a geologist. In hilly areas or in quarried rocks, geological investigations should indicate the quality of surficial rock, depth to sound rock and the possibility of interconnected aquifers beneath the landfill base in the rock mass. Detailed seismic data may be obtained as a part of geological investigations (if required) in seismically active areas.

5.0. PLANNING AND DESIGN CRITERIA

5.1. Essential Components :

A HW landfill shall have the following seven essential components :

(a) A liner system at the base and sides of the landfill which prevents migration of leachate or gas to the surrounding soil.

(b) A leachate collection and treatment facility, which collects and extracts leachate from within and from the base of the landfill and then treats the leachate to meet standards, notified under E(P)Act 1986.

(c) A gas collection and treatment facility (optional) which collects and extracts gas from within and from the top of the landfill and then treats it or uses it for energy recovery.

(d) A final cover system at the top of the landfill, which enhances surface drainage, prevents infiltration of water and supports surface vegetation.

(e) A surface water drainage system, which collects and removes all surface runoff from the landfill site.

(f) An environmental monitoring system which periodically collects and analyses air, surface water, soil-gas (optional) and ground water samples around the landfill site.

(g) A closure and post-closure plan which lists the steps that must be taken to close and secure a landfill site once the filling operation has been completed and the activities for long-term monitoring, operation and maintenance of the completed landfill.

5.2. Design life

A landfill design life will comprise of an 'active' period and an 'closure and post-closure' period. The 'active' period shall comprise of the period for which waste filing is in progress at the landfill and typically range from 10 to 25 years depending on the availability of land area. The 'closure and post-closure' period for which a landfill will be monitored and maintained shall be 30 years after the 'active period' is completed.

5.3. Waste Volume, Waste Compatibility and Landfill Capacity

The volume of waste to be placed in a landfill will be computed for the active' period of the landfill taking into account (a) the current generation of waste per annum and (b) the anticipated increase in rate of waste generation on the basis of past records.

A landfill will comprise of separate 'units'. In each unit, only compatible wastes will be disposed. Table 1 gives guidelines regarding compatibility of wastes. Incompatible wastes will be stored in separate units.

The actual capacity of each landfill unit will be computed taking into account the volume occupied by the liner system and the cover material [daily/weekly (optional) intermediate and final cover] as well as the compacted density of the waste. In addition, the amount of settlement a

waste will undergo due to overburden stress and due to bio-degradation (if any) shall also be taken into account.

The total landfill area should be computed on the basis of the designed height of the landfill (usually between 5 to 20m). Approximately 15 to 20% area more than the area required for landfilling should be adopted to accommodate all infrastructure and support facilities as well as to allow the formation of a green belt around the landfill. This additional area shall be computed separately and may be as high as 30% of the total area in case of small to medium landfills. The total landfill area is computed on trial and error basis.

There is no standard method for classifying landfills by their capacity. However the following nomenclature is often observed in literature :

Small size landfill	:	less than 5 hectare area
Medium size landfill	:	5 to 20 hectare areas
Large size landfill	:	greater than 20 hectare area

5.4. Landfill Layout

A landfill site will comprise of the area in which the waste will be filled as well as additional area for support facilities. The area in which waste is to be filled may comprise of separate landfill units with each unit accommodating a group of compatible wastes. Within each unit work may proceed in phases with only a part of the area under active operation. A typical site layout is shown in Fig 1. Such a layout must be prepared for all landfills. The following facilities must be located in the layout: (a) access roads; (b) equipment shelters; (c) weighing scales; (d) office space; (e) location of waste inspection facility (if used); (f) temporary waste storage and/or disposal sites for special wastes; (g) demarcation of the landfill areas and areas for stockpiling cover material and liner material; (h) location of surface water drainage facilities; (i) location of landfill leachate management facilities; (j) location of gas management facilities (optional); (k) location of monitoring wells/environmental monitoring facilities; (l) fencing and green belt along the peripheral boundary and (m) emergency exit.

It is essential that for each landfill site, a layout be designed incorporating the above mentioned facilities.

5.5. Landfill Section

Landfills may have different types of sections depending on the topography of the area. The landfills may take the following forms: (a) above ground landfills; (b) below ground landfill; (c) slope landfills; (d) valley landfills (canyon landfills); and (e) a combination of the above. Fig 2 shows some typical landfill sections.

It is recommended that the landfill section be arrived at keeping in view the topography, depth to water table and availability of liner and cover material. Above ground landfills shall be preferred to below ground landfills as leachate collection in the former is by gravity flow and does not require the use of pumps.

Slope landfills and valley landfills are normally adopted in hilly areas, above-ground landfills in flat undulating ground and below-ground landfills in low-lying areas, depressions or pits.

5.6. Phased Operation

Before the main design of a landfill can be undertaken it is important to develop the operating methodology. A landfill is operated in phases because it allows the progressive use of the landfill area, such that at any given time a part of the site may have a final cover, a part being actively filled, a part being prepared to receive waste, and a part undisturbed.

For each landfill unit, a phased operation plan will be drawn up.

The term 'phase' describes a sub-area of the landfill. A 'phase' consists of cells, lifts, daily/weekly (optional) or intermediate cover, liner and leachate collection facility, gas control facility (optional) and final cover over the sub-area (Fig.3).

Each phase is typically designed for a period of 12 months. Phases are generally filled from the base to the final/intermediate cover and capped within this period leaving a temporary unrestored sloping face. Fig.4 shows a simplified sequence of phased operation.

A 'phase plan' shall be drawn up for the active life of the landfill as soon as the landfill layout and section are finalised. It must be ensured that each phase reaches the final cover/intermediate cover level at the end of its construction period and that it is capped before the onset of monsoons.

During the monsoon months the waste may stockpiled in a temporary holding areas (covered with roof). During this period and the landfill may be kept capped with the final cover/intermediate cover and landfilling operations suspended to reduce infiltration of rain water into the landfill. However, if the incoming waste quantity is too large for temporary stockpiling or the monsoon period lasts for a long period, special phases may have to be designed with high leachate handling capacity and special operating procedures adopted.

5.7. Estimation of Leachate Quantity

Leachate is generated on account of the infiltration of water into landfills and its percolation through waste as well as by the squeezing of the waste due to self weight. The quantity of leachate generated in a landfill

is strongly dependent on the quantity of infiltrating water. This, in turn, is dependent on weather and operational practices. The amount of rain falling on a landfill, to a large extent, controls the leachate quantity generated. Precipitation depends on geographical location.

Significant quantity of leachate is produced from the 'active' phases of a landfill under operation. The leachate quantity from those portions of a landfill which have received a final cover is minimal. Fig. 5 shows the components of a water balance approach for estimating leachate quantity.

For design, computer simulated models (e.g. HELP) have to be used for estimation of leachate quantity generation. It is recommended that such studies be conducted to estimate the quantity of leachate and design the leachate drainage, collection and removal facility.

5.8. Liner System

Leachate control within a landfill involves the following steps: (a) prevention of migration of leachate from landfill sides and landfill base to the subsoil by a suitable liner system and (b) drainage of leachate collected at the base of a landfill to the side of the landfill and removal of the leachate from within the landfill.

On a basis of review of liner systems adopted in different countries and in consideration with Indian conditions, it is recommended that for all HW landfills the liner system criteria listed in Section 7.0 be adopted in consultation with SPCB/PCC and commensurate with local area specified needs.

5.9. Leachate Drainage, Collection and Removal

A leachate collection system shall be designed at the base of all landfills. It shall comprise of a drainage layer, a perforated pipe collection system, sump collection area, and a removal system.

The leachate collection layer (drainage layer) will usually be a 30 cm thick sand-gravel layer with a slope of 2% or higher and a permeability of greater than 10^{-2} cm/sec (10^{-4} m/sec). A system of perforated pipes and sumps is provided within the drainage layer. The pipe spacing will be governed by the requirement that the leachate head shall not be greater than the drainage layer thickness. Fig. 6 shows a typical layout of pipes and sumps.

Leachate will be removed from the landfill (Fig. 7) by (a) pumping in vertical wells or chimneys (b) pumping in side slope risers, or (c) by gravity drains through the base of a landfill in above-ground and sloped landfills. Side slope risers may be preferred to vertical wells to avoid any down drag problems. Submersible pumps have been used for pumping for several years; educator pumps are also being increasingly used. The

leachate may be stored in a holding tank (for a few days) before being sent for treatment.

The design of following components should be undertaken :

(a) leachate pipe and leachate trench network

(b) leachate sumps and pumps

(c) leachate wells/side slope riser

(d) leachate holding tank

(e) backwashing/backflushing arrangement to prevent clogging/ choking/headloss.

The material used for pipes etc., should be such that it is not affected by the leachate quality.

5.10. Leachate Management

The following alternatives shall be considered for leachate management :

(a) Offsite treatment of leachate : This involves storage, pretreatment and transportation of leachate to off-site facilities not associated with the landfill e.g. industrial effluent treatment facility etc. This will be feasible where offsite facilities are available at a reasonable distance and where pretreatment requirements for the leachate (such as adjustment of pH, reduction in concentration etc.) are not very stringent. Transportation of leachate to offsite facility will be undertaken through a manifest system in accordance with HWM rules of MoEF.

(b) Onsite treatment of leachate : This involves complete treatment of the leachate at the landfill site to meet discharge standards for lined drains. Treatment processes may be biological, chemical or physical processes. Processes which have been judged as having been "demonstrated", should be adopted.

(c) Recirculation : One of the methods for treatment of leachate is to recirculate it through the landfill. This has two beneficial effects (i) the process of landfill stabilisation is accelerated and (ii) the constituents of the leachate are attenuated by the biological, chemical and physical changes occurring with the landfill. Recirculation of a leachate requires the design of a distribution system to ensure that the leachate passes uniformly throughout the entire waste. Leachate recirculation has been used in some municipal waste landfills. Information on its efficacy in HW landfills is scanty.

5.11. Gaseous Emissions Management

Landfill gas is generated as a product of waste biodegration or on account of presence of VOCs in the waste. Gas generation can be reduced or eliminated by avoiding disposal of biodegradable/organic wastes. For HW landfills where gaseous emissions are anticipated (as in the case of mixed waste having biodegradable components) the gas management strategy shall be (a) controlled passive venting or (b) controlled collection and treatment/reuse.

5.12. Final Cover System

A final landfill cover, comprising of several layers, each with a specific function shall be installed after each landfill phase reaches the full height. The final cover system shall enhance surface drainage, minimise infiltration, support vegetation to prevent erosion and control the release of landfill gases. On the basis of a review of HW landfill covers adopted in different countries [#] and in consideration with Indian Conditions the cover system criteria listed in Section 7.0 be adopted in consultation with SPCB/PCC and commensurate with local area specified needs.

5.13. Surface Water Drainage System

Surface water management is required to ensure that rainwater run-off does not drain into the waste from surrounding areas and that there is no waterlogging/ponding on covers of landfills. A surface water drainage system comprising of channels, drains, culverts and basins (Fig.8) shall be designed to ensure the following:

(a) Rainwater running off slopes above and outside the landfill area shall be intercepted and channelled to water courses without entering the operational area of the site. This diversion channel may require a low permeability lining to prevent leakage into the landfill.

(b) Rain falling on active tipping areas shall be collected separately and managed as leachate, via the leachate collection drain and leachate collection sumps to the leachate treatment and disposal system.

(c) Rainfall on areas within the landfill site, but on final covers of phases which have been completed and are not actively being used for waste disposal shall be diverted in drainage channels away from active tipping areas, and directed through a settling pond to remove suspended silt, prior to discharge.

(d) Any drainage channels or drains constructed on the restored landfill surface shall be able to accommodate settlement, resist erosion and cope with localised storm conditions.

(e) The horizontal surface of the final cover shall be provided a slope of 3 to 5% for proper surface water drainage. The slope of the cover on the sides will be higher and governed by slope stability considerations.

(f) All interceptor channels, drainage channels and settling ponds (storm water basins) shall be designed by a hydrologist using hydrometerological data.

(g) It shall be ensured that water collected by surface water drainage system and leachate collected by the leachate collection system do not get intermixed at any stage of collection or storage. This shall apply to the 'active' and 'post closure' periods of the landfill.

The design of following components shall be undertaken :

(a) stormwater drains, diversion channel
(b) stormwater basin
(c) culverts

5.14. **Base stability, Slope stability and Seismic Aspects**

For landfills constructed on loose/soft soil, the base will be checked for stability against bearing failure or excessive settlements.

The stability of side slopes of a landfill shall be checked for the following cases (Fig. 9).

(a) stability of excavated slopes
(b) stability of liner system along excavated slopes
(c) stability of temporary waste slopes constructed to their full height (usually at the end of a phase)
(d) stability of slopes of above-ground portion of completed landfills
(e) stability of cover systems in above ground landfills.

The stability analysis shall be conducted using the following soil mechanics methods depending upon the shape of the failure surface : (a) failure surface parallel to slope; (b) wedge method of analysis; (c) method of slices for circular failure surface and (d) special methods for stability of anchored geomembranes along slopes.

In preliminary design of a landfill section, the following slopes may be adopted :

(a) Excavated soil slopes	(2.5 horizontal : 1 vertical)
(b) Temporary waste slopes	(3.0 horizontal : 1 vertical)
(c) Final cover slopes	(4.0 horizontal : 1 vertical)

Slopes can be made steeper, if found stable by stability analysis results. Acceptable factors of safety may be taken as 1.3 for temporary slopes and 1.5 for permanent slopes. In earthquake prone areas, the stability of all landfill slopes shall be conducted taking into account seismic coefficients as recommended by BIS codes.

5.15. Materials Balance

A materials balance shall be prepared for each material required for construction of a landfill phase-by-phase, indicating materials required materials available and deficient material to be improted or surplus material to be exported. If a borrow area is located within the landfill site it shall not become a part of an early phase to avoid stockpiling and double handling.

5.16. Site Infranstructure

The following site infrastructure shall be provided at each HW landfill

(a) Site Entrance and Fencing
(b) Administrative and Site Control Offices
(c) Access Roads
(d) Waste Inspection and Sampling Facility
(e) Equipment Workshops and Garages
(f) Signs and Directions
(g) Water Supply
(h) Lighting
(i) Vehicle Cleaning Facility
(j) Fire Fighting Equipment.

Site entrance infrastructure should include

(a) A permanent, wide, entrance road with separate entry and exit lanes and gates
(b) Sufficient length/parking space inside the entrance gate till the weighbridge to prevent queuing of vehicles outside the entrance gate and on to the highway
(c) A properly landscaped entrance area with a green belt of 20m containing tree plantation for good visual impact
(d) Proper direction signs and lighting at the entrance gate
(e) A perimeter fencing of atleast 2m height all around the landfill site with lockable gates to prevent unauthorised access
(f) Full time security guard at the site.

An accurate record of waste inputs is essential, hence good quality weighbridges shall be used. For sites receiving more than 400 tons per day of waste, twin weighbridges to weigh both entry and exit weights may be located on either side of an island on which a weighbridge office room

is located. The weighbridge office should be elevated and the weighbridge operator should be able to see entering vehicles as well as speak to drivers.

Administrative and site control offices should include : administrative office building (permanent); site control office (portable) near the active landfill area; stores (permanent) within or near administrative office; welfare facilities - toilets, shower room, first aid room, mess room, small temporary accommodation; infrastructural services - electricity, drinking water supply, telephone, sewerage and drainage system and communication services (telephone etc.) between site control office and administrative office and weighbridge office.

5.17. Environmental Monitoring System

Monitoring at a landfill site (Fig. 10) shall be carried out in four zones (a) on and within the landfill; (b) in the unsaturated subsurface zone (vadose zone) beneath and around the landfill; (c) in the groundwater (saturated) zone beneath and around the landfill and (d) in the atmosphere/local air above and around the landfill.

The parameters to be monitored regularly are :

(a) long-term movements of the landfill cover;
(b) leachate head within the landfill;
(c) leachate quality within the landfill;
(d) gas quality (optional) within the landfill;
(e) quality of pore fluid in the vadose zone;
(f) quality of pore gas (optional) in the vadose zone;
(g) quality of groundwater in the saturated zones and
(h) air quality above the landfill, at the gas control facilities, at buildings on or near the landfill and along any preferential migration paths

The indicators of leachate quality and landfill gas quality must be decided after conducting a study relating to the type of the waste, the probable composition of leachate and gas likely to be generated and the geotechnical as well as hydro-geological features of the area.

A monitoring programme must specify (i) a properly selected offsite testing laboratory capable of measuring the constituents at current detection levels (ii) a methodology for acquiring and storing data; and (iii) a statistical procedure for analyses of the data.

The following instruments/equipment shall be used for monitoring :

(a) Groundwater samplers for groundwater monitoring wells.
(b) Leachate samplers for leachate monitoring within the landfill and at the leachate tank.

(c) Vacuum lysimeters, filter tip samplers, free drainage samplers for leakage detection beneath landfill liners.

(d) Surface water samplers for collection of sample from sedimentation basin.

(e) Downhole water quality sensors for measuring conductivity, pH, DO, temperature in leachate wells, groundwater wells and sedimentation basins.

(f) Landfill gas monitors (portable) for onsite monitoring of landfill gases.

(g) Active and passive air samplers for monitoring ambient air quality.

It is recomemended that the location of each type of instrument/equipment be finalsed in conjunction with an expert on the basis of the topography of the area and the layout of the landfill. A minimum of 4 sets of ground water monitoring wells (one up-gradient and three down gradient) for sampling in each acquifer are considered desirable at each landfill site (Fig 11)

5.18. Closure and Post-Closure Maintenance Plan

A statement on the end-use of landfill site is an essential part of the plan for landfill closure and post-closure maintenance. Some possible uses of closed landfill sites near urban centres include parking area, recreational area etc. A closed landfill should be aesthetically landscaped.

A closure and post-closure plan for HW landfills must be evolved and should indicate the following components

- Plan for vegetative stabilization of the final landfill cover and side slopes
- Plan for management of surface water run-off with an effective drainage system
- Plan for periodical inspection and maintenance of landfill cover and facilities.
- Plan for post-closure management of leachate and gas
- Plan for post-closure environment monitoring.

6.0. WASTE ACCEPTANCE CRITERIA

A waste acceptance criterion shall be formulated for each landfill site. The following guidelines for waste acceptance are suggested

(a) All waste shall be routinely accepted if the truck/tipper carries authorised documents indicating the source and type of waste. Such waste shall be routinely inspected visually at the tipping area in the landfill site.

(b) Bulk or non-containerised liquid hazardous waste or slurry-type hazardous waste containing free liquid or waste sludge, which has not been dewatered, shall not be placed in landfills. Such waste, (usually transported in pipelines) shall be placed in Hazardous Waste Impoundments designed specifically for liquid hazardous waste.

(c) Incinerable/compostable waste or any other type of waste from which energy/material recovery is feasible, shall not be placed in HW landfills.

(d) Incompatible wastes shall not be placed in the same landfill unit. Compatible wastes will be grouped together and placed in the same landfill unit (each such unit shall have its own phase, cells etc). Incompatible waste group shall be accommodated in separate landfill units (each such unit shall have its own phases, cells etc).

(e) Wastes which are incompatible with the liner material shall either be containerised and placed in the landfill (ensuring adequate container safety, or placed in a separate landfill unit made of alternate compatible liner material).

(f) Extremely hazardous waste (e.g. radioactive waste) shall not be disposed off in HW landfills but in specially designed waste disposal units.

(g) Non-hazardous waste (e.g. municipal solid waste) shall not be deposited in HW landfills. However such waste can be deposited in a MSW landfill units in the vicinity of HW landfills.

(h) Residue of treated biomedical waste (e.g. incinerator ash etc) can be deposited in HW landfills.

7.0. LANDFILL LINER AND COVER CRITERIA

7.1 Liner Criteria

The liner system shall be designed, constructed and installed to satisfy the following:

(a) Prevent migration of waste, leachate or gas to the adjacent subsurface soil or ground water or surface water.

(b) Constructed of materials that have adequate chemical properties, physical properties and engineering properties to prevent failure on account of loads, climatic conditions, and contact with waste or leachate.

(c) Placed in a stable manner on the base and side slopes.

(d) Installed to cover all surrounding soils likely to come in contact with the waste or leachate.

The base of the liner system (at the lowest point in a landfill) shall be atleast 2.0 meter above the highest anticipated ground water table level.

7.1.1. Minimum Specifications

The liner system shall be designed specifically for each site to meet the criteria stated in Section 7.1.

The liner system must include the following components. However depending on the design requirements, the number of components as well as the specifications of the components can exceed the minimum specifications listed below. The components listed below are wastedownwards (Fig. 12).

(a) A leachate collection layer of thickness 30 cm or more and coefficient of permeability in excess of 10^{-2} cm/sec (10^{-4} m/sec.).

(b) A single composite liner comprising of

(i) A HDPE geomembrane of thickness 1.5 mm or more (see specification* below) and

(ii) A compacted clay (or compacted amended soil) layer of thickness 150 cm or more having a coefficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less. At locations where availability of clay is limited, amended soil will be constituted by mixing bentonite or any other suitable clay to locally available soil to achieve the desired permability.

In regions where rainfall is high and/or subsoil is highly permeable (e.g. gravel, sand, silty sand) and/or the water table is within 2.0 m to 6.0 m beneath the base of the landfill, the liner system shall be a double composite liner and shall include the following components, wastedownwards (Fig. 13).

(a) A primary leachate collection layer of thickness 30 cm or more and coefficient of permeability in excess of 10^{-2} cm/sec (10^{-4} m/sec).

(b) A primary composite liner comprising of

(i) A HDPE geomembrane of thickness 1.5 mm or more (see specification* below) and

(ii) A compacted clay (or compacted amended soil) layer of thickness 45 cm or more having a coefficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less.

(c) A secondary leachate collection layer (also called leak detection layer) of thickness 30 cm or more and coefficient of permeability in excess of 10^{-3} cm/sec (10^{-5} m/sec)

(d) A secondary composite liner comprising of

(i) A HDPE geomembrane of thickness 1.5 mm or more (see specification* below) and
(ii) A compacted clay (or compacted amended soil) layer of thickness 45 cm or more having a coefficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less.

**Specification : [The geomembrane must have (a) Tensile Strength at yield > 18 kN/m, (b) Tensile Strength at break > 30 kN/m, (c) Tear Resistance > 150 N and (d) Puncture Resistance > 250 N]*

The liner materials listed above can be substituted by equivalent materials only if the following is satisfied :

(a) the liner system components continue to function as 'composite liners; and
(b) the use of such components has been demonstrated over a 10 year period in different HW landfill and approved by a regulatory agency
(c) the design, construction and quality control specifications of such materials have been approved by a regulatory agency and are available for implementation.

For extremely hazardous waste, the number of composite liner layers shall, if necessary, exceed two and these will be finalised by the design engineer in consultation with SPCB/PCC as per site specific conditions

7.1.2. Design Requirements

The liner system shall meet the following design requirements :

(a) Requirement of adequate stability at the base of the landfill (in soft soil)
(b) Requirement of adequate stability along the sides of the landfill
(c) Requirement of adequate strength to withstand construction loads/vehicle loads
(d) Requirement of permeability and material properties as specified in Section 7.1.1.
(e) Requirement of compatibility with leachate and waste
(f) Requirement of transition filters between waste and leachate collection layer to prevent clogging of the leachate collection layer.

(g) Requirement of protection layer/transition layer between each component of the liner system (A protection layer between a leachate collection layer and the HDPE geomembrane may sometimes be required if coarse/angular sand or gravel is used in the leachate collection layer. The protection layer may comprise of silt/local earth (15cm thick or a geotextile).

(h) Requirement of adequacy of clay additive in amended soils.

Guidelines for design are indicated in "Manual for Design, Construction & Quality Control of Liners & Covers" (to be prepared).

7.1.3. Construction Requirements

The liner system shall be constructed to ensure that :

(a) the compacted clay (or compacted amended soil) layer has a co-efficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less, is devoid of clods and shrinkage cracks; and achieves the desired strength.

(b) the geomembranes is laid in intimate contact with the compacted clay/compacted amended soil layer, is properly joined/welded at the seams and is not punctured by construction vehicles/tools.

(c) the leachate collection layer has a coefficient of permeability of 10^{-2} cm/sec (10^{-4} m/sec) or more and does not become clogged by intermixing or migration of fine particles.

On side slopes, the horizontal width of the 150 cm thick clay liner will normally exceed 300 cm and the clay can be compacted in horizontal layers using standard compaction equipment or in inclined layers using slope compactors.

Guidelines for construction are indicated in "Manual for Design, Construction & Quality Control of Liners & Covers" (to be prepared).

7.1.4. Quality Control

A quality assurance programme shall be drawn up by the owner/operator during construction of the liner system. Such a programme will include :

(a) Regular performance of quality assurance test in the field for each component of the liner system – one set of field and laboratory tests for each soil component per 500 to 1000 cubic meters of earthwork and one set of field and laboratory tests for the geomembrane per 200 sq m. of installed area.

(b) Approval by the regulatory authority of the lists of tests, their frequency and the acceptance criteria.

(c) Periodical visits by representatives of the regulatory authority (or their nominee) during construction of the liner.

(d) Complete documentation of all quality control records and their submission to the SPCB/PCC alongwith statistical analysis showing satisfactory achievement of acceptance criteria.

The quality control tests for compacted clay layer (or amended soils) as well as the leachate collection/drainage layer shall include (i) in-situ density tests, (ii) in-situ moisture content tests, (iii) compaction tests, (iv) permeability tests, (iv) grain size distribution tests and (v) Atterberg's limits tests (vi) others.

The quality control tests for geomembrane liners shall include (i) thickness tests, (ii) density tests, (iii) strength tests, (iv) toughness tests, (v) durability tests, (vi) chemical resistance tests, (vii) field seam strength tests, (viii) overlap check tests, (ix) others.

Guidelines for quality control are indicated in "Manual for Design Construction & Quality Control of Liners & Covers" (to be prepared)

7.2. Cover Criteria

The cover system shall be designed, constructed and installed to satisfy the following :

(a) Prevent infiltration of precipitation into the closed landfill.
(b) Promote drainage of surface water accumulated on the cover.
(c) Minimise erosion of the cover.
(d) Withstand or accommodate settlement of the cover to maintain its integrity
(e) Have a permeability less than or equal to the liner system
(f) Function with minimum maintenance for the post-closure period of 30 years.

7.2.1. Minimum Specifications

The cover system shall be designed specifically for each site to meet the criteria stated in Section 7.2.

The cover system must include the following components. However, depending on design requirements, the number of components as well as the specification of the components shall exceed the minimum specifications listed below. The components listed below are from top surface downwards to the waste (Fig. 14).

(a) A surface soil layer of local top soil which supports self-sustaining vegetation and which has a thickness not less than 60 cm.

(b) A drainage layer of thickness 30 cm or more having a coefficient of permeability in excess of 10^{-2} cm/sec (10^{-4} m/sec).

(c) A single composite barrier comprising of

(i) A HDPE geomembrane of thickness 1.5 mm or more and
(ii) A compacted clay (or compacted amended soil) layer of thickness 60 cm or more having a coefficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less. At locations where availability of clay is limited, amended soil will be constituted by mixing bentonite or any other suitable clay to locally available soil to achieve the desired permeability

(d) A regulatory layer (optional) of thickness 30 cm having coefficient of permeability greater than 10^{-2} cm/sec (10^{-4} m/sec). Such a layer shall be provided whenever there is requirement of (i) gas collection or (ii) transition filter between waste and soil.

The drainage layer shall be replaced by the local top soil if the coefficient of permeability of the local top soil is greater than 10^{-4} cm/sec. In such a case the total thickness of the surface soil layer (of top soil) will be 90 cm.

In dry arid regions, where self sustaining vegetation is not possible, special erosion control measures shall be adopted for the stability for the cover soil layer.

The cover materials listed above can be substituted by equivalent materials if the following is satisfied.

(a) the use of such components has been demonstrated over a 10 year period in different HW landfills and approved by a regulatory agency o. SPCB/PCC.
(b) the design, construction and quality control specifications of such materials have been approved by a regulatory agency or SPCB/PCC and are available for implementation.

7.2.2. Design Requirements

The cover system shall meet the following design requirements

(a) Requirement of stability/integrity of cover under settlement through design/maintenance/repair.
(b) Requirement of stability of steep side slopes of cover
(c) Requirement of establishment of self-sustaining vegetative cover for long-term stabilisation/or special measures in dry arid regions.
(d) Requirement of adequate strength to withstand construction loads/vehicle loads.
(e) Requirement of permeability and material properties as specified in Section 7.2.1.

(f) Requirement of surface water drainage as specified in Section 5.13.

(g) Requirement of transition filter between waste and the layer immediately above it.

(h) Requirement of protection layer/transition layer between each component of the liner system.

Guidelines for design are indicated in "Manual for Design, Construction & Quality Control of Liners & Covers" (to be prepared).

7.2.3. Construction Requirements

The cover system shall be constructed to ensure that

(a) the surface soil layer is adequately compacted and prepared to allow vegetative growth.

(b) the compacted clay/compacted amended soil layer has a coefficient of permeability of 10^{-7} cm/sec (10^{-9} m/sec) or less, is devoid of clods and shrinkage cracks and achieves the desired strength.

(c) the geomembranes is laid in intimate contact with the compacted clay/compacted amended soil layer; is properly joined/welded at the seams; and is not punctured by construction vehicles/tools.

(d) the drainage layer has a coefficient of permeability of 10^{-2} cm/sec (10^{-4} m/sec) or more and does not become clogged by intermixing or migration of fine particles.

(e) the final cover slopes are as specified in section 5.13.

Guidelines for construction are indicated in "Manual for Design, Construction & Quality Control of Liners & Covers" (to be prepared).

7.2.4. Quality Control

A quality assurance programme shall be drawn up by the owner/operator during construction of the cover system. Such a programme shall include :

(a) Regular performance of quality assurance tests in the field for each component of the cover system – one set of field and laboratory tests for each soil component per 500 to 1000 cubic meters of earthwork and one set of field and laboratory tests for the geomembrane per 200 sq m. of installed area.

(b) Approval by the regulatory authority of the lists of tests, their frequency and the acceptance criteria.

(c) Periodical visits by representative of SPCB/PCC (or their nominee) during construction of the cover.

(d) Complete documentation of all quality control records and their submission to the SPCB/PCC alongwith statistical analysis showing satisfactory achievement of acceptance criteria.

The type of quality control tests for the drainage layers, compacted clay layer and geomembrane shall be the same as those indicated in Section 7.1.4. for the liner system.

Guidelines for quality control are indicated in "Manual for Design, Construction & Quality of Liners & Covers" (to be prepared)

8.0. Construction and operational criteria

The construction and operation of a landfill shall consist of the following steps :

(a) Site Development
(b) Phase Development
(c) Phase Operation
(d) Phase Closure
(e) Landfill Closure
(f) Post-closure vegetative stabilisation

8.1. Site Development

The following construction activities shall be undertaken during site development :

(a) Construction of perimeter fence, entrance gate, and green belt
(b) Construction of main access road near the entrance gate with parking area
(c) Construction of road along the perimeter of the site and well as construction of arterial load to tipping area of the first phase
(d) Acquisition and installation of weighbridges
(e) Construction of weighbridge room/office, administrative office and site control office
(f) Construction of waste inspection facility, equipment workshop and garage, vehicle cleaning area
(g) Installation of direction signs, site lighting, fire fighting facilities, communication facilities
(h) Construction of water supply and waste water/sewage disposal system
(i) Construction of surface water drainage system
(j) Construction of main leachate pipe, tank and treatment facility
(k) Installation of environmental monitoring facilities
(l) Construction of gas collection pipe and treatment facility (if needed)
(m) Construction of waste recovery/incineration/waste processing facility (if so planned)
(n) Construction of emergency exit gate

8.2. Site Procedures : Record Keeping & Waste Inspection

Record keeping procedures as well as waste acceptance procedures to be followed at the landfill site shall be formulated.

Records shall be kept on a daily, weekly and monthly basis. In addition a site Manual shall be kept at the site office giving all site investigation design and construction details – these are necessary as landfill design may get modified during the operational phase.

(i) Site Manual : The site manual shall contain the following information :

(a) Data collected during site selection
(b) Environmental impact assessment report
(c) Site investigation and characterisation data
(d) Detailed topographical map
(e) Design of all landfill components
(f) Landfill layout and its phases
(g) Construction plans
(h) Details of leachate management plan
(i) Details of gas management plan (optional)
(j) Environmental monitoring program
(k) Closure and post-closure plan
(l) All permissions/licences from concerned authorities.

(ii) **Site Reports** : The daily, weekly and monthly reports shall comprise of the following :

(a) Weighbridge data (daily inflow and outflow for each vehicle)
(b) Waste inspection data (daily)
(c) Materials, stores etc. (daily)
(d) Bills/accounts (daily)
(e) Visitor record (daily)
(f) Complaints record from nearby areas (daily)
(g) Topographic survey at operating phase (daily/weekly)
(h) Photographic record at operating phase (daily/weekly)
(i) Environmental monitoring data (weekly/monthly)
(j) Wastefilling plan and actual progress i.e. cell construction (daily/weekly) and review (monthly).
(k) Leachate generation and gas generation (weekly/ monthly/extreme events).
(l) Weather/climatic data (extreme events)
(m) Accidents etc. (adhoc)
(n) Others.

(iii) Vehicle Inspection :

Each vehicle carrying the waste shall be checked for

(a) Incoming weight (full)
(b) Outgoing weight (empty)
(c) Availability of relevant docuemnts
(d) Visual check at weigh-in (if feasible)
(e) Visual inspection after discharge at tipping area (inspection report to be filed for each vehicle). A visual inspection checklist must be framed which should list visual features for identification of unacceptable material. This checklist shall be filled for every unloading by a vehicle in tipping area at the working phase in the landfill.

If there is reason to doubt the presence of unacceptable waste, the vehicle shall be taken to the waste inspection facility, the waste down-loaded, inspected visually and samoled (if necessary). Vehicles having non-conforming waste shall be held-up and matter reported to engineer or manger at site.

8.3. **Phase Development**

Development of each phase shall be done in stages. These stages are:

(a) Clearing the area of all shrubs and vegetation
(b) Excavation (if required),
(c) Stockpiling of excavated material and material imported from borrow area,
(d) Levelling of base and side slopes of landfill and achieving desirable grades at the base of the landfill,
(e) Construction of embankment and temporary berms along the perimeter of the phase,
(f) Construction of temporary surface water drains,
(g) Installation of monitoring instruments,
(h) Liner Construction
(i) Leachate collection and removal system

8.4. **Phase operation**

At the design stage, the phases of a landfill are clearly demarcated. Operation of a phase requires planning and execution of daily activities – daily waste filling plan and demarcation, waste discharge and inspection, waste placement, waste compaction, daily covering of waste, prevention of pollution and fires.

(a) **Daily waste filling plan and demarcation at site :** On the completion of a phase and before the start of a new phase, a waste filling plan for daily cells shall be evolved. A study of the landfill base contour maps

and the final cover levels of the phase allows such a plan to be devloped. If a phase is to be operational for 365 days, all 365 cells must be marked in plan and in sectional drawings. These may require revision as a landfill is constructed because waste quantities may vary in an unforeseen manner. The area and height proposed to be filled every day should be demarcated at the site on a daily or weekly basis using temporary markers or bunds.

(b) **Waste discharge and inspection :** Waste shall be discharged by tipping at the working area of a landfill, within the area demarcated for the cell. Every discharged load shall be visually inspected by a designated operator. Working area personnel shall be trained and competent at waste identification in order that they can recognise waste which may be non-conforming. In the event of reasonable doubt as to the waste acceptability, the operator shall inform the waste reception facility and/or the site manager immediately and the consignment shall be isolated pending further inspection.

(c) **Waste placement (spreading) and compaction :** Once waste has been discharged it shall be spread in layers and compacted in a well defined manner to ensure that the completed slopes of a daily cell are at the designed gradients. Waste placement (spreading) can be done by the following methods :

(i) Face tipping method : Waste is deposited on top of existing surface and spread horizontally by tipping over an advancing face.

(ii) Inclined layering method (onion skin tipping) : Similar to (a) but inclined layering (gentle slope) done instead of advancing of face.

(iii) Working upwards : Waste is deposited on the lower surface and pushed upwards.

It is necessary to level and compact the waste as soon as it is discharged at the working area. Steel wheeled mobile landfill compactors (smooth / cleated / spiked / special wheels) are generally accepted as the best equipment for this purpose. They have largely replaced the small crawler-tracked machines which were previously in general use.

(d) **Daily / Weekly Cover :** Daily / Weekly cover (optional) is primarily used for prevention windblown dust, litter and odours, deterrence to scavengers, birds, reduction of infiltration (during unseasonal rian) and in improving the site's visual appearance. Soil used as daily / weekly cover shall give a pleasing uniform appearance from the site boundary. To achieve this a thickness of about 150 mm is usually adequate and shall be adopted.

(e) **Operation in Monsoons :** During the monsoon month, high rainfall results in excessive generation of leachate. Hence, before the onset of monsoons, the phase must be capped with a cover. Waste received

during monsoon months shall be stockpiled in temporary holding area (covered). Alternatively special "monsoon phases" may be designed with high leachate holding capacity and operated using daily covers / temporary covers.

8.5. **Pollution Prevention and Safety During Operation**

The following measures are needed to ensure that the landfill operation shall not adversely affect local environment within and outside the landfill.

(i) **Traffic :** Heavy lorry traffic shall give rise to nuisance, damage to road surface and verges and routing problems. The following measures are helpful :

(a) routing to avoid residential area
(b) using one-way routes to avoid traffic conflict in narrow roads
(c) carrying out road improvements, for example strengthening or widening roads, improved provision of footpaths, improvement of sight lines, provision of passing places, provision of new roads,
(d) Limiting the number of vehicle movements
(e) Restrictions on traffic movement hours which are staggered with respect to peak traffic hours

(ii) **Noise :** Adverse impacts on the local community from noise may arise from a number of sources including : throughput of vehicles and fixed and mobile plant, for example compactors, generators at the site. Peripheral noise abatement site measures shall be adopted.

(iii) **Odour :** Offensive odours at landfill sites may emanate from a number of sources, including waste material which have decomposed significantly prior to landfilling, leachates and leachate treatment systems, and landfill gas. Good landfill practices shall greatly reduce general site smell and reduce impact from odours which could lead to complaints from the local community, site users and site staff. Good practice includes : (a) adequate compaction; (b) speedy disposal and burial of malodorous wastes; (c) effective use of appropriate types of daily cover; (d) progressive capping and restoration; (e) effective landfill gas management; (f) effective leachate management and (g) consideration of prevailing wind direction when planning leachate treatment plants, gas flares, and direction of tipping.

(iv) **Litter :** Poor litter control both on and off site is particularly offensive to neighbours. Good operational practice shall be adhered to in terms of temporary fencing, waste discharge, placement, compaction and covering to minimise the occurrence of windblown litter.

(v) **Bird Control :** Birds are attracted to landfill sites in large numbers where sites receive appreciable amounts of bio wastes. Measures which can be used to mitigate birds nuisance include the employment

of good landfill practice, working in small active areas and progressive prompt covering of waste, together with the use of bird scaring techniques.

(vii) **Vermin and Other Pests** : Landfills have potential to harbour flies, rodents and vermin particularly where the waste contains bio materials. Modern landfilling techniques including prompt emplacement, compaction and covering of wastes in well defined cells are effective in the prevention of infestation by rodents and insects.

(viii) **Dust** : Dust from landfill operations is mainly a problem during periods of dry weather but can also arise from dusty waste as it is tipped. Dust is generally associated with (a) site preparation and restoration activities; (b) the disposal of waste comprising of fine particles, for example powders; and (c) traffic dust. Dust suppression can be effected by (a) limiting vehicle speed; (b) spraying roads with water; and (c) spraying site and powder type waste with water; (d) covering powder type waste with daily soil cover.

(ix) **Mud on the Road** : Mud on the public highway is one of the most common causes of public complaint. It is therefore in the interest of the landfill operator to provide adequate wheel cleaning facilities to ensure that mud is not carried off site by vehicles.

(x) **Landfill Fire Management** : Fires in waste on landfill sites are not uncommon and it is important for site operators to be aware of the dangers, how to treat fires and to address the problems associated with them. All fires on-site shall be treated as a potential emergency and dealt with accordingly.

(xi) **Landfill Safety Aspects** : Training of employees shall include site safety, first aid and the handling of dangerous materials where appropriate. Since landfill sites can pose dangers to both site operator and users, emergency plans shall be laid down. Landfill sites shall be regarded as potentially hazardous locations and the operator shall have a written safety plan for the site. Safety hazards present at landfill sites may include : (a) moving plant and vehicle; (b) steep slopes; (c) bodies of standing water; (d) contaminated, putrescible, toxic, flammable or infective material and (e) noxious, flammable, toxic or hazardous gas. All employees and visitors to the site shall be made aware of the potential hazards and the safety procedures to be implemented including fire safety.

8.6. Phase Closure

After the last set of cells of a phase are placed (on the highest lift), an intermediate or final cover shall be constructed. If another phase is to be placed over the just completed phase, an intermediate cover is provided. However if the just completed phase has reached the final

height of the landfill, the final cover system and surface water drainage system is provided

An intermediate cover shall be made of locally available soil (preferably low permeability) and is 45 to 60 cm thick. It is compacted with smooth steel drum rollers and provided a suitable gradient (3 to 5%) to encourage surface water to run-off from the cover and thus minimise infiltration. The side slopes of the intermediate cover are compacted by the crawler tracked dozer moving up and down the slope

Final cover construction and quality control all criteria are discussed in Section 7.0.

8.7. Landfill Closure

As each phase is completed and as the final cover level is reached in successive phases, the following interconnectivities are established :

(a) the leachate collection system of each phase is sequentially connected (if so designed)
(b) the surface water drainage system at the cover of each phase is sequentially connected (if so designed)
(c) the temporary surface water drainage system constructed at the base of each completed phase is dismantled
(d) the gas collection system (if provided) of each phase is sequentially connected

Upon completion of all phases a final check is made of the proper functioning of all inter connected systems

An access road is provided on the landfill cover to enable easy approach for routine inspection of the landfill cover.

8.8. Post Closure Vegetative Stabilisation (Long Term)

If a landfill cover is intended to be used for a specific purpose e.g. park or vehicle parking area, then the cover shall be stabilised in such a manner that the end-use is achieved. However, if no specific end-use is envisaged, then long-term vegetative stabilisation will be undertaken to return the land to its original and natural vegetative landform.

Vegetation is by far the most common and usually the preferred stabilisation option after closure of landfills. If a self-perpetuating vegetative cover can be established, not only can wind and water erosion be minimized, but also the landfill can be returned to some semblance of its original appearance and land use. In favourable climates, revegetation may require only modest effort or may occur by natural process during a reasonably short period of time. However in arid climates or a harsh environment, establishment of vegetation may

be a difficult and costly process and alternative techniques may be examined for vegetative stabilisation.

While the specific procedures are unique to each landfill and climatic regime the following representative elements of the process shall be adopted in all procedures.

(a) Seedbed Preparation : Seedbed preparation is necessary to set the stage for establishment of the short-term community. Initial operations shall include grading, furrowing, or grouping to enhance microclimate and addition of nutrients and soil amendments, if required.

(b) Short-Term Vegetation : It is common practice, in both humid and dry environments, to rely largely on grasses for the primary initial source of short-term land cover. Usually several species are included in the initial seeding mixture to increase diversity and reduce the chance of total community failure. Short term vegetation is usually assisted by irrigation.

(c) Long Term Vegetation : To achieve the ultimate goal of attaining a self sustaining and stable community, a transition between short term and long term vegetation must occur. In some cases this may be left to invasion by native species after short term vegetation is assured and soil development is well under way. In other cases – for example, when irrigation has been used temporarily to establish the short term community – it may be necessary or desirable to enhance the natural succession process by replanting with a more diverse mix of species suited to the next stage of community succession, such as shrubs. The need for artificial enhancement of the successional process shall depend on the success of previous short term efforts and on the ultimate intended land use of the reclaimed area. All vegetation efforts, however, shall work toward self generation and minimum management in the long term. Fig. 15. illustrates the sequential steps in vegetation growth after landfill closure.

9.0. INSPECTION, MONITORING & RECORD KEEPING CRITERIA

9.1. During Construction of Liners and Covers

(a) During the construction of liners and covers, inspection shall be carried by the SPCB/PCC (or its nominee) atleast twice during each phase to ensure that construction procedures and quality control procedures isted in section 7.0 are being followed.

(b) Immediately upon the completion of construction of a liner in each phase, the complete set of construction records and quality control test results as listed in Section 7.0 will be provided by the

owner/operator to the SPCB/PCC for verification and record keeping. The same will also be done upon the completion of cover system in each phase

9.2. **During Operation**

(a) The owner/operator shall monitor and keep a record of the following in the operation period :

(i) Functioning of the leachate management system (including levels in leachate holding tank) (weekly)

(ii) Functioning of the surface water run-off system (weekly)

(iii) Functioning of the gas management system (if any) (weekly)

(iv) Waste filling records shall be kept on daily basis as specified in Section 8.2 on site procedure

(v) Environmental monitoring shall be done, 1 to 2 times a month, and all parameters listed in Section 5.17 shall be recorded and compared with the permissible limits provided by the SPCB/PCC

(vi) After a major storm, the occurence of the storm and functioning of various systems shall be recorded

(b) The SPCB/PCC (or its nominee) shall inspect all facilities atleast twice a year. The owner/operator shall provide a copy of the environmental monitoring record to the SPCB/PCC on a yearly basis.

9.3. **During Closure and Post Closure Period**

Period inspection and routine maintenance at a closed landfill site shall be carried out for a period of 30 years after closure. The SPCB/PCC shall inspect all facilities during the closure and post closure period atleast once a year. The owner/operator shall provide a copy of the environmental monitoring record to the SPCB/PCC once a year. The following components of a closed landfill shall be inspected visually after landfill closure to confirm that all functional elements are working satisfactorily and inspection report will be recorded. A maintenance schedule with specified reporting formats is drawn up after each inspection.

(a) Cover System : The final cover is inspected 2 to 4 times a year (a) to check that vegetation growth is occurring satisfactorily and that plants are not showing stunted growth, (b) to detect if any erosion gullies have been formed thereby exposing the barrier

layers, (c) to earmark depressions that may have developed with time and (d) to identify ponding of water on the landfill cover. Atleast one inspection shall be carried out during or immediately after the peak of the monsoon season.

Closed landfills show significant settlement. Rectification measures shall not only re-establish the initial slope of the cover (for proper surface water run-off) but shall also ensure that all the components of the landfill cover system continue to perform as originally envisaged. Site managers shall have sufficient equipment and funds to periodically carry out maintenance work in the form of soil filling, re-grading the cover and revegetating the landfill cap.

In areas where extensive erosion gully formation is observed filling of cover material, regrading of cover slopes and re-vegetation must be routinely undertaken.

(b) Surface Water Drainage System : The surface water drainage system is also inspected 2 to 4 times a year (a) to identify cracks in drains due to settlements, (b) to delineate clogged drains requiring immediate clean-up and (c) to study the level of deposited soil in the storm water basin and initiate excavation measures. Broken pipes and extensively cracked drains may require replacement after filling soil beneath them to establish slopes for gravity flow. In extreme cases where long-term settlement shall be excessive it shall become necessary to make sumps and operate storm water pumps for removal of accumulated water in the drainage system.

(c) Gas and Leachate Management Systems : A weekly operating record of leachate and gas management systems shall be kept in the post-closure period. Periodic inspection of the leachate and gas collection systems (2 to 4 times a year) is undertaken to identify broken pipes, leaking gas (if any) and damaged or clogged wells/sumps. Repair work requires skilled manpower and shall be carried out by the agencies operating the gas treatment and leachate treatment facilities. One may often have to install new gas extraction wells and leachate collection wells if the damaged/clogged facilities are inaccessible and irrepairable.

9.4. Environmental Monitoring Systems

Ground water monitoring wells, air quality monitoring systems and vadose zone monitoring instruments shall be periodically inspected 2-4 times a year to check that all systems are functioning satisfactorily and that well caps and sampling ports are not subjected to damage due to excessive settlement or vandalism.

Environmental monitoring systems have to be maintained during the entire post-closure period. Wherever possible, monitoring instruments must be periodically re-calibrated. Sampling devices shall be routinely detoxified and also regularly checked for proper functioning of the opening and closing of valves or spring loaded mechanisms.

10.0. Post-Closure Criteria

(a) After closure of the landfill the owner/operator of the landfill shall maintain the integrity of the final cover systems including making repair, as necessary, to rectify the settlement subsidence or erosion of the cover

(b) After closure of the landfill, the owner/operator shall continue to operate all leachate, gas and surface water management systems as well as continue environmental monitoring of the landfill for a period of 30 years or until such time that harmful leachate is not produced for 5 continuous years.

(c) If after a few years of closure, the leachate is observed to meet all discharge standards, the same shall be discharged directly to lined drains.

(d) The landfill shall be abandoned after 30 years of closure if concentrations of contaminants in all liquid and gaseous emissions from the landfill are observed to be below prescribed limits. However, if the emissions continue to be hazardous, the landfill management strategy shall have to be evolved for future years.

11.0. FINANCIAL ASSURANCE CRITERIA

The owner/operator shall prepare detailed financial estimates for the following :

(a) the fixed initial cost for setting up the landfill facility

(b) the recurring annual costs for operating the facilities

(c) the cost of hiring a third party to close the landfill

(d) the cost of hiring a third party to conduct post-closure care for 30 years after closure of the landfill

(e) the cost of hiring a third party to undertake corrective action in case of an emergency resulting in loss of ecology due to the failure of the system during the active, closure and post-closure periods.

The owner/operator shall demonstrate the funds needed for (c), (d) and (e) above will be available whenever they are needed in the form of options such as trust funds, surety bonds, letter of credit, insurance etc

12.0. CONTINGENCY PLAN FOR EMERGENCIES

The owner/operator of a HW landfill shall prepare a contingency plan listing procedures to be executed immediately whenever there is fire, explosion or unexpected release of hazardous waste at the landfill site during the active period as well as during the closure and post-closure periods. Such a contingency plan shall be approved by the SPCB/PCC.

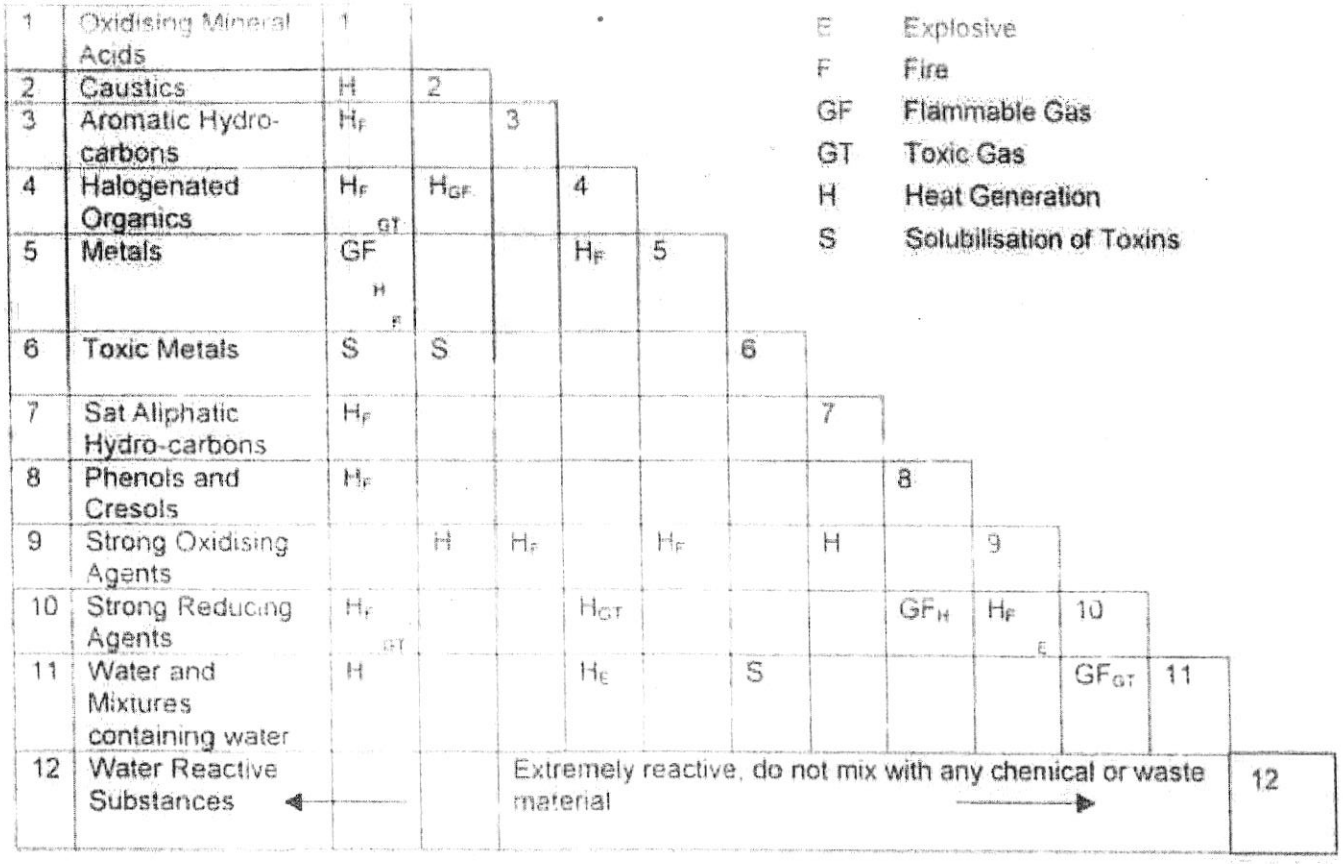
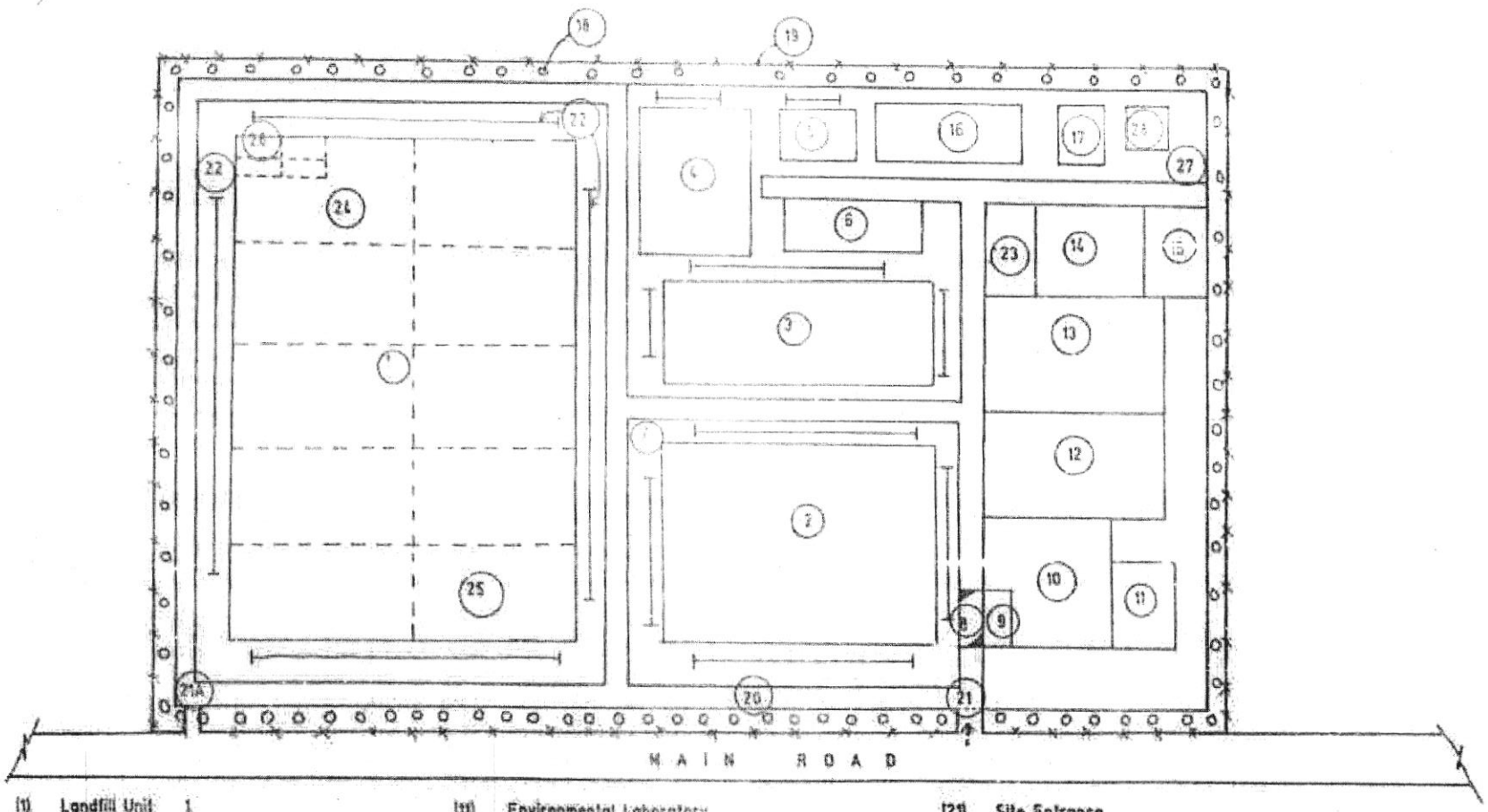
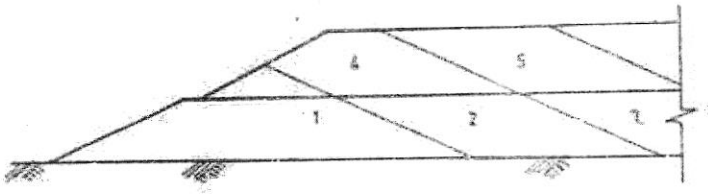


Table 1 : Compatibility of Selected Hazardous Wastes

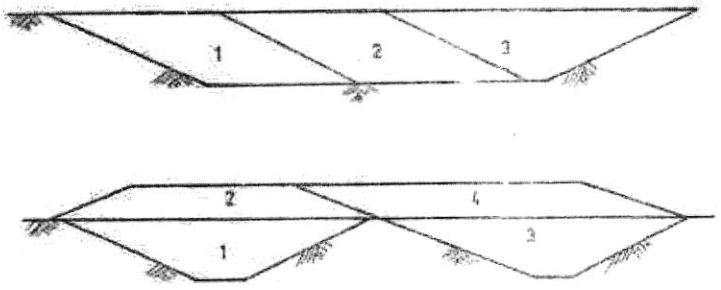


(1) Landfill Unit 1
(2) Landfill Unit 2
(3) Landfill Unit 3
(4) Landfill Unit 4
(5) Landfill for Special Hazardous Waste
(6) Area for Stockpiling Cover and Liner Material
(7) Mobile Site Office
(8) Weigh Bridge
(9) Reception/Security
(10) Administrative Office
(11) Environmental Laboratory
(12) Open Lorry/Tanker Parking Area
(13) Temporary Waste Storage Shed
(14) Equipment Shelter
(15) Workshop
(16) Landfill Leachate Management Facilities
(17) Storm-water Collection/Sedimentation Tank
(18) Green belt
(19) Fencing
(20) Approach Road/Arterial Roads
(21) Site Entrance
(21A) Emergency Exit
(22) Environmental Monitoring Facilities
(23) Vehicle Washing
(24) Phase (1) of Landfill Unit 1
(25) Phase (10) of Landfill Unit 1
(26) Cell (1) of Phase (1) of Landfill Unit 1
(27) Air Quality monitoring Station to be located at 120° from each other
(28) Space for Waste Recovery/Incineration/Waste Processing Facilities

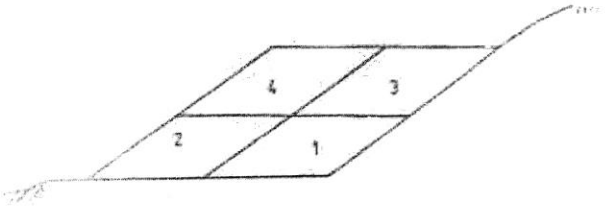
FIG. 1: TYPICAL LAYOUT OF HAZARDOUS WASTES LANDFILL



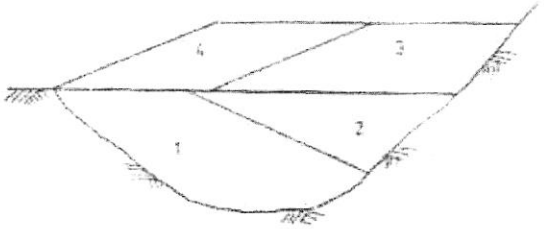
(a) Above ground landfill



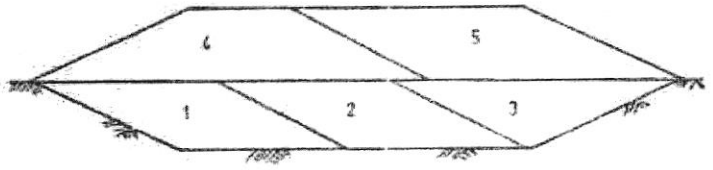
(b) Below ground and trench landfill



(c) Slope landfill



(d) Valley landfill



(e) Above and below ground landfill

FIG. 2: TYPICAL SECTION OF HW LANDFILLS

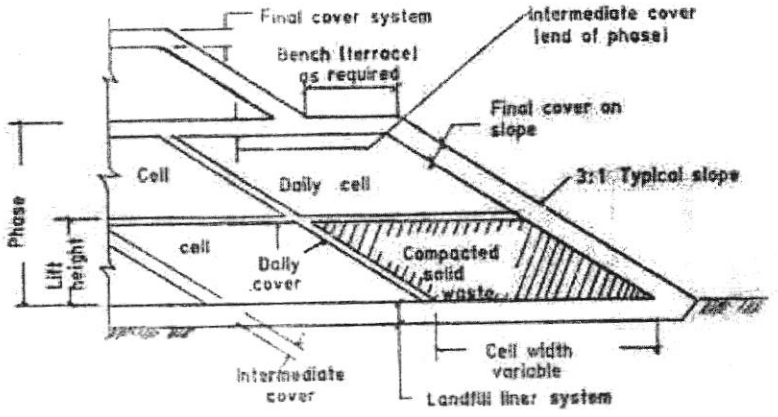
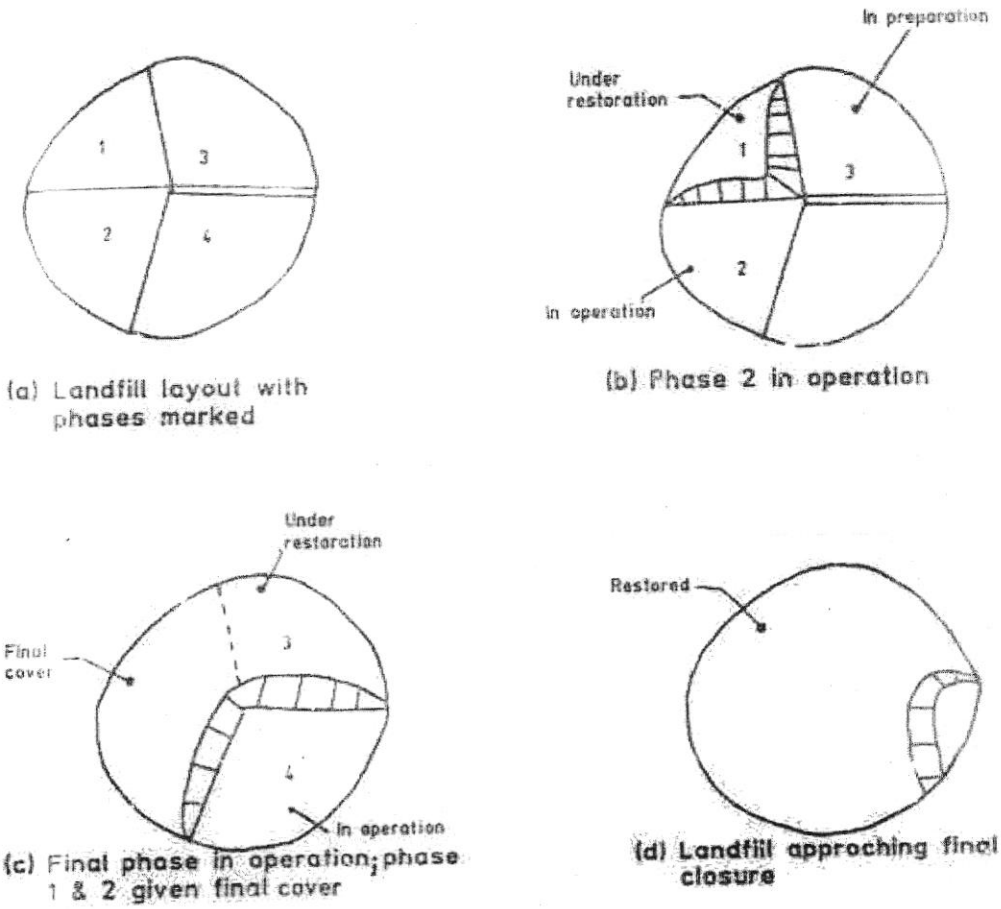


FIG. 3: COMPONENTS OF A LANDFILL PHASE



(a) Landfill layout with phases marked

(b) Phase 2 in operation

(c) Final phase in operation; phase 1 & 2 given final cover

(d) Landfill approching final closure

FIG. 4: OPERATION OF A LANDFILL IN PHASES

- Precipitation conditions (P)
- Evaporation transpiration (E_T)
- Surface water runoff (R)
- Infiltration and precipitation over the landfill site (P_I)
- Changes in the water storage in the sealing layer (ΔU_S)
- Overland water flow from surrounding terrain (R_t)
- Ground water flow from surrounding land (I_G)
- Decomposition of waste generating small volumes of water (b)
- The moisture content of the waste when it is deposited(S)
- Leakage of leachate volume (L_I)
- Collected leachate volume (L_R)
- Changes in the moisture content of the waste (ΔU_W)

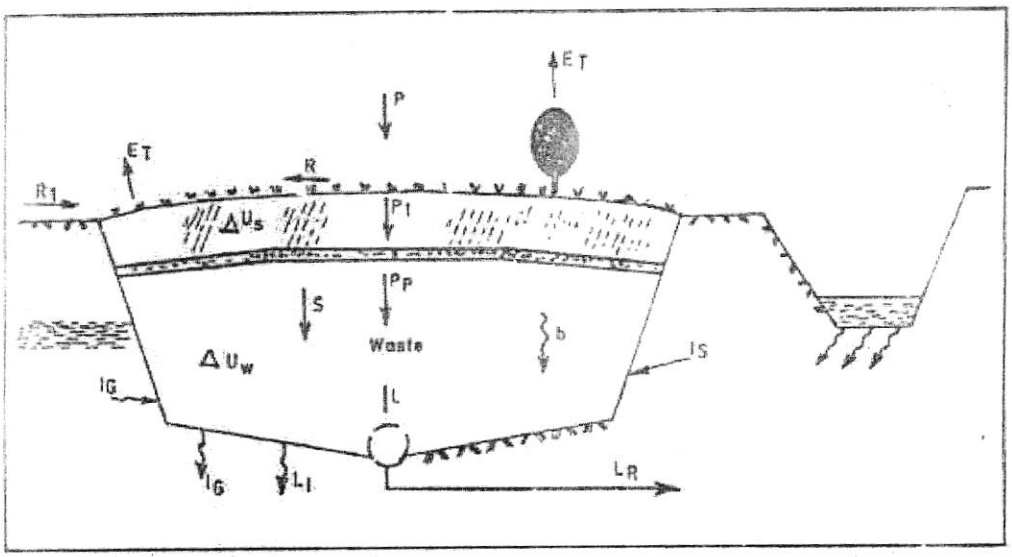
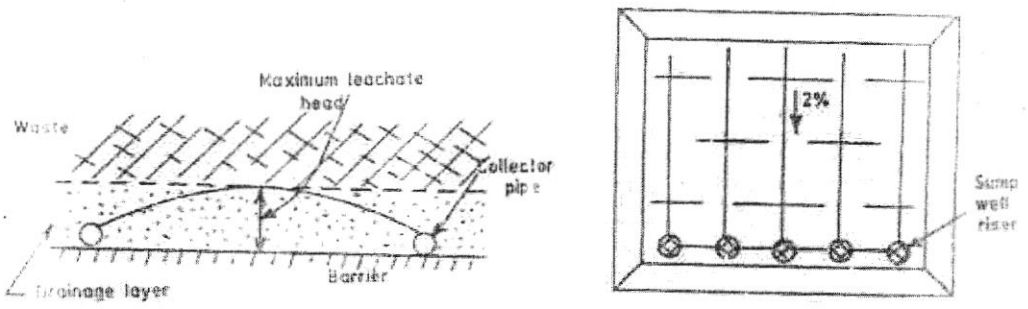


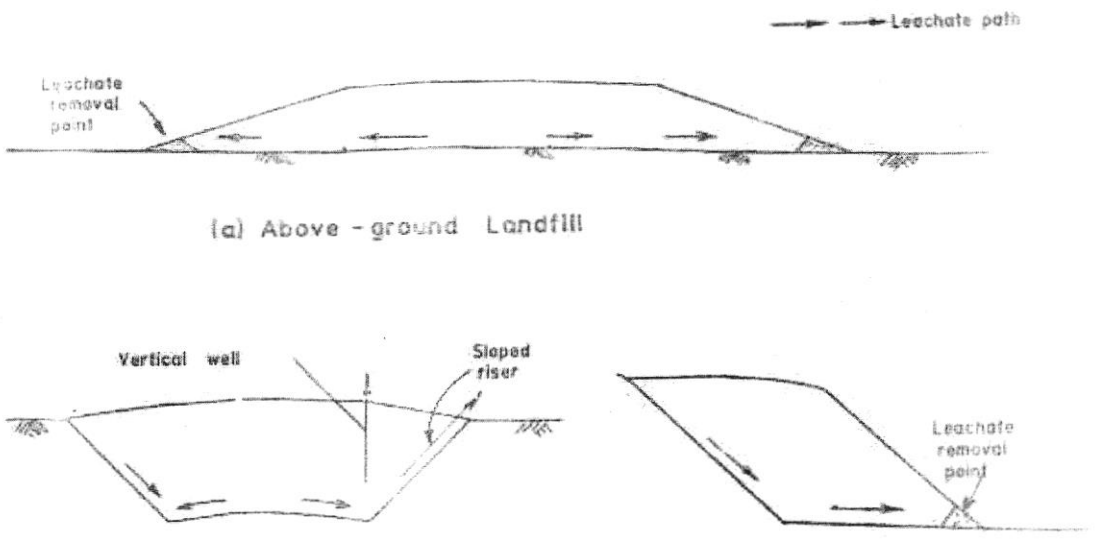
FIG. 5: WATER-BALANCE FOR ESTIMATION OF LEACHATE QUANTITY



(a) Leachate mound

(b) Pipe network (plan) at base of Landfill

FIG. 6: LEACHATE COLLECTION PIPE NETWORK



(a) Above - ground Landfill

(b) Below ground landfill

(c) Sloped landfill

FIG. 7: LEACHATE PATH AND LEACHATE REMOVAL

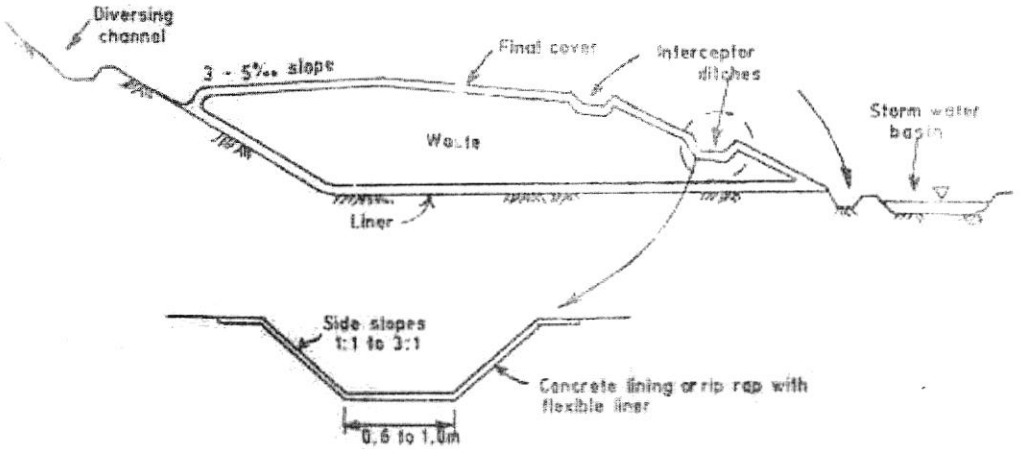


FIG. 8: SURFACE WATER DRAINAGE SYSTEM FOR A COMPLETED LANDFILL

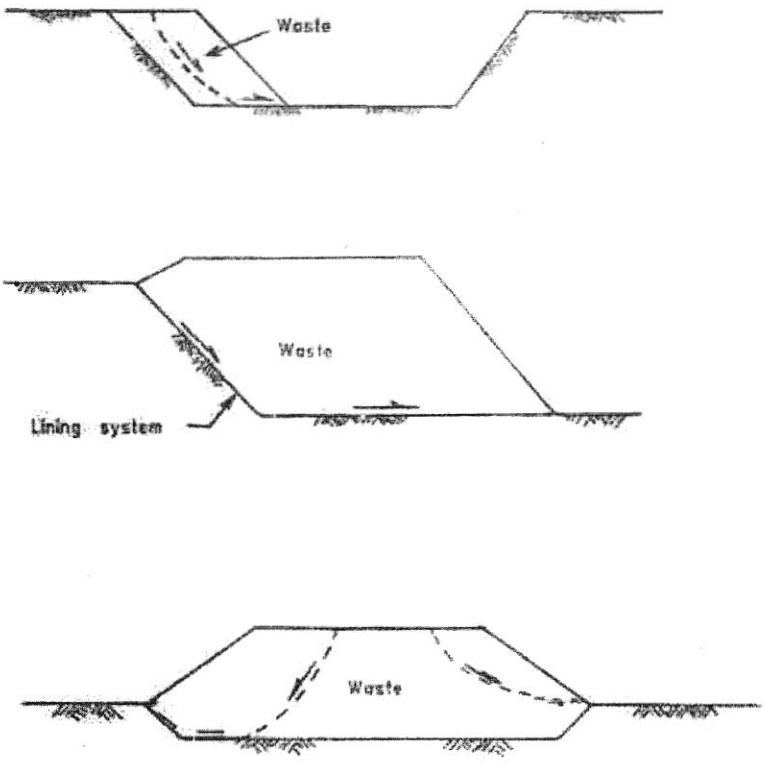


FIG. 9: SOME TYPICAL FAILURE MECHANISMS FOR SLOPES IN LANDFILLS

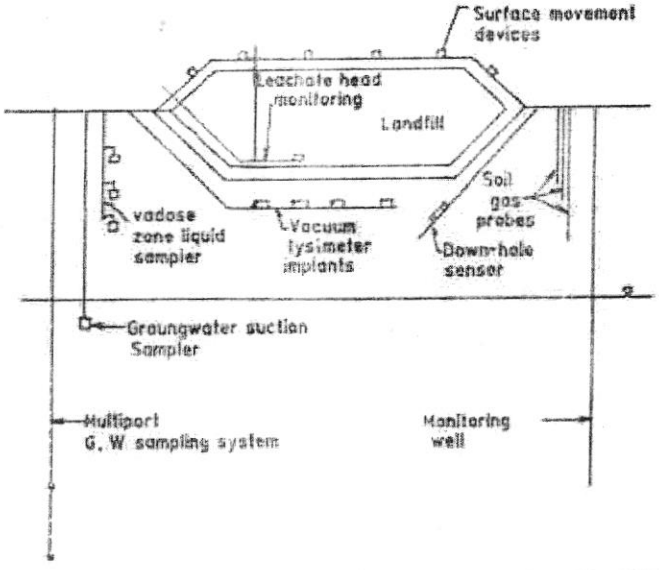


FIG. 10: TYPICAL LANDFILL INSTRUMENTATION

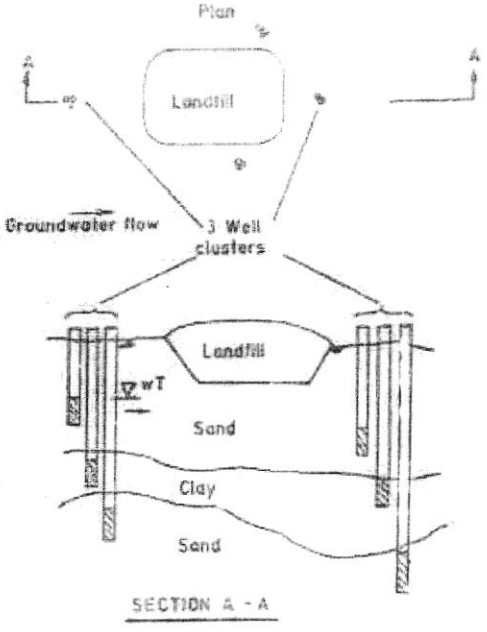


FIG. 11: GROUND WATER MONITORING WELLS AROUND A LANDFILL

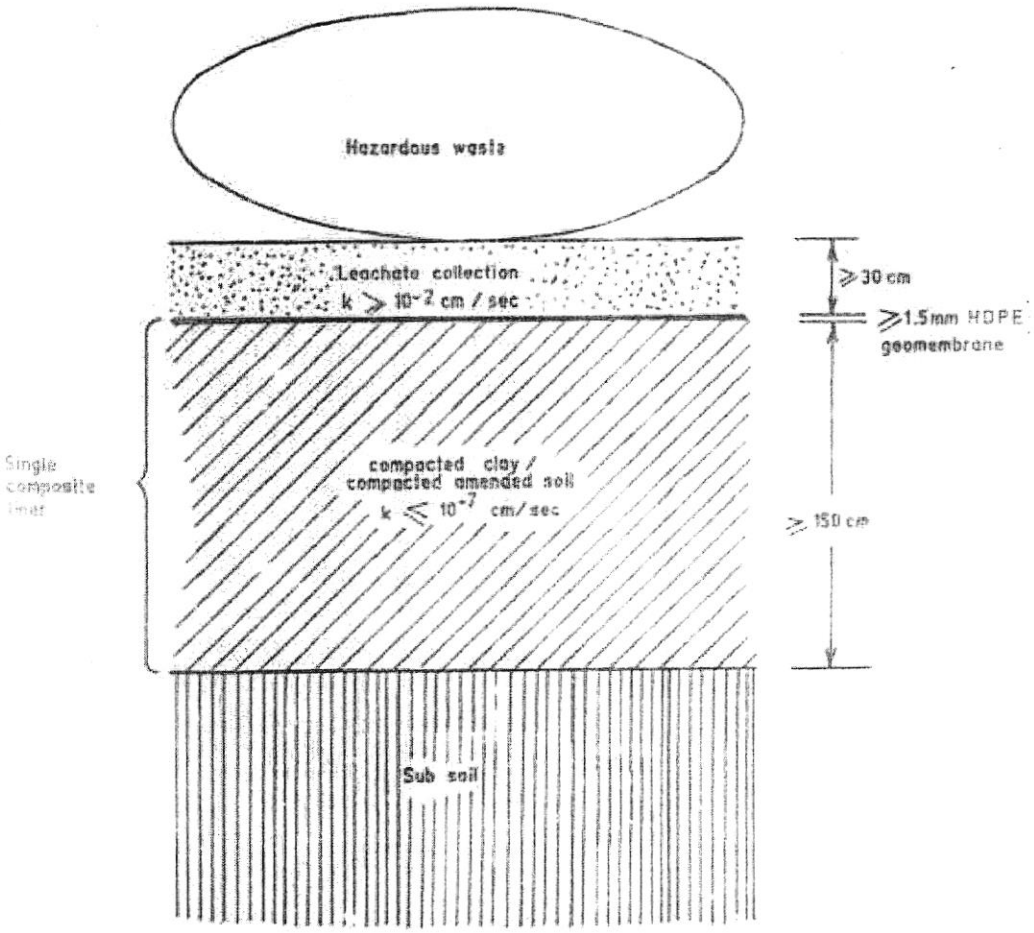


FIG. 12 : SINGLE COMPOSITE LINER SYSTEM

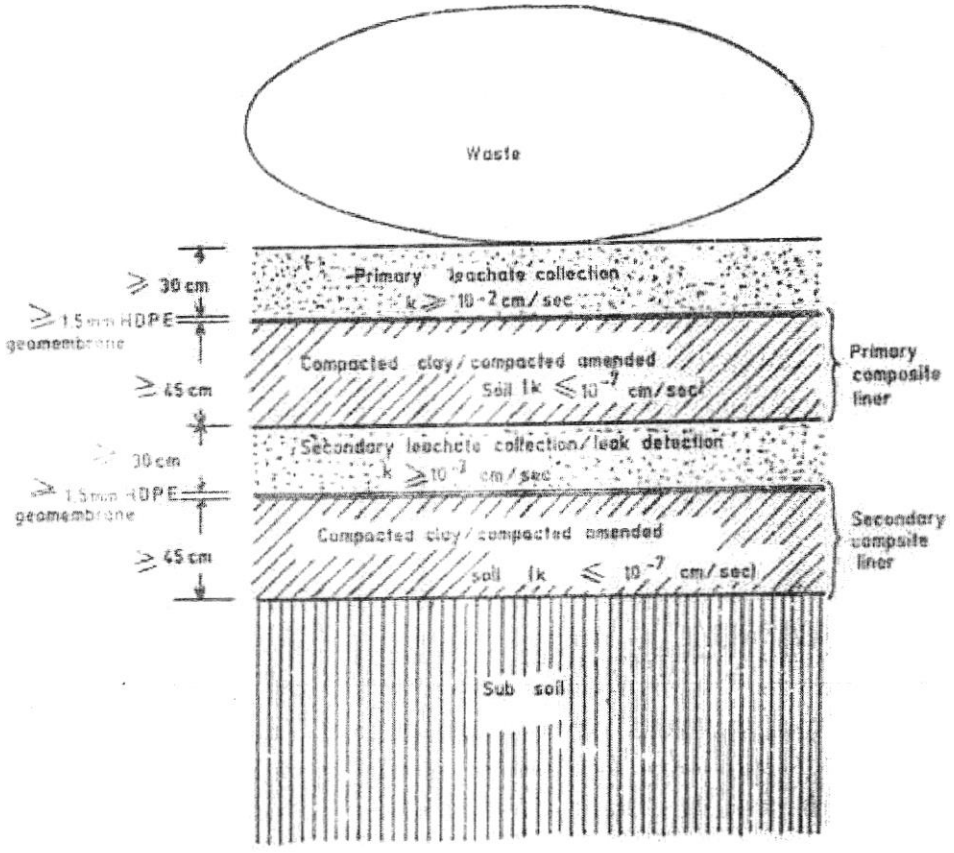


FIG. 13 : DOUBLE COMPOSITE LINER SYSTEM

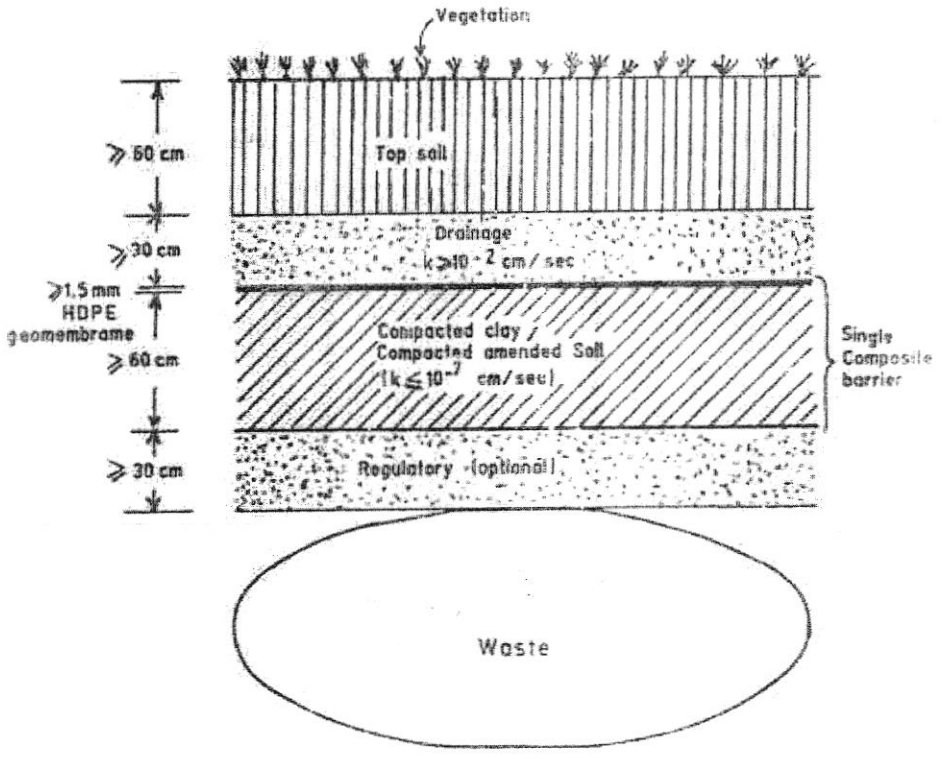
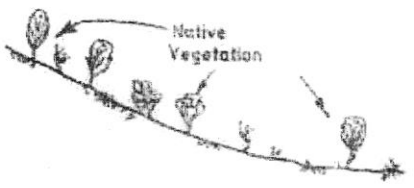
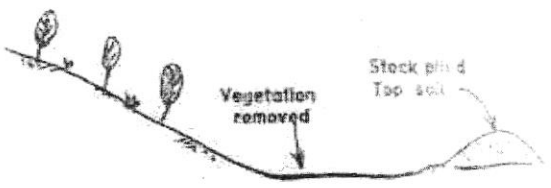


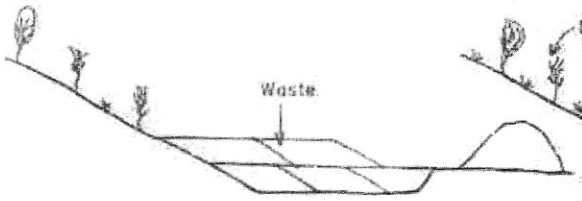
FIG. 14 : COVER SYSTEM



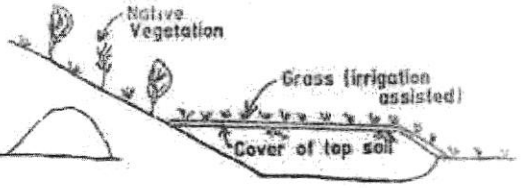
(a) Original Landform



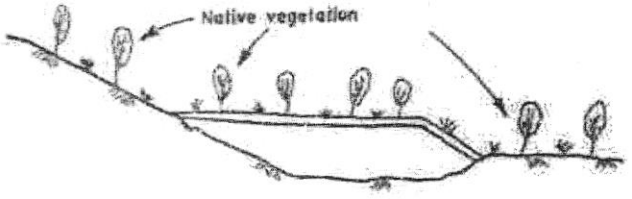
(b) Excavation for Landfill



(c) Landfilling in Progress

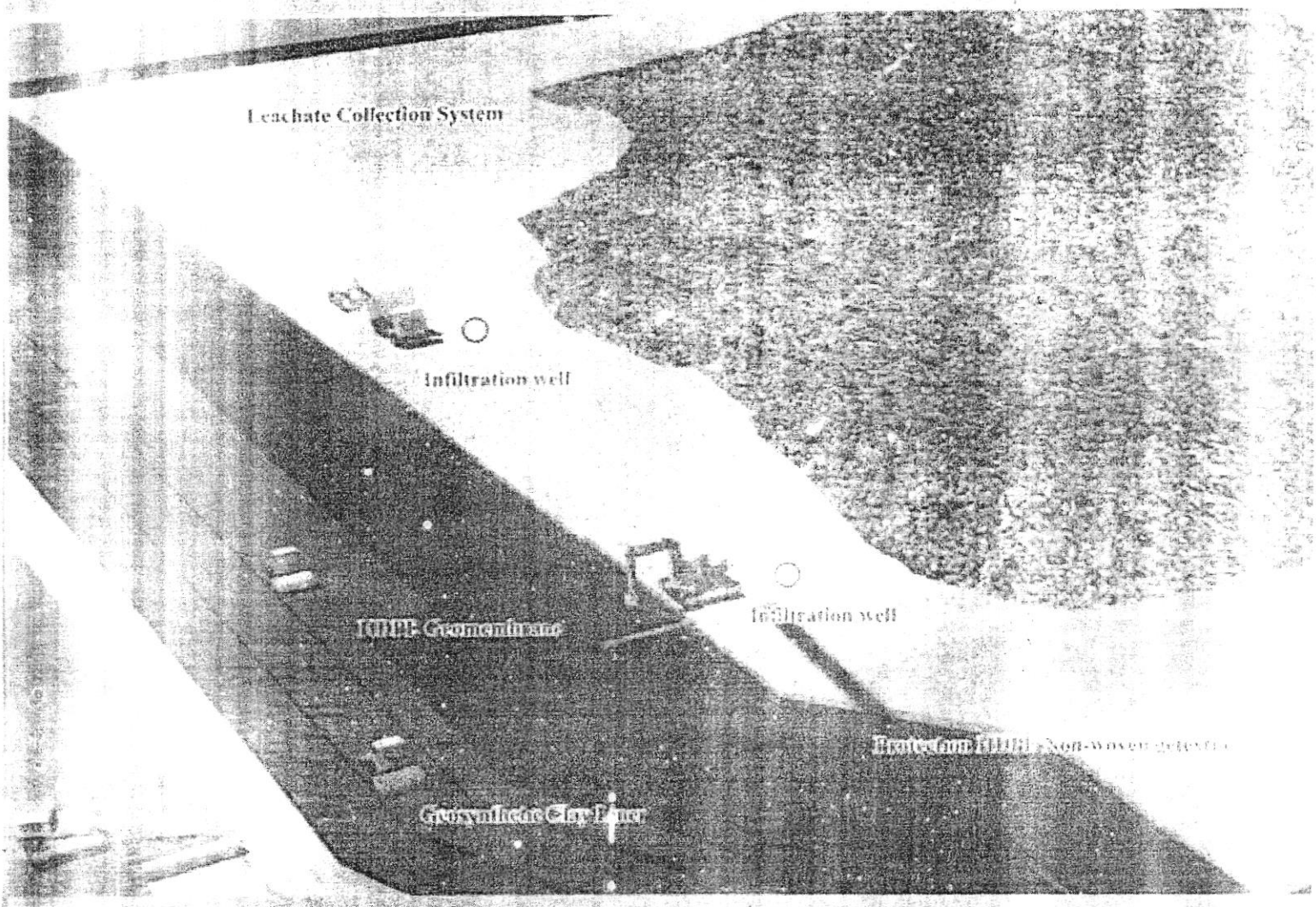


(d) Short-Term Vegetation on Landfill Cover



(e) Long-Term Vegetation on Landfill Cover

FIG. 15 : LONG-TERM VEGETATIVE STABILISATION OF CLOSED LANDFILL


Leachate Collection System
Infiltration well
Infiltration well

Standard Operating Procedure and Checklist of Minimal Requisite Facilities for utilization of hazardous waste under Rule 9 of the Hazardous and Other Wastes (Management and Transboundary movement) Rules, 2016

Utilization of contaminated barrels/ containers/ drums containing hazardous wastes/ chemicals/ oil and lubricants

(Revised)

November, 2024

Central Pollution Control Board
(Ministry of Environment, Forest & Climate Change, Government of India)
Parivesh Bhawan, East Arjun Nagar,
Shahdara, Delhi – 110032

Procedure for grant of authorization by State Pollution Control Boards (SPCBs)/ Pollution Control Committees (PCCs) for utilization of Hazardous waste

1) While granting authorization for utilization of hazardous wastes, SPCBs/PCCs shall ensure that authorization is given only to those wastes for which Standard Operating Procedures (SOPs) for utilisation have been circulated by Central Pollution Control Board (CPCB) ensuring the following:

   a) The waste (intended for utilization) belongs to similar source of generation as specified in SOP.
   b) The utilization shall be similar to as described in SOP.
   c) End-use/ product produced from the waste shall be same as specified in SOP.
   d) Authorization shall be granted only after verification of details and minimum requisite facilities as given in SOP.
   e) Issuance of passbooks (similar to passbooks issued for recycling of used oil, waste oil, non-ferrous scraps, etc.) fo · maintaining records of receipt of hazardous waste for utilization.
   f) Monitor closely the quantity of hazardous waste (Contaminated barrels/ containers/ drums) being sent by generators and the quantity being utilized by authorized facilities in manufacturing of magnesium chloride.

2) After issuance of authorization, SPCBs/PCCs shall verify the compliance of checklist and SOP on quarterly basis for initial 1 year; followed by random checks during subsequent period for at least once a year. The compliance reports may be submitted to CPCB.

3) In-case of lack of requisite infrastructures with the SPCBs/PCCs, they may engage 3rd party institutions or laboratories having EPA, 1986/NABL/ISO17025 accreditation / recognition for monitoring and analysis of prescribed parameters in SOPs for verification purpose.

4) SPCBs/PCCs shall provide half yearly updated list of units permitted under Rule 9 of Hazardous & Other Wastes (Management & Transboundary Movement) Rules, 2016 (HOWM Rules, 2016) to CPCB and also upload the same on SPCB/PCC website, periodically.

5) Authorization for utilisation shall not be given to the units located in the State/Union Territory where there is no Common TSDF, unless the unit ensures authorised captive disposal of the hazardous waste (generated during utilisation) or its complete utilisation or arrangement of sharing with any other authorised disposal facility.

6) In case of the utilization proposal is not similar with respect to source of generation or utilization process or end-use as outlined in this SOP, the same may be referred to CPCB for clarification /conducting trial utilization studies and developing SOPs thereof.

7) The source and work zone standards suggested in the SOP are based on EPA notified and OSHA standard respectively, however, SPCBs/PCCs may impose more stringent standards based on the location or process specific conditions.

8) SPCBs/PCCs shall ensure that the utilizer of Contaminated barrels/containers/drums shall maintain daily records in National Hazardous Waste Tracking System (NHWTS).

12.0 Utilization of Contaminated barrels/ containers/ drums containing hazardous wastes/ chemicals/ oil and lubricants:

Type of HW	Source of generation	Recovery /Product
Contaminated barrels/ containers/ drums containing hazardous wastes/ chemicals/ oil and lubricants (Category 33.1, of Schedule-I of HOWM Rules, 2016	All industrial processes except pesticides industry	Cleaned barrel and drums for industrial re-use and/or production of plastic granules

12.1 Source of Waste:

Contaminated barrels/ containers/ drums containing hazardous wastes/ chemicals/ oil and lubricants generated from all industrial processes (except pesticides industry) is categorized as hazardous waste Category 33.1, of Schedule-I of HOWM Rules, 2016, which is required to be disposed in an authorized disposal facility in accordance with authorization condition, when not utilized as resource recovery.

12.2 Utilization Process

The utilization of contaminated barrels/containers/drums for further re-use involves two stage cleaning i.e. Caustic /surfactants (detergent) cleaning in hot water, followed by fresh water cleaning with fixed nozzles arrangement. During the first stage of washing i.e. cleaning with hot water with caustic solution up to 2% concentration or adequate quantity of detergent shall be carried out. In case of producing plastic granules, there should be two-stage cleaning as specified above followed by shredding. The waste water is recycled after treatment.

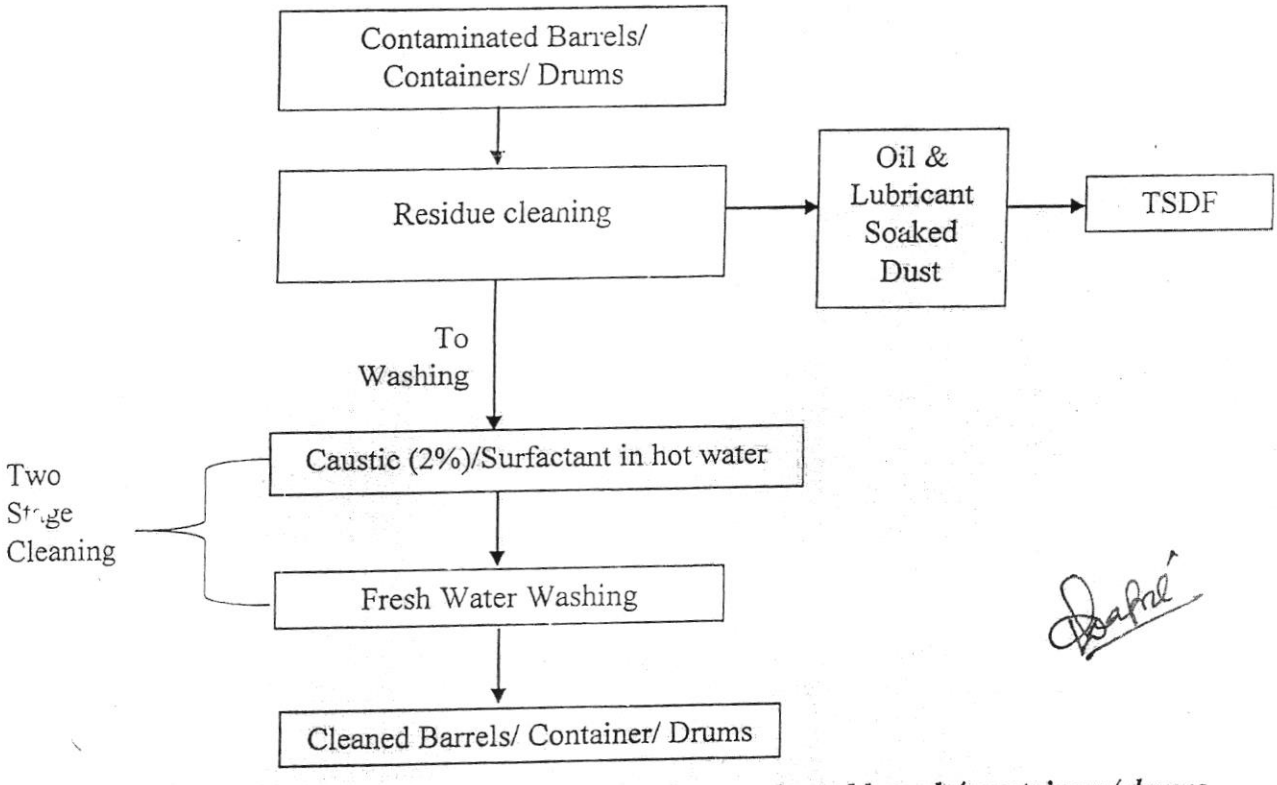


Figure-1.: Process flow diagram for cleaning of contaminated barrels/ containers/ drums

12.3 Standard Operating Procedure for utilization of contaminated barrels/ containers/ drums

This SoP is applicable only for utilization of Contaminated barrels/ containers/ drums containing hazardous wastes/ chemicals/ oil and lubricants generated from all industrial processes (except pesticides industry).

1) Collection Storage & Handling of contaminated barrels/containers/drums:

   The unit shall procure only those drums for washing whose contents are compatible with cold water/hot water/detergents/caustic solutions and do not react or become spontaneously flammable or give off flammable/toxic gases in contact with the same.

   Transportation of contaminated barrels/containers/drums shall be carried out by sender or receiver (utilizer) after obtaining authorization from the concerned SPCB under the Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016.

   It shall be ensured that the contaminated containers/drums/barrels to be procured from the units, who have valid authorization for the same from the concerned State Pollution Control Board as required under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

2) The cleaning of barrels/ containers/ drums contaminated with chemicals generated from all industrial processes except pesticides industry and not exhibiting characteristics of Class C3, C4, C5, C6 and C11 of Schedule II of HOWM Rules, 2016 and also does not liberate toxic gases in contact with air or water.

3) The unit shall provide separate covered storage area for both contaminated containers and cleaned containers so as to eliminate rain water intrusion. Further, the sheds shall have proper slope and spillage collection pit so as collect spillages/floor washings. The collected spillages/floor washings shall be channelized to Effluent Treatment Plant for their treatment.

4) There shall be a designated space for dry draining of drums contaminated with oils & lubricants where drums to be hanged in inverted position on saw dust bed for 2-3 hours before washing. Oil & lubricant soaked dust to be collected and send to TSDF for disposal, the liquid effluent shall be channelized to Effluent Treatment Plant for treatment.

5) Some vapors may liberate at the time of opening of cap of drums containing chemicals which may not be safe for the workers/personnel. Therefore, it shall be ensured that:

   i. The cap of the drums shall be opened only in well-ventilated area.
   ii. The personnel handling the drum shall wear protective gas mask while opening the drum.
   iii. Exhaust/suction blowers shall be provided in the shed area where drums will be opened as well as area, where these are proposed to be hanged invertedly.

6) The manifest system and logbook should be maintained. Labeling should be done on all contaminated drums indicating source, date of receipt and chemicals/ hazardous waste which were stored.

7) The unit shall ensure that prior to cleaning of contaminated containers/drums/barrels; the left-over or residual material in the drums is safely transferred into a separate container for storage and disposal at common Treatment Storage and Disposal Facility (TSDF).

8) For washing of the drums/containers in both stages, the number of nozzles in 1 HP pump shall not exceed 03. Each of these nozzles can clean maximum 02 nos. of used drums per hour.

Thus, number of nozzles and pump capacity thereof shall accordingly be installed for the permitted quantity of drums to be washed/day.

9) The nozzles should have multiple jets to ensure that water jets hit entire inner surface of the containers.

10) The unit shall provide bund wall along the container storage and washing area with proper slope and collection pit for channelization to Effluent treatment plant for further treatment.

11) There should be a separate area with provision of hose pipe with spray nozzle for washing outer surface of the containers along with proper slope, periphery drainage, oil and grease trap and collection pit followed by channelization to Effluent Treatment Plant for their treatment.

12) The effluent generated shall be evaporated and /or Physico-chemically treated by neutralization, coagulation, sedimentation, aeration, and filtration for recycling in the washing process, as applicable.

13) In case of evaporator, the flow to the evaporator should be regulated based on heating capacity of the evaporator. The vent of vacuum pump of the evaporator should be elevated at least up to 6 mtr above the roof level. MEE is preferred over simple evaporator. Water flow meter shall be installed at the inlet to evaporator and at the inlet to ETP.

14) The unit should ensure zero discharge by recycling of treated wastewater in the washing process.

15) If feasible, the unit shall become member of Common Effluent Treatment Plant (CETP) and send their effluent for final treatment and disposal to CETP.

16) The unit shall ensure that all personnel involved in the plant operation shall wear proper personal protective equipment such as masks, safety gloves, goggles, safety shoes etc.

17) The monitoring of the effluent for the parameters specified in the Consent issued by the concerned SPCB shall be carried out quarterly through NABL/EPA accredited laboratory and report shall be submitted quarterly to the concerned the SPCB.

18) Transportation of the contaminated drums and residues generated from cleaning shall be carried out by sender or receiver (drum cleaners / TSDF operator) as per authorization issued by concerned SPCB under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

19) The residue generated from the drums, evaporator and sludge generated from ETP shall be packaged and temporarily stored in a dedicated hazardous waste storage area and sent to TSDF within 90 days from generation of the waste as per the conditions stipulated under consent/authorization issued by concerned SPCB. Such hazardous waste shall be stored under covered shed with proper ventilation.

20) Prior to the utilization of hazardous waste, the unit shall obtain authorization for storage, utilization and disposal of hazardous waste from the concerned SPCB/PCC under HOWM Rules, 2016.

21) The unit shall maintain proper ventilation in the work zone and process areas. All personnel involved in the plant operation shall wear proper personal protective equipment (PPE) specific to the process operations involved and type of chemicals handled as per Material Safety Data Sheet (MSDS). The safety precautions of the worker shall be in accordance with the Factory Act, 1948, as amended from time to time.

22) In case of environmental damages arising due to improper handling of hazardous wastes including accidental spillage during generation, storage, processing, transportation and disposal, the occupier (sender or receiver, as the case may be) shall be liable to implement immediate response measures, environmental site assessment and remediation of contaminated soil/ groundwater/ sediment etc. as per the *"Guidelines on Implementing Liabilities for Environmental Damages due to Handling & Disposal of Hazardous Wastes and Penalty "* published by CPCB.

23) The unit shall provide suitable fire safety arrangements and flame proof electrical fittings.

24) During the process of utilization and handling of hazardous waste, the unit shall comply with requirement in accordance with the Public Liability Insurance Act, 1991 as amended, wherever applicable.

12.4 Product Usage/Utilization

1. Cleaned barrel, containers and drums for sent for industrial re-use and/or production of plastic granules.
2. The pre-existing labels on the drums/containers should be removed physically or with solvent then with a paint and the cleaned containers should be labeled with following prominent indelible text

"Drum Cleaned by: M/s_____;
Date:_____"
"For industrial use only
'NOT FOR STORAGE OF ANY FOOD MATERIAL".

3. The above labelling is not applicable in case the cleaned drums are dismantled, shredded and re-cycled.

12.5 Record/Returns Filing

1) The unit shall maintain a passbook issued by concern SPCB/PCC and maintain details of each procurement of contaminated barrels/containers/drums as mentioned below:

- Address of the sender
- Date of dispatch
- Quantity procured
- Seal and signature of the sender
- Date of Receipt in the premises

2) A log book with information on source and date of procurement of of contaminated barrels/containers/drums, date wise utilization of the same, hazardous waste generation and its disposal, etc. shall be maintained including analysis report of fugitive emission monitoring & effluent discharged, as applicable.

3) The unit shall maintain record of contaminated barrels/containers/drums generated, utilized and disposed as per Form-3 & also file an annual return in Form-4 as per Rule 20 (1) and (2) of HOWM Rules, 2016, to concerned SPCB/PCC.

4) The unit shall submit quarterly and annual information on quantity of used drums procured & cleaned and their source, mode of cleaning the drum (i.e. detergent/caustic solution), quantity of waste water generated, treated & recycled and residue generated ((i.e. left over residue,

Evaporator residue & ETP Sludge) or resources conserved (specifying the details like type and quantity of resources conserved) to the concerned SPCB.

5) The unit shall use NHWTS to manage the manifest, enter daily records of quantity generated, disposed, etc.

12.6 Siting of Industry

Facilities for utilization of of contaminated barrels/containers/drums be preferably located in a notified industrial area or industrial park/ estate/ cluster and in accordance with Consent to Establish issued by the concerned SPCB/PCC. This may not be applicable to the facility already engaged in the utilization of contaminated barrels/containers/drums and have obtained CTE/CTO.

12.7 Checklist of Minimal Requisite Facilities

Sr. No.	Particulars
1.	Separate covered storage area for both contaminated containers and cleaned containers with proper slope and spillage collection pit and channelizing to ETP.
2.	Exhaust/ Suction blowers in the contaminated drums/container handling and storage area.
3.	Size/capacity of storage sheds to be adequate to store at least 7 days requirement of contaminated drums
4.	Shed with dry draining facility for used drums, having saw dust bed for dry draining of oily/ lubricant/ greasy drums
5.	Two stage cleaning facility (i.e. hot water with caustic solution/ detergent followed fresh water cleaning) having fixed nozzles arrangement.
6.	Bund wall along the container storage and washing area.
7.	Number of nozzles for 1 HP pump shall not exceed 03.
8.	Multiple jets to ensure that water jets hit entire inner surface of the containers.
9.	Separate area with provision for washing outer surface of the containers with periphery drainage, adequate slope and collection pit and channelizing to ETP.
10.	Designated space for drum cleanings channelized to Effluent Treatment Plant.
11.	Effluent Treatment Plant and/or Forced Evaporator of adequate capacity.
12.	Sludge drying Bed of adequate size.
13.	Zero discharge by evaporation of the effluent and/ or recycling of treated effluent in washing process or member of Common Effluent Treatment Plant.
14.	Water flow meter at the inlet to evaporator and ETP.
15.	Vent of vacuum pump (if any) elevated at least up to 6 mtr above the roof level.
16.	Separate covered hazardous waste storage area to store hazardous waste generated during the utilization process viz. left over residues from contained drums, residue from forced evaporator and ETP sludge.

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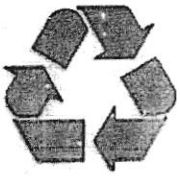
Standard Operating Procedure and Checklist of Minimal Requisite Facilities for utilization of hazardous waste under Rule 9 of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016

Utilization of Used Oil and Off Specification Products (Shampoo, Detergent & Creams) for Recycling



December, 2021

Central Pollution Control Board
(Ministry of Environment, Forest & Climate Change, Government of India)
Parivesh Bhawan, East Arjun Nagar,
Shahdara, Delhi – 110032

Procedure for grant of authorization by State Pollution Control Boards (SPCBs)/Pollution Control Committees (PCCs) for utilization of Hazardous waste

1) While granting authorization for utilization of hazardous wastes, SPCBs/PCCs shall ensure that authorization is given only to those wastes for which Standard Operating Procedures (SoPs) for utilisation have been circulated by Central Pollution Control Board (CPCB) ensuring the following:

   a. The waste (intended for utilization) belongs to similar source of generation as specified in SoP.

   b. The utilization shall be similar to as described in SoP.

   c. End-use/ product produced from the waste shall be same as specified in SoP.

   d. Authorization shall be granted only after verification of details and minimum requisite facilities as given in SoP.

   e. Issuance of passbooks (similar to passbooks issued for recycling of used oil, waste oil, non-ferrous scraps, etc.) for maintaining records of receipt of hazardous waste for utilization.

2) After issuance of authorization, SPCBs/PCCs shall verify the compliance of checklist and SoP on quarterly basis for initial 2 years; followed by random checks during subsequent period for atleast once a year.

3) In-case of lack of requisite infrastructures with the SPCBs/PCCs, they may engage 3rd party institutions or laboratories having EPA, 1986/NABL/ISO17025 accreditation / recognition for monitoring and analysis of prescribed parameters in SoPs for verification purpose.

4) SPCBs/PCCs shall provide half yearly updated list of units permitted under Rule 9 of Hazardous & Other Wastes (Management & Transboundary Movement) Rules, 2016 (HOWM Rules, 2016) to CPCB and also upload the same on SPCB/PCC website, periodically. Such updated list shall be sent to CPCB on half yearly basis i.e., by July and January respectively.

5) Authorization for utilisation shall not be given to the units located in the State/Union Territory where there is no Common TSDF, unless the unit ensures authorised captive disposal of the hazardous waste (generated during utilisation) or its complete utilisation or arrangement of sharing with any other authorised disposal facility.

6) In case of the utilization proposal is not similar with respect to source of generation or utilization process or end-use as outlined in this SoP, the same may be referred to CPCB for clarification /conducting trial utilization studies and developing SoPs thereof.

7) The source and work zone standards suggested in the SoP are based on E(P)A notified and OSHA standard respectively, however, SPCBs/PCCs may impose more stringent standards based on the location or process specific conditions.

75.0 **Utilization of hazardous waste (H.W):**

Type of HW	Source of generation	Recovery/Product
Used Oil and Off Specification Products (Shampoo, Detergent & Creams), Category 5.1 and 28.4 of, Schedule I (of HOWM Rules, 2016) respectively.	Off Specification Products generated during manufacturing of health care product and used oil from service station/ other industries etc.	Car & floor washing solution, Tyre polishing, Tent houses to wash their tent cloths & carpets respectively. Used oil recycled and send to Tyre manufacturers and Bitumen companies

75.1 **Source of Waste:**

Off Specification Products generated during manufacturing of health care products and used oil from service station/ other industries etc. the hazardous wastes are listed under the Category 28.4 and 5.1 of, Schedule I of HOWM Rules, 2016.

75.2 **Utilization Process**

a.) Used oil:

Used oil generated from service stations and hydro power generation units is collected and undergoes pre-treatment, centrifugation and dehydration where the water from the oil and sludge gets separated. The sludge generated will be sent to TSDF and collected water will be treated in the ETP. The refined oil will be sold to tyre manufacturers and Bitumen companies.

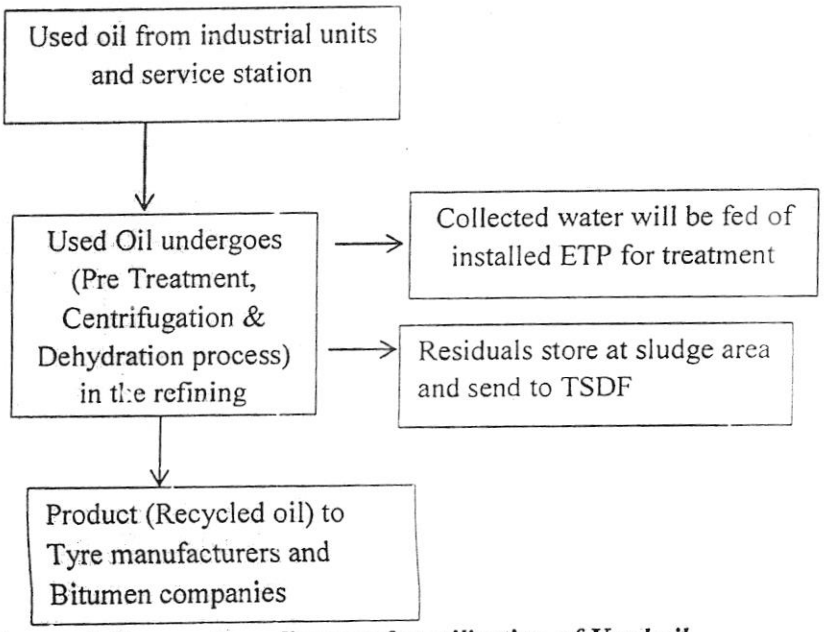


Figure: 1-*Process flow diagram for utilization of Used oil.*

b.) Off specification products:

Off specification products (i.e., shampoo/ cream/ detergent) will be collected from the factories. Removal of shampoo/ cream/ detergent from sachets/tubes/ bottles will be carried out at the unit primases. Further plastic tubes / bottles will be shredded. Plastic material and material (shampoo/ cream/ detergent) will get screened and the material is sent to recycler.

Plastic material will be washed and kept for drying on the mesh, effluent will be discharged to ETP. Cleaned plastic material will be sold to granular manufacturer plants. Color will be added to the material (shampoo/ cream/ detergent) and then recycled Shampoo shall sell to Car/floor washing solution manufacturers, recycled creams to Tyre polishing vendor and recycled detergent to tent houses to wash their tent cloths & carpets

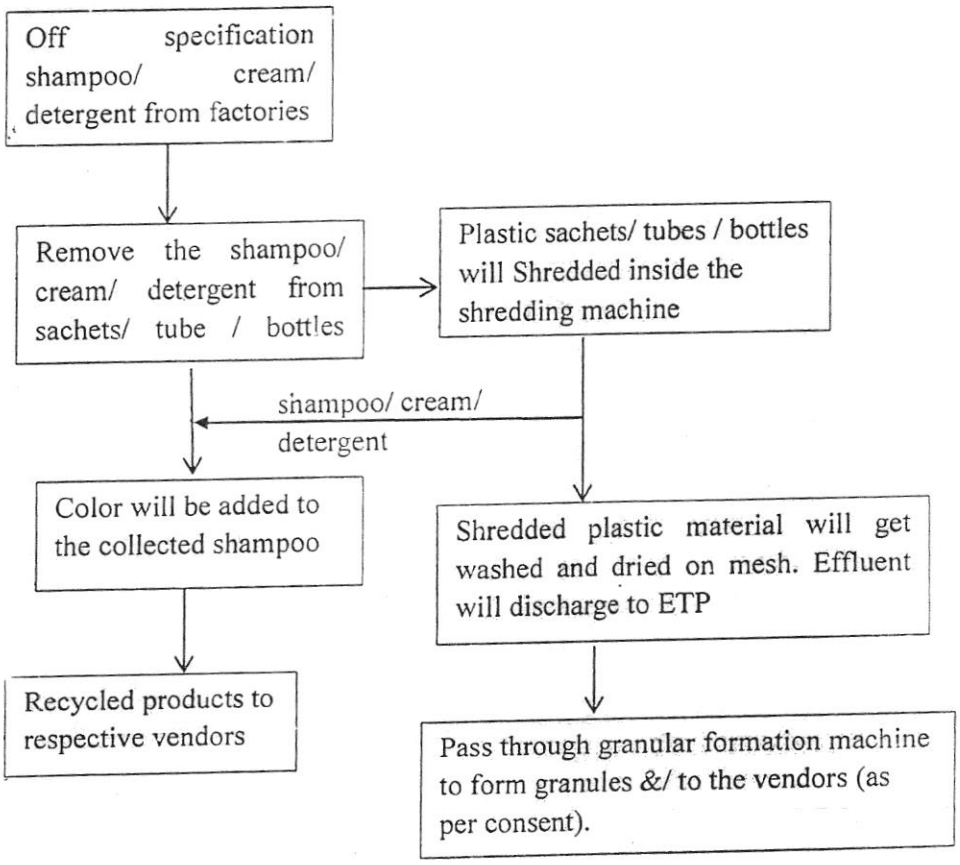


Figure: 2-*Process flow diagram for utilization of Off-specification product.*

75.3 Product Usage / Utilization

Off-specification products i.e., shampoo, cream and detergent recycled to produce Car & floor washing solution, Tyre polishing and for tent houses to wash their tent cloths & carpets respectively. Used oil recycled and send to Tyre manufacturers and Bitumen companies.

75.4 Standard Operating Procedure for utilization

This SoP is applicable only for utilization of Used oil and Off specification products (Shampoo, Detergent & Creams) for Recycling.

1) The unit shall ensure the removal of shampoo/ cream/ detergent from plastics (sachets/ tubes / bottles) through proper segregation method and further plastics contents shall be handled (i.e., recycled &/ disposed) in accordance with "Plastic Waste Management Rules, 2016".
2) Used oil procured for recycling shall meet the specification mentioned in the part A of Schedule V (HOWM Rules, 2016).
3) The unit shall install firefighting system specially in the Used oil handling area.
4) Used oil and its recycled product shall be handled in compatible containers with an unbroken screw top lid.
5) The unit shall ensure control of fugitive emissions through dust/fumes extraction system followed by APCD such as wet scrubber (As prescribed in the consent) near plastic shredding and extruder machine area.
6) Products recovered from recycling the off specification products shall not be sell as products that intend to intended to be rubbed, poured, sprinkled or sprayed on, or introduced into, or otherwise applied to, the human body or any part thereof for cleansing, beautifying, promoting attractiveness or altering the appearance.
7) Treatment and disposal of wastewater: Wastewater generated from floor-washings, spillages, washing plastics, collected water while recycling the used oil, scrubber bleed shall be treated in an Effluent Treatment Plant (ETP) or may sent to Common Effluent Treatment Plant (CETP) for final disposal or be treated further in a captive facility to comply with surface water discharge standards. In case of zero discharge, the treated waste water from ETP may be managed as per conditions stipulated by the concerned SPCB/PCC.
8) The treated effluent shall be discharged in accordance with the conditions stipulated in the Consent to Operate issued by concerned SPCB/PCC under the Water (Prevention and Control of Pollution) Act, 1974.
9) Shampoo, Detergent, Creams & Used oil shall be collected and stored under cool, dry, well ventilated covered storage shed(s) with impervious floor within premises, so as to eliminate rain water intrusion. Further, the storage sheds shall have proper slope and collection pit so as to collect seepage/floor washings. The collected seepage/floor washings shall be channelized to ETP for treatment.
10) The unit shall maintain proper ventilation in the work zone and process areas. All personnel involved in the plant operation shall wear proper personal protective equipment (PPE) specific to the process operations involved and type of chemicals handled as per Material Safety Data Sheet (MSDS). The safety precautions of the worker shall be in accordance with the Factory Act, 1948, as amended from time to time.

11) The hazardous wastes generated during recycling of Shampoo, Detergent, Creams and used oil (namely Oil sludge, APCD residue, ETP sludge etc.) shall be collected and temporarily stored in non-reactive drums/ bags under a dedicated hazardous waste storage area and sent to authorized common TSDF or other authorized facility within 90 days from generation of the waste in accordance with the authorization issued by the concerned SPCB/PCC.

12) The Used Oil and Off Specification Products shall be procured from authorized industries under HOWM Rules, 2016.

13) Transportation of Used Oil and Off Specification Products shall be carried out by sender (generator) or receiver (utilizer) only after obtaining authorization from the concerned SPCB/PCC under HOWM Rules, 2016. Requisite manifest document shall be followed as laid down under the said Rules.

14) Prior to utilization of Used Oil and Off Specification Products, the unit shall obtain authorization for storage, utilization and disposal of Used oil and Off specification products (Shampoo, Detergent & Creams) from the concerned SPCB/PCC under HOWM Rules, 2016.

15) In case of environmental damages arising due to improper handling of hazardous wastes including accidental spillage during generation, storage, processing, transportation and disposal, the occupier (sender or receiver, as the case may be) shall be liable to implement immediate response measures, environmental site assessment and remediation of contaminated soil/ groundwater/ sediment etc. as per the *"Guidelines on Implementing Liabilities for Environmental Damages due to Handling & Disposal of Hazardous Wastes and Penalty"* published by CPCB.

16) The unit shall provide suitable fire safety arrangements and flame proof electrical fittings.

17) During the process of utilization and handling of hazardous waste the unit shall comply with requirement in accordance with the Public Liability Insurance Act, 1991 as amended, wherever applicable.

75.5 Record/Returns Filing

1) The unit shall maintain a passbook issued by concern SPCB/PCC and maintain details of each procurement of Used oil and Off specification products as mentioned below:

   - Address of the sender
   - Date of dispatch
   - Quantity procured
   - Seal and signature of the sender
   - Date of Receipt in the premises

2) A log book with information on source and date of procurement of Used oil and Off specification products, date wise utilization of the same, hazardous waste generation and its disposal, etc. shall be maintained including analysis report of fugitive emission monitoring & effluent discharged, as applicable.

3) The unit shall maintain record of hazardous waste generated, utilized and disposed as per

Form 3 & file annual returns in Form 4 as per Rule 20 (1) and (2) of the HOWM Rules, 2016.

4) The unit shall submit quarterly and annual information on hazardous wastes consumed, its source, products generated or resources conserved (specifying the details like, type and quantity of resources conserved) to the concerned SPCB/PCC.

75.6 Standards

1) Fugitive emission in the work zone area shall comply with the standards as prescribed by the concerned SPCB/PCC.

2) Monitoring of the Fugitive emission shall be carried out quarterly for first year followed by at least annually in the subsequent year of utilization. The monitoring shall be carried out by ISO 17025 accredited or EPA, 1986 approved laboratories and the results shall be submitted to the concerned SPCB/PCC on a quarterly basis.

3) Standard for wastewater discharge: Treated effluent shall be discharged in accordance with the conditions stipulated in Consent to Operate issued by concerned SPCB/PCC under the Water (Prevention and Control of Pollution) Act, 1974. In case of zero discharge or no discharge condition stipulated in the said consent or non-availability of CETP, zero discharge shall be met.

75.7 Siting of Industry

Facilities for utilization of Used oil and Off specification products shall be preferably located in a notified industrial area or industrial park/estate/cluster and in accordance with Consent to Establish issued by the concerned SPCB/PCC.

75.8 Size of Plant and Efficiency of Utilisation

This SoP is applicable for utilization of Used oil and Off specification products recycling. The yield of recycling during trial run is observed around 96 – 99 % for Off specification products and 84 – 87 % for Used oil. Therefore, requisite facilities of adequate size of storage shed and other plant & machineries shall be installed accordingly.

75.9 Checklist of Minimal Requisite Facilities

Sl. No	Particulars
1.	Cool, dry well-ventilated covered sheds for Used oil and Off specification products and process activities within premises and dedicated hazardous storage area for temporary storage of hazardous waste generated during utilization process.
2.	Compatible containers with an unbroken screw top lid for used oil.
3.	Firefighting system with alarm in the Used oil handling area.
4.	Shredder and ETP
5.	Fumes extraction system followed by APCD like wet scrubber near plastic shredding and extruding area.

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CP-22/21/2023-WM-III-HO-CPCB-HO

Standard Operating Procedure(SOP) for Recycling of Lead Scrap/ Used Lead Acid Batteries

January 04, 2024

Central Pollution Control Board

(Ministry of Environment, Forest & Climate Change, Government of India)

Parivesh Bhawan, East Arjun Nagar, Shahdara, Delhi – 110032

STANDARD OPERATING PROCEDURES

for

Recycling of Lead Scrap/ Used Lead Acid Batteries such as Lead Acid Battery plates, Rains, Rinks, Radio, Racks, Rakes, Ropes, Rono, Rents, Relay, Rails and other Lead Scrap/Ashes/Residues etc.

1. Requirements for seeking permission for import of Lead Scrap/ Used Lead Acid Batteries for recycling

1.1.1 Any Unit desirous of importing lead scrap/ used lead acid batteries should have valid authorization from the concerned SPCB/PCC under Hazardous and Other Waste (Management &Transboundary Movement) Rules, 2016. The requirement (pertaining to recycling facilities and standard operating procedures) for grant of authorization to such Units are given in this SOP at **Annexure-I**;

1.1.2 Import of the used lead batteries should be done in pallets and it should be either stretch wrapped or shrink wrapped to the full height of the pallet stack and should be air tight to avoid any gas within the pallets. The wrapping should be abrasion and pierce resistant The pallets used should have sufficient weight bearing capacity and impact resistance. The pallet should be leak-proof and should be labelled as acid containing material;

1.1.3 Imported used lead acid batteries should have the caps of cells properly tightened in place at the time of transportation.

1.1.4 For considering applications for import of lead scrap/ used lead acid batteries, the following are also required along with filled up application in Form-5:

i. Valid Consent to Establish (CTE), Consent to Operate (CTO) under Water (Prevention and Control of Pollution) Act, 1974 and Air (Prevention and Control of Pollution) Act 1981;
ii. The analysis reports of stack emissions, waste waters, ambient air, work zone environment, soil and ground water specially in respect of lead content;
iii. The latest blood analysis report in respect of blood lead level of workers engaged in the Unit from accredited laboratories;
iv. Justification notes for import of lead scrap/ used lead acid batteries;
v. Geotagged photographs & geotagged video of running plant and facilities including pollution control devices;
vi. Acknowledgement for receipt of copy of application from concerned State Pollution Control Board (SPCB) / Pollution Control Committee (PCC);

1.1.4 In addition to the above, those desirous of importing used lead acid batteries (Rains & Rinks) have to fulfil the following requirements:

i. Should have registration on the EPR Portal under Battery Waste Management Rules, 2022;
ii. Should have registration on the EPR Portal under Plastic Waste Management Rules,2016 and amendments thereof;

iii. Should have automatic battery breaking system having acoustic enclosure, dust and fume extraction system as well as wet separation system for lead and plastic;
iv. Should have mechanical facility for draining the acid from batteries into the acid collection tank; and
v. Should have rotary furnace with air pollution control system.

Anand Kumar

Annexure-I.

STANDARD OPERATING PROCEDURES
Recycling of Lead Scrap/ Used Lead Acid Batteries

1. Grant of Authorization by SPCBs/PCCs

1.1.1 Any person who desires to set up a recycling Unit for recycling of lead bearing waste such as scrap/used lead acid batteries, Lead acid battery plates, Radio, Racks, Rains, Rinks, Rakes, Ropes, Rono, Rents, Relay, Rails and other lead scrap/ashes/residues etc. should submit an application in Form1 of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, accompanied with copies of the following documents for the grant of the authorization to concerned SPCB/ PCC.

i. Consent to establish granted by the State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and the Air (Prevention and Control of Pollution) Act, 1981 (21 of 1981);

ii. Consent to operate granted by the State Pollution Control Board under the Water (Prevention and Control of Pollution) Act, 1974 (25 of 1974) and/or Air (Prevention and Control of Pollution) Act, 1981, (21 of 1981);

iii. In case of renewal of authorization, a self-certified compliance report in respect of effluent, emission standards and the conditions specified in the authorization for hazardous and other wastes;

iv. Process flow chart of recycling or reprocessing of lead scrap/ used lead acid battery scraps along with the details of equipment installed;

v. Proof of installed capacity of plant and machinery as per registration issued by District Industry Centre or any other authorized government agency.

vi. Membership of Treatment, Storage and Disposal Facility (TSDF) for final disposal of slag after recycling of lead bearing waste;

vii. Details of Air Pollution Control Systems (APCS) installed in the Unit along with the diagram and their specification;

viii. Details of Effluent Treatment Plant (ETP) for treatment of acidic waste water and discharge from scrubber;

ix. Details of on-site secured storage (covered) facility for slags generated during the recycling process;

x. Details of covered storage space having impervious fooring for storage of raw material and finished products. Acid proof flooring in used batteries storage and breaking areas.

1.1.2 After receiving the application, the designated officer/officers should examine it and the shortcomings if any be communicated to the applicant within 7 working days of receiving the application;

1.1.3 After obtaining the required information /documents from the applicant, a dry inspection has to be carried out by the concerned SPCB/PCC for verification of the installed facilities. In the inspection report, the inspecting officer/officers shall certify that he has seen the recycling facility and also shall detail out the pollution control equipment installed in the recycling Unit and put his signature;

1.1.4 On the basis of inspection report the SPCB/ PCC, after being satisfied that the applicant is having environmentally sound technology, requisite technical capabilities, adequate facilities & equipment, shall grant authorization. If required, the SPCB/PCC at their discretion may constitute a committee to examine the proposals seeking authorization and to recommend for grant of authorization;

1.1.5 The authorization Certificate shall be granted by the State Pollution Control Board/ Pollution Control Committee along with a Passbook;

1.1.6 The authorization issued is valid for a period of five years, unless the operation is discontinued by the Unit or the authorization is suspended or cancelled for any violation of rules/conditions specified in authorization certificate;

1.1.7 SPCBs/PCCs is expected to dispose applications for authorization as stipulated in the HoW(M&TM) Rules 2016 within a period of six months from the date of receiving application completed in all respect. SPCBs/PCCs shall carry out performance evaluation of the pollution control devices including ETP for assessing adequacy (meaning whether capable of controlling pollution or not) of pollution control equipment. The inspection report has to be certified by the inspecting officer/officers that he has seen all the pollution control devices which are part of APCS and ETP in running condition and the devices & ETP are capable of controlling pollution; and

1.1.8 The list of the authorized recyclers or re-processors should be regularly updated and placed on the official website of the concerned SPCB/PCC. Statement of authorized recyclers in the State may be sent to CPCB on yearly basis by all the SPCBs/PCCs to maintain a centralized list of such recyclers in the country at CPCB website.

1.1.9 SPCBs/PCCs to ensure that the vehicles designated for transportation of used lead acid batteries (Rains & Rinks) should meet the criteria laid down at section 5 of this SOP and should enter the vehicle registration number in the respective authorization after satisfying themselves that the vehicle meets the laid down criteria.

2. Minimum required facilities, operating procedures

Type of furnace installed (Rotary/Mandir Bhatti)

a. Rotary furnace with suction hood connected with APCS over the charging point exists.

b. Mandir Bhatti with suction hood connected with APCS over the charging point and molten metal tapping point exists.

2.1.1 Furnace connected with expansion chamber, cooling tubes/ducts, Cyclone/ Multi Cyclone, Bag filter with pulse jet/ mechanical shaker arrangement, Alkaline Scrubber with arrangement of alkali dosing, & connected with ETP, ID fan and stack of minimum 30-meter height. Each stack should have a port- hole (as per specifications given in CPCB document COINDS-III) with platform for stack monitoring. There should be an easy ladder for safe access to stack monitoring platform;

2.1.2 Battery–Breaking Processes: After draining the acid there are two modes of braking of batteries before battery plates are processed for smelting. The first mode is manual where the battery is cut from top, plates are removed and left over acid is drained. The second mode is where the battery is mechanically broken along with casing;

2.1.3 The facilities required for manual dismantling include suction hood, connected to pollution control device, arrangement for washing of plastic components before being sent for recycling and acidic water neutralization facility. All the facilities with capacity more than 5000 MTA should install mechanical/automatic battery breaking Units;

2.1.4 The Unit should have separate covered storage space, having impervious acid proof flooring with acid collection tank connected with neutralization tank, for storage of used/waste lead acid battery. The acid collection tank should have arrangements for control of acid fumes such as fume arrester connected with APCS;

2.1.5 The Unit should have a ETP plant to treat waste water from battery-breaking system. The ETP should be based on physic-chemical treatment of waste water and should have provision for acid neutralization. After neutralizing the acid, for its disposal the Unit should follow the consent conditions. The acidic effluent from floor washing should be channelized into the neutralization tank;

2.1.6 The automatic battery breaking system will have arrangement for noise control in the form of acoustic enclosure, dust and fume extraction system, acid collection and neutralization facilities and ETP for treatment of lead and acidic wastewater;

2.1.7 The Unit should have adequate facilities for the collection and storage of ETP sludge. The sludge from the ETP plant should be stored in a covered sludge storage facility and sent to TSDF;

2.1.8 Unit should have separate, secured and covered space for storage of residue and slag generated from recycling of lead scrap/used lead acid batteries and maintain records of transfer of hazardous waste to TSDF; and

2.1.9 The pallets packaging material should be disposed only to TSDF.

3. SPCBs/PCCs may prescribe the following standards for Emission /Discharge for Lead

3.1.1 Lead in work area, NIOSH 8-hr avg (mg/ m^3): 0.05;

3.1.2 Lead in emission through stack (mg/ Nm^3)* :10.0 (already notified);

3.1.3 Lead in effluents (mg/ l) :0.10 (notified general standard);

3.1.4 Lead in factory premises near boundary wall 24-hr avg (µg/ m^3): 1.0;

(* Nm^3 -normal cubic meter)

3.1.5 Workers Blood lead levels: As a practice, all lead related Units should periodically examine their workers at least once in year for lead level in blood as well as urine. Persons with higher lead levels (greater than 42 µg /dl) should be shifted immediately to non-lead activity areas and given special medical treatment till the lead levels come back to acceptable level (10 µg/dl).

4. Steps to minimize fugitive emissions of Lead .

4.1.1 The design of hood /fume collection system from the smelting/ refining operations (from metal tapping point, charging doors, furnace joints etc.) should be capable of collecting lead emissions and transfer to the air pollution control system;

4.1.2 The storage and handling of all the raw materials, intermediates and products should be in covered area/ shed having concrete floors and mechanized equipment should be used to handle these materials as far as possible;

4.1.3 The floors in the loading area should be kept wet through sprinklers to reduce the chances of lead particles/ dust getting airborne; and

4.1.4 Any water used for washing, rain water etc, should be collected through separate pits (to delink this from the regular drain) for removing metallic lead etc. and the pit should have fine screens for passage of clear water.

4.1.5 The movement of vehicles to the administrative /working /production areas should ensure that only the trucks /vehicles involved in the material handling/ transportation reach the work areas, and their tyres are washed before they leave these areas;

4.16 The Unit should have facilities for washing tyres of vehicle entering and going out of the recycling facility.

5. The minimum requirement for transportation of used lead acid batteries (Rains & Rinks)

The following are the requirements pertaining to the transportation of used lead acid batteries:

5.1.1 Vehicle used for transportation shall be in accordance with the provisions under the Motor Vehicles Act, 1988, and rules made there under;

5.1.2 Transporter shall possess requisite copies of the certificate (valid authorization obtained from the concerned SPCB/PCC for transportation of used lead acid batteries by the importer) for transportation of used lead batteries:

5.1.3 Transporter should have valid "Pollution Under Control Certificate" (PUCC) during the transportation of used lead acid batteries and shall be properly displayed;

5.1.4 Vehicle should be fitted with GPS.

5.1.5 Vehicle should be fitted with mechanical handling equipment such as pallet jack, pallet lift, pallet truck, lift gate etc. for safe handling of the wastes;

5.1.6 The vehicles involved in the material handling/transportation of pallet of batteries should be leakage-proof. The vehicles should be labelled with logo for carrying Hazardous waste material;

5.1.7 Name of the facility operator or the transporter, as the case may be, shall be displayed;

5.1.8 Emergency phone numbers and transport emergency (TREM) Card having details of characteristics of waste (type, properties, chemical constituents, exposure hazards and first aid requirements) shall be displayed properly. MSDS must be provided with each consignment;

5.1.9 Import of the used lead batteries should be done in pallets and it should be either stretch wrapped or shrink wrapped to the full height of the pallet stack and should be air tight to avoid any gas within the pallets. The wrapping should be abrasion and pierce resistant The pallets used should have sufficient weight bearing capacity and impact resistance. The pallet should be leak-proof and should be labelled as acid containing material;

5.1.8 Imported used lead acid batteries should have the caps of cells properly tightened in place at the time of transportation;

5.1.10 Used lead acid batteries scrap must be transported inside shock resistant and acid resistant sealed container in upright position due to the risk of leakage;

5.1.11 The containers must be well packed to the transport vehicle and should not be allowed to move while being transported. The containers have to be bound, shrink wrapped or stacked properly to avoid movement;

5.1.12 During the unpacking of pallets of batteries, the workers should be equipped with Personal Protective Equipment e.g., PPE kit, Eyeglasses, Mask, Rubber Gloves and Shoes. Also, emergency kits and arrangement have to be readily available. The containers with pallets of batteries must not be opened during its transportation from port to the recycling facilities. The containers with pallets of batteries must be allowed to unload only at the recycling facility;

5.1.13 Vehicle shall be fitted with roll-on / roll-off covers if the individual containers do not possess the same. Carrying of passengers is strictly prohibited and those associated with the waste haulers shall be permitted only in the cabin;

5.1.14 Transporter shall carry documents of manifest for the used lead acid batteries during transportation and follow the manifest system as per HoW (M & TM) Rules, 2016 and it should be registered in the National Hazardous Waste Tracking System whenever it is implemented;

5.1.15 Each vehicle shall carry first-aid kit, spill control equipment and fire extinguisher;

5.1.16 Hazardous Waste transport vehicle shall run only at a speed specified under Motor Vehicles Act in order to avoid any eventuality during the transportation of used lead acid batteries;

5.1.17 Educational qualification for the driver shall be as per Motor Vehicles Act, 1988, and rules made there under and preferably 10th pass. The driver of the transport vehicle shall have valid driving license for heavy vehicles from the State Road Transport Authority and shall have a minimum of five years of experience in transporting the chemicals;

5.1.18 Driver(s) shall be properly trained for handling emergency situations and safety aspects involved in the transportation of hazardous wastes;

5.1.19 The design of the trucks shall be such that there is no spillage during transportation;

5.1.20 The loading and unloading of used lead acid batteries should be done through mechanical means. The manual loading and unloading of used lead acid batteries are not allowed; and;

5.1.21 The vehicles used for transportation of the used lead acid batteries should be leak proof. The flooring of the containers should be having wood sawdust. The containers being used for transportation of batteries should not be used for other purposes.

6. Liability:

6.1.1 In case of environmental damages arising due to improper handling of battery wastes including accidental spillage during generation, storage, processing, handling, transportation and disposal, the occupier (sender or receiver, as the case may be) shall be liable to implement immediate response measures, environmental site assessment and remediation of contaminated soil / groundwater / sediment etc. as per the "Guidelines on Implementing Liabilities for Environmental Damages due to Handling & Disposal of Hazardous Wastes and Penalty" published by CPCB.

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Standard Operating Procedure and Checklist of Minimal Requisite Facilities for utilization of hazardous waste under Rule-9 of the Hazardous and Other Wastes (Management and Transboundary Movement) Rules – 2016

Utilization of Black mass (generated by Lithium Ion Batteries dismantlers/recyclers or e-waste dismantlers/recyclers) for the recovery of Carbon/Graphite material and Metal compounds (Sulphates, Carbonates, Phosphates of Co, Mn, Ni, Li, Cu, Fe, Al & Na) by adopting Hydro-Metallurgy

CPCB

January, 2025

Central Pollution Control Board
(Ministry of Environment, Forest & Climate Change,
Government of India)
Parivesh Bhawan, East Arjun Nagar,
Shahdara, Delhi – 110032

Procedure for grant of authorization by State Pollution Control Board (SPCBs)/Pollution Control Committee (PCCs) for utilization of Hazardous waste

1) While granting authorization for utilization of hazardous wastes, SPCBs/PCCs shall ensure that authorization is given only to those wastes for which Standard Operating Procedures (SoPs) for utilisation have been circulated by CPCB ensuring the following:

   a. The hazardous waste (intended for utilization) belongs to same source of generation as specified in SoP.

   b. The utilization shall be same as described in SoP.

   c. End-use/ product produced from the waste shall be same as specified in SoP.

   d. Authorization shall be granted only after verification of details and minimum requisite facilities as given in SoP.

   e. Issuance of passbooks (similar to passbooks issued for recycling of used oil, waste oil, non-ferrous scraps, etc.) for maintaining records of receipt of hazardous waste for utilization.

   f. Monitor closely the quantity of Black mass generated (generated by authorized lithium ion batteries dismantlers/recyclers or e-waste dismantlers/recyclers) and sold to utilizers.

2) After issuance of authorization, SPCBs/PCCs shall verify the compliance of checklist and SoP on quarterly basis for initial 1 year; followed by random checks during subsequent period for atleast once a year. The compliance reports may be submitted to CPCB.

3) In-case of lack of requisite infrastructures with the SPCBs/PCCs, they may engage 3rd party institutions or laboratories having EPA/NABL/ISO17025 accreditation/ recognition for monitoring and analysis of prescribed parameters in SoPs for verification purpose.

4) SPCBs/PCCs shall provide half yearly updated list of units permitted under Rule 9 of Hazardous & Other Wastes (Management & Transboundary Movement) [HOWM] Rules, 2016 to CPCB and also upload the same on SPCB/PCC website, periodically. Such updated list shall be sent to CPCB.

5) Authorization for utilisation shall not be given to the units located in the State/Union Territory where there is no Common TSDF, unless the unit ensures authorised captive disposal of the hazardous waste (if any generated during utilisation) or its complete utilisation or arrangement for transfer to authorised disposal facility.

6) In case of the utilization proposal is not same with respect to source of generation or utilization process or end-use as outlined in this SoP, the same may be referred to CPCB for clarification /conducting trial studies and developing SoPs thereof.

7) The source and work zone standards suggested in the SoP are based on E(P)A notified and OSHA/NAAQ standard, respectively. However, SPCBs/PCCs may impose more stringent standards based on the location or process specific conditions.

8) SPCBs/PCCs shall ensure that the utiliser of Black mass (generated from crushing and shredding of Lithium-ion batteries generated by batteries dismantlers/recyclers or e-waste dismantlers/recyclers) shall maintain daily records on National Hazardous Waste Tracking System (NHWTS). The manifest system should also be generated on NHWTS.

115.0 Utilization of hazardous waste (H.W.):

Type of HW	Source of generation	Recovery/ Product
Black mass (under the Category: A6/ A65/ A66 A68/ A72 of Schedule-II under HOWM Rules, 2016 accordingly as per the type of Li ion Battery)	Generated from dismantling, crushing and shredding of waste Lithium-Ion Batteries generated by Lithium Ion Batteries dismantlers/ recyclers or e-waste dismantlers/ recyclers.	Recovery of Carbon and Metal compounds (Sulphates, Carbonates, Phosphates of Co, Mn, Ni, Li, Cu, Fe, Al & Na) for downstream industrial use.

115.1 Source of Waste:

Black mass is hazardous material generated by authorised lithium ion batteries dismantling/recycling units or e-waste dismantling/recycling facilities involved in crushing and shredding of waste Lithium-Ion Batteries, after physically separating material like copper, plastics, Aluminum, steel, etc. It majorly comprising of the anode & cathode material; and categorized as Hazardous waste under A6/ A65/ A66 A68/ A72 of Schedule-II of HOWM Rules 2016 where constituents may vary depending on the type of Li ion battery from which Black mass is generated; which is required to be disposed in an authorized disposal facility in accordance with condition, when not utilized as resource recovery.

Table 1. Typical Characteristics of Black mass (BM from 2 types of Batteries studied during trial run)

S. NO.	TEST PARAMETERS	Unit	Results	
			Black mass from Battery type-1 (BM-1)	Black mass from Battery type-2 (BM-2)
1.	pH	-	8.90 - 9.02	6.0 - 8.26
2.	Moisture	%	2.27 - 3.4	6.4 - 8.1

3.	Total Organic Carbon	%	1.09 - 1.64	2.35
Leaching concentrations				
4.	Ammonia (as NH_3)	mg/L	3.68 - 3.77	1.38-1.53
5.	Cyanide (as CN-)	mg/L	7.15	5.96
6.	Sulphide (as S^{-2})	mg/L	BDL	BDL
7.	Phosphate (as PO_4)	mg/L	0.32 - 0.35	0.3
8.	Fluoride	mg/L	310.9 - 342	501.9 - 548
9.	Cobalt (as Co)	mg/L	259.6 - 285.3	3.48 - 3.79
10.	Iron (as Fe)	mg/L	0.462 - 0.508	11.69 - 12.81
11.	Nickel (as Ni)	mg/L	21.9 - 24.2	0.585 - 0.653
12.	Lead (as Pb)	mg/L	0.17	BDL
13.	Manganese (as Mn)	mg/L	277.1 - 302	0.602 0.661
14.	Zinc (as Zn)	mg/L	0.524	0.098
15.	Aluminium (as Al)	mg/L	98.4 - 105.7	61.8
16.	Cadmium (as Cd)	mg/L	BDL	BDL
17.	Copper (as Cu)	mg/L	234.4 - 259.8	52.68 - 58.6
18.	Antimony (as Sb)	mg/L	BDL	BDL
19.	Molybdenum (as Mo)	mg/L	BDL	BDL
20.	Mercury (as Hg)	mg/L	BDL	BDL
21.	Vanadium (as V)	mg/L	0.013	1.305
Total concentrations				
22.	Titanium (as Ti)	mg/L	BDL	BDL
23.	Lithium (as Li)	mg/L	38500 - 39400	25400

BDL: Below Detectable Limit (Sulphide <1.0 mg/L, Pb <0.1 mg/L, Cd <0.05mg/L, Sb<0.1mg/L, Mo<0.5mg/L, Hg<0.1mg/L, Ti<2.5mg/L)

ND: Not Detected

Note: It is expected that there may be large variation in metal constituents in Black Mass, depending on type of batteries used in production. SPCBs/PCCs need to check the characteristics of Black mass (by identifying type of waste Li ion battery used) prior to issuance of authorization, any significant deviation with respect to typical values mentioned in the table above may be examined with respect to the source and available process units or may be referred to CPCB.

115.2 Utilization process of Black mass at Production Stage:

Hydrometallurgical process is adopted to recover the metal compounds of Co, Mn, Ni, Li, Cu, Al & Carbon from the hazardous waste i.e., Black mass.

Black Mass alongwith water, Sulphuric acid and leaching reagent are fed to the leaching reactor. pH and temperature conditions are controlled during this process. The leachate is separated from the leached material via filtration, and the resulting solid residue (cake). The cake formed from the filtration of leached liquor is washed with water & collected as Graphite/carbon material. If the filtered cake contains traces of iron, then the same is re-leached followed by filtration to obtain graphite cake and Iron salt by precipitating the filtrate.

The filtered leach liquor is processed through a purification process through oxidising reagents and soda ash followed by filtration process. The obtained cake is leached for extraction of Copper and further stripped from the solution using sulfuric acid, yielding a copper sulfate solution. Subsequent evaporation results in the production of copper sulfate. Post-copper removal, the cake undergoes further purification/extraction processes to obtain Alumina (Aluminium Hydroxy Carbonate).

The filtrate generated from purification unit is directed to solvent extraction circuit to sequentially recover manganese, cobalt, nickel, and lithium by using organic extracting solvents.

The extracted manganese, Cobalt, Nickel and Lithium are stripped separately (solvent extraction with sulphuric acid followed by evaporation/ precipitation using soda ash to get respective manganese salts (Manganese sulfate/ Manganese carbonate, Cobalt salts (Cobalt sulfate/cobalt carbonate), Nickel salts (Nickel sulfate/ Nickel Carbonate), and Lithium salts (Lithium Sulfate/Lithium Carbonate).

The raffinate (the remaining filtrate after removal of metal compounds) from solvent extraction circuit contains mainly sodium sulphate solution which is further processed to produce Sodium sulphate through MEE route where Sodium sulphate crystals are recovered. The condensate water generated from MEE plant is recycled in the process for leaching or washings of process units etc.

Note: In liquid-liquid extraction, the extract is the layer with the solvent and the desired substance, while the raffinate is the remaining phase depleted of that substance.

A typical process flow diagram is given at figure given below:

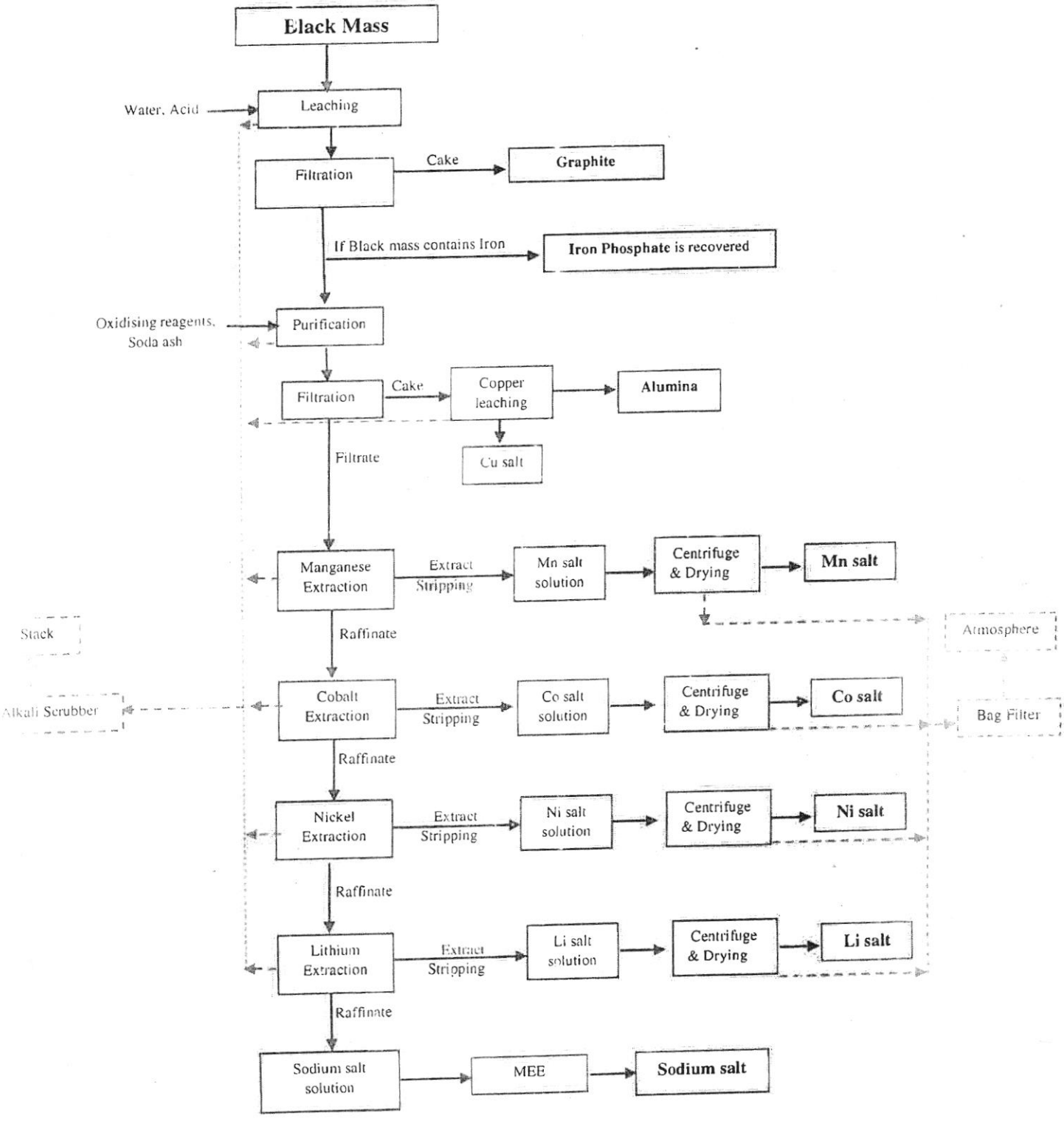

Figure: 1-Process flow diagram for utilization of Black mass

115.3 Standard Operating Procedure for utilization of Black mass:

This SoP is applicable only for utilization of Black mass (generated by lithium ion batteries dismantlers/recyclers or e-waste dismantlers/recyclers) for the recovery of carbon/graphite material and metal compounds (Sulphates, Carbonates, Phosphates of Co, Mn, Ni, Li, Cu, Fe, Al & Na) by adopting Hydro-Metallurgy. These SOPs shall become part of the comprehensive guidelines of CPCB on waste batteries recycling, if it involves captive utilization of black mass generated from lithium ion batteries recycling.

1) The utilizer (unit) shall procure the Black mass from the batteries dismantlers/ recyclers or e-waste dismantlers/ recyclers units complying with comprehensive guidelines on recycling of waste batteries issued by CPCB and authorised by SPCBs/PCCs, in leakproof HDPE bags in trucks registered with SPCB/PCC fitted with requisite safeguards ensuring no spillage.

2) There shall be a designated space for unloading/ keeping of HDPE bags of Black mass in storage sheds. The receiving waste shall be placed above the ground on a pallet, enclosed with low raise parapet wall to contain spillages, if any, alternatively, the bags may be placed above spill containment pallet.

3) The Black mass shall be stored in designated covered storage area (with caution sign) within premises on pallets placed on acid proof brick/tile lined floor area.

4) The unit shall provide separate storage tanks for other raw materials of utilization process i.e., solvents, reagent chemicals, intermediate raffinates, acids etc in dedicated storage area on acid proof brick/tile lined area within premises with caution sign.

5) The Storage and utilization area should have equipped with proper firefighting equipment and fire hydrant system to avoid the fire hazard especially in solvent storage area.

6) The Unit shall obtain necessary PESO license if required as per threshold quantum of solvents stored for the purpose of utilization process.

7) The entire utilization process area shall have leak-proof and acid proof tiles with adequate slope to collect spillages, if any, and shall be transferred to ETP or reaction tanks, as the case may be, through chemical process pump.

8) The unloading, storage, transfer and other handling of Black mass in entire utilization process shall be carried out through dedicated mechanical means minimizing manual intervention.

9) The unit shall ensure that the said utilization process and its associated activities shall be demarcated separately within premises.

10) The unit shall provide a suction hood connected to a bag filter system to control fugitive emissions during the charging of Black Mass (Particulate Matter) into the reactor.

11) The unit shall provide acid proof suction ducts connected to receive acidic fumes if any from the reactors (leaching and extraction units). These ducts may be connected to a common manifold duct, leading to an alkaline scrubbing system.

12) The unit shall provide bag filters to control metallic salt dust generated from the salt crushing process.

13) The unit shall provide fume extractions system followed by activated carbon filter to control VOC fumes in the solvent extraction unit area.

14) The treated gases / dust emissions from above mentioned pollution control systems shall comply with the emission standards and then only be released in the atmosphere through dedicated stacks. The stack height shall be a minimum of 30m from ground level or as prescribed by the concerned SPCB/PCC, whichever is higher.

15) Treatment and disposal of wastewater - Wastewater generated from the process, floor washing, spillage, reactor washing, scrubber bleed, condensate from MEE etc. may be reused in the process or treated physio chemically in an ETP to comply with wastewater discharge standards and may be sent to CETP for final disposal as prescribed by SPCB/PCC. In case of zero discharge, the treated waste water from ETP may be managed as per conditions stipulated by the SPCB/ PCC.

16) The treated effluent shall be discharged in accordance with the conditions stipulated in the Consent to Operate issued by concerned SPCB/PCC under the Water (Prevention and Control of Pollution) Act, 1974.

17) SPCBs/ PCCs shall ensure that recovered metal compounds containing traces of other heavy metals as impurities; may be permitted for end usage by industries only subject to meeting the criteria as supplementary material [as mentioned in section 115.4 (1)] and in no case shall be permitted for use in the food, pharma, animal feed, cosmetic, nutrient or fertilizer sector.

    Further, any fraction of recovered material not meeting the end usage quality requirements of downstream industries shall be treated as hazardous waste, which may be sent for co-processing in cement plants or disposed through TSDF.

18) The hazardous wastes (namely floor scrapping /sweepings, filter residue, ETP sludge etc.) generated shall be collected and temporarily stored in non-reactive drums/ bags category wise under a dedicated hazardous waste storage area having proper caution sign and be sent to authorized common TSDF or other authorized facility within 90 days from the generation of the waste in accordance with the authorization issued by the concerned SPCB/PCC. Such storage area shall have proper ventilation.

19) The unit shall ensure that the Black mass is procured from the industries, which have valid authorization from the concerned SPCB/PCC as required under HOWM Rules, 2016.

20) Transportation of Black mass shall be carried out by sender (generator) or receiver (utilizer) only after obtaining authorization from the concerned SPCB under Hazardous

and Other Wastes (Management and Transboundary Movement) Rules, 2016. Requisite manifest document shall be followed as laid down under the said Rules on national hazardous waste tracking system.

21) Prior to utilization of Black mass, the unit shall obtain authorization for collection, storage and utilization of Black mass from the concerned SPCB/ PCC under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

22) The unit shall maintain proper ventilation in the work zone and process areas. All personnel involved in the plant operation shall wear proper personal protective equipment (PPE) specific to the process operations involved and type of chemicals handled as per Material Safety Data Sheet (MSDS). The safety precautions of the worker shall be in accordance with the Factory Act, 1948, as amended from time to time.

23) In case of environmental damages arising due to improper handling of hazardous wastes including accidental spillage during generation, storage, processing, transportation and disposal, the occupier (sender or receiver, as the case may be) shall be liable to implement immediate response measures, environmental site assessment and remediation of contaminated soil / groundwater / sediment etc. as per the "Guidelines on Implementing Liabilities for Environmental Damages due to Handling & Disposal of Hazardous Wastes and Penalty" published by CPCB.

24) During the process of utilization and handling of hazardous waste the unit shall comply with requirement in accordance with the Public Liability Insurance Act, 1991 as amended, wherever applicable.

25) The unit shall provide suitable fire safety arrangements and flame proof electrical fittings.

115.4 Product Usage / Utilization

1) The recovered materials, i.e., graphite/carbon material and metal compounds (such as sulfates, carbonates, and phosphates of Co, Mn, Ni, Li, Cu, Fe, Al, and Na), shall be permitted for use in industries only under the following conditions:

1.1 The recovered materials shall meet the quality criteria as supplementary material for downstream industrial usage with respect to purity including BIS quality specifications if any. Accordingly, the SPCBs/ PCCs shall monitor the quality of recovered material required for domestic end users and the applicable standards such as BIS specifications.

1.2 The end use of recovered materials i.e., Graphite/ Carbon material and metal compounds (Sulphates, Carbonates, Phosphates of Co, Mn, Ni, Li, Cu, Fe, Al & Na) shall not be utilized in the food, pharma, animal feed, cosmetic, nutrient or fertilizer sector in any form.

1.3 The recommended industrial uses of Recovered Products from the Black mass through hydro-metallurgical route are as follows:

S. No.	*Name of products*	*End Use in industries for production of*
1.	Graphite/Carbon material	Industrial Electrodes
2.	Aluminium carbonate Solid (Alumina)	Co-processing in Cement Plant
3.	Copper Salt	Pigments, paints, Varnish
4.	Manganese Salt	Pigments, Glaze, Ceramics
5.	Cobalt Salt	Pigments, electroplating, Catalyst, Ceramics, Paints, Pigments, purified cobalt salt
6.	Nickel Salt	Catalyst, Electroplating, Ceramics, purified nickel salt
7.	Lithium Salt	Glass, Ceramics, purified lithium salt
8.	Iron Salt	Paints, Pesticides
9.	Sodium Sulphate	Paper, Specialty Chemicals

2) Any fraction of recovered material not meeting the end usage quality requirements of downstream industries shall be treated as hazardous waste, which may be sent for re-processing or co-processing in cement plants or disposed through TSDF.

3) The unit shall label its products i.e. Recovered metal compounds/ Graphite prepared by utilizing aforesaid Black mass as *"This Carbon/[metal] salt has been prepared by utilizing Black mass (generated in crushing and shredding of Lithium-ion batteries)"*.

115.5 Record/Returns Filing

1) The unit shall maintain a passbook issued by concern SPCB/PCC and maintain details of each procurement of Black mass as mentioned below:

- Address of the sender
- Date of dispatch
- Quantity procured
- Seal and signature of the sender
- Date of Receipt in the premises

Above records shall also be maintained on National Hazardous Waste Tracking System.

2) A log book with information on source and date of procurement of Black mass, date wise utilization of the same, hazardous waste generation and its disposal, etc. shall be maintained including analysis report of emission monitoring & effluent discharged, as applicable.

3) The unit shall maintain records on sales details of the recovered products (manufactured by utilizing Black mass).

4) The unit shall maintain record of hazardous waste generated, utilized and disposed as

per Form-3 & also file an annual return in Form-4 as per Rule 20 (1) and (2) of HOWM Rules, 2016, to concerned SPCB/PCC.

5) The unit shall submit quarterly and annual information on hazardous wastes consumed, its source, products generated or resources conserved (specifying the details like, type and quantity of resources conserved) to the concerned SPCB/PCC.

6) The unit shall use NHWTS to manage the manifest, enter daily records of quantity generated, disposed, etc.

115.6 Standards

1) Source emissions from the stack connected to reactors/ process unit shall comply with the following Emission standards or as prescribed by the concerned SPCB/PCC, whichever is stringent:

Particulate Matter	50 mg/Nm^3
Manganese as Mn	5 mg/Nm^3
Sulphuric acid mist	50 mg/Nm^3
Total Fluoride	25 mg/Nm^3
TOC	20 mg/Nm^3

2) Work zone emission in the work zone area shall comply with the following standards:

PM_{10}	5 mg/m^3 TWA* (PEL)
Sulphuric acid	1 mg/m^3 TWA* (PEL)
Hydrogen Fluoride	3 ppm TWA* (PEL)
Fluorides (as F)	2.5 mg/m^3 TWA* (PEL)
Manganese compounds (as Mn)	5 mg/m^3 #
Cobalt metal, dust, and fume (as Co)	0.1 mg/m^3 TWA* (PEL)
Copper Dusts and mists (as Cu)	1 mg/m^3 TWA* (PEL)
Nickel	1 mg/m^3 TWA* (PEL)

*PEL - Permissible Exposure Limit.

*Time-weighted average (TWA)- measured over a period of 8 hours of operation of process.

- A ceiling limit is one that may not be exceeded for any period of time, and is applied to irritants and other materials that have immediate effects.

3) Monitoring of the above specified parameters for Source emissions and Work zone emission shall be carried out quarterly for first year followed by at least annually in the subsequent year of utilization. The monitoring shall be carried out by ISO 17025 accredited or EPA, 1986 approved laboratories and the results shall be submitted to the concerned SPCB/PCC on a quarterly basis.

4) Standard for wastewater discharge: Treated effluent shall be discharged in accordance with the conditions stipulated in Consent to Operate issued by concerned SPCB/PCC under the Water (Prevention and Control of Pollution) Act, 1974. In case of (i) zero discharge as per consent or (ii) non-availability of the common Effluent Treatment Plant (CETP), the unit shall achieve zero discharge by setting up adequate captive treatment facility.

115.7 Siting of Industry

Facilities for utilization of Process residue shall be preferably located in a notified industrial area or industrial park/estate/cluster and in accordance with Consent to Establish issued by the concerned SPCB/PCC.

115.8 Size of Plant and Efficiency of Utilisation

During trial study, a total of 21.5 Tons of Black mass (14.9 Tons of BM-1 & 6.6 Kg of BM-2) was utilized. Accordingly, based on the available metals in the respective black mass samples the total metal recovery is 90% for cobalt; 93% for Nickel; 96% for Manganese; 83% for Lithium; 73% for Copper; 76% for Iron; 76% for Aluminum; and 97% for carbon shall be achieved. Therefore, based on the type of Black mass (generated from various types of Li ion batteries) requisite facilities of adequate size of storage shed and other plant & machineries shall be installed accordingly.

115.9 Online detectors/ Alarms/ Analyzers

In case of continuous process operations, online emission Analyzers for PM, HF, and TOC in the stack shall be installed and the online data be connected to the server of the concerned SPCB/ PCC.

115.10 Checklist of Minimal Requisite Facilities*:

Sl. No	Particulars
1.	Dedicated space for receiving black mas. Dedicated storage space under covered shed, for storage of Black mass bags or containers; raw chemicals, solvents. Pallets to store bags containing Black Mass. Containment of storage space with low raise wall/ bund.
2.	Acid and solvent storage tanks shall have proper ventilation, acid proof brick lining, proper slope and collection pit with caution sign under cool, dry, well-ventilated covered sheds shall have proper slope and seepage collection pit to collect seepage / floor washing.
3.	Storage and utilization area should have equipped with proper firefighting equipment including fire hydrant system.
4.	Sign boards indicating, storage, process, product and hazardous waste areas.
5.	Mechanised systems - for unloading, storage, transfer and other handling of Black mass in entire utilization process.
6.	Suction hood connected to a bag filter system (to control dust emission) while charging the Black Mass into the reactor.

7.	An alkaline scrubbing system connected with acid proof suction ducts to the reactors (leaching and extraction units) for control of acidic fumes. The scrubbing unit shall be connected to stack
8.	Bag dust collectors to the salt crushing processes connected to stack
9.	Fume extractions system followed by activated carbon filter in the solvent extraction unit area connected to a stack.
10.	Wastewater generated from the process, floor washing, spillage, reactor washing, scrubber bleed, condensate from MEE etc. may be reused in the process or treated physio chemically in an ETP to comply with wastewater discharge standards and may be sent to CETP for final disposal as prescribed by SPCB/PCC.
11.	Separate Leaching reactors for each stage of process
12.	Filtration units
13.	Extraction reactors (solvent / acid based)
14.	Stripping units
15.	Centrifuges
16.	Crystallization units.
17.	Evaporation/ drying units
18.	Crushing units
19.	MEE unit.
20.	Stack - to have sampling port, platform, access to the platform etc. as per the guidelines on methodologies for source emission monitoring published by CPCB under Laboratory Analysis Techniques LATS/80/2013-14. The air pollution control systems (fume scrubbers and bag dust collectors shall be connected to stack of height 30m or more as may be prescribed by SPCBs/PCCs.
21.	Online analyzers - for PM, HF, and TOC in the stack in case of continuous process operations.

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