

**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 Pot Lining (SPL) generated from Primary Aluminium
Smelting Industries
(Revised)**



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Central Pollution Control Board
(Ministry of Environment, Forest & Climate Change, Government of India)
Parivesh Bhawan, East Arjun Nagar,
Shahdara, Delhi – 110032

Standard Operating Procedure and Checklist of Minimal Requisite Facilities- Utilization of Spent Pot Lining (SPL) generated from Primary Aluminium Smelting Industries

Procedure for grant of authorisation by SPCBs/PCCs for utilization of Hazardous Waste

- 1) While granting authorisation for utilization of hazardous wastes, SPCBs/PCCs shall ensure the following:
 - a. The waste (intended for utilization) belongs to similar source of generation as specified in Standard Operating Procedures (SoPs).
 - b. The utilization process is similar to the process of utilization described in SoPs.
 - c. End-use / product produced from the waste shall be same as specified in SoPs.
 - d. Authorisation shall be granted only after verification of utilization process and minimum requisite facilities installed as given in SoPs.
 - e. Issuance of passbooks (similar to the passbooks issued for recycling of used oils, waste oil, non-ferrous scraps, etc.) for maintaining records of receipt of hazardous wastes for utilization.
- 2) After issuance of authorization, SPCB shall verify the utilization process, checklist and SOPs on quarterly basis for the initial 02 years; followed by random checks in subsequent period for at least once a year.

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.

- 3) SPCBs/PCCs shall provide half yearly updated list of units permitted under Rule 9 of Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 (HOWM Rules) to CPCB and also upload the same on SPCB website, periodically. Such updated list shall be sent to CPCB on a half yearly basis by July and January respectively.
- 4) 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 (generated during utilisation) or its complete utilisation or arrangement of sharing with any other authorised disposal facility.
- 5) In case 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.
- 6) The source and work zone standards suggested in the SoPs are based on the E(P)A notified and OSHA standard respectively, however, SPCB/PCC may impose more stringent standards based on the location or process specific conditions.
- 7) Patent has granted for "A Novel Method for Detoxification of Spent Pot Lining (SPL) by Controlled Heat Treatment" by The Patent Office, Government of India, therefore, to protect the patent rights the utilizers of this particular SoP should take permission from the patent holder and abide by the regulations stipulated for Patent No. 343974 dated 22.09.2017, as per provisions of the Patents Act, 1970
- 8) Central Pollution Control Board/Ministry of Environment, Forest and Climate Change (CPCB/MoEF&CC) shall not be made responsible for violations of Patent No. 343974 in accordance with the provisions of the Patent Act, 1970", by utilizers of this revised SoP for utilization of SPL generated from primary Aluminium Smelters.

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32.0 Utilization of Spent Pot Lining (SPL):

Type of HW	Source of generation	Recovery/Product
Spent Pot Lining (SPL) - Category.11.2 of Schedule-I of HOWM Rules, 2016	During production of Primary Aluminium from Alumina Smelting Industries	For manufacturing of carbon mineral fuel to be used as resource/energy recovery in high temperature (more than 1000°C) applications such as cement kiln, iron, steel and ferrous alloy industries

32.1 Source of Waste

Spent Pot Lining (SPL) is a waste generated in the primary aluminium smelting industries. Primary aluminium is produced by the electrolysis of alumina in Hall-Heroult electrolytic reduction pots at 960°C using carbon anode and a mixture of molten Cryolite (Na_3AlF_6) with 28% of dissolved alumina (Al_2O_3) and other additives. The reduction pot is provided with electrically conductive carbon linings for electrolyzing the molten electrolyte by passing an electric current between carbon anode dipped into the molten bath whereas the carbon lining acting as cathode. The outer pot lining consists of refractory material enclosed in a steel pot- shell. Cells of this type have a typical life span of 3 to 6 years. During pot operation, carbon lining gradually deteriorate with slow penetration of molten melt. The lining gets deteriorated and the continued operation of the cells demands replacement of pot- lining. This replaced pot lining is termed as Spent Pot Lining (SPL) which is categorised as hazardous waste at S.No.11.2 of Schedule-I of HOWM Rules, 2016 which is required to be disposed in authorized disposal facility in accordance with authorization condition, when not utilized as energy/ resource recovery. Typical spent pot lining contains carbon (60-75%), SiO_2 (1-2%), Al_2O_3 (7-8%), Fe_2O_3 (1-2%), Na (7-11%), Fluoride (4-7%) and Cyanide (100-250 ppm).

32.2 Utilization Process

The utilization process involves crushing of SPL (of size 200-500 mm received from generator) in crusher followed by screening (30mm). The screened (<30mm) SPL is subjected to heat treatment in a rotary kiln at 430-460°C for cyanide destruction. The heat treated SPL is fed directly to the rotary hydro mist reactor along with lime and controlled water mist to convert the leachable fluoride into non- leachable CaF_2 . Resultant mass from the reactor is collected and packed in bags as finished product termed as Carbon mineral fuel to be used in cement kiln.

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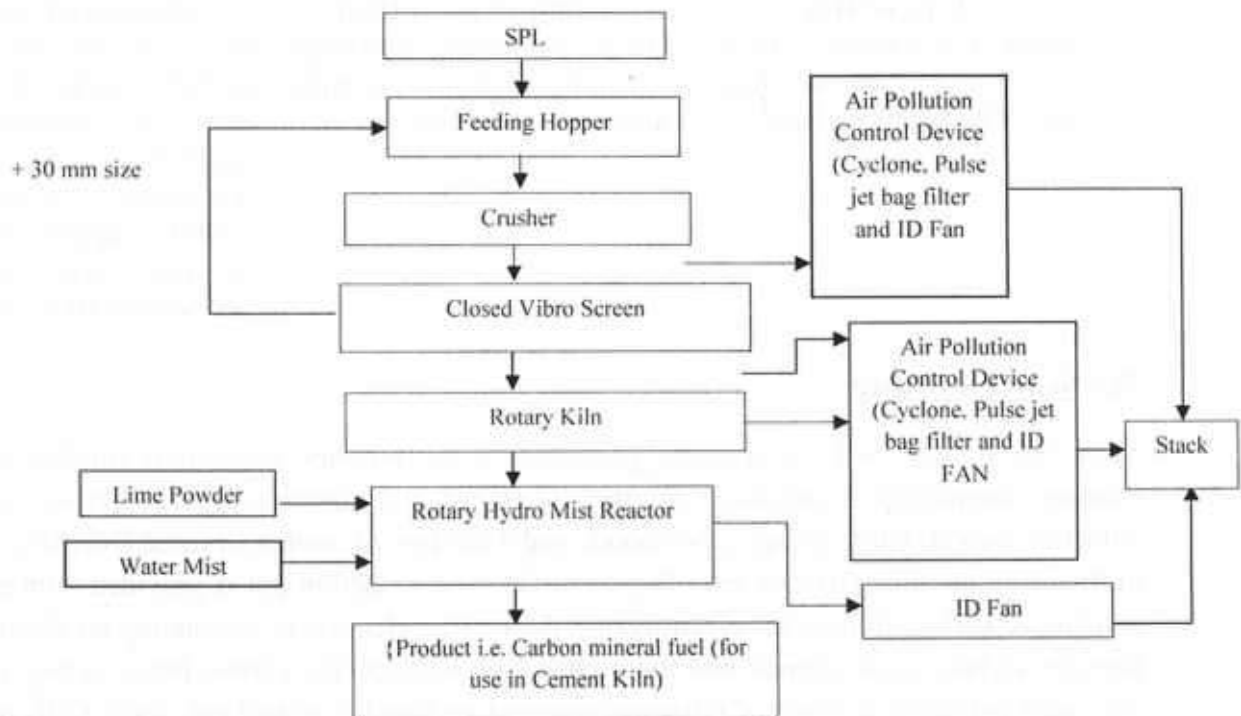


Fig. 1: Process Flow Diagram for utilization of SPL

32.3 Product Usage /Utilization

De-toxified SPL (Carbon) named as carbon mineral fuel shall be used as resource/energy recovery in high temperature (more than 1000 °C) applications such as cement kiln, iron, steel and ferrous alloy industries but not for use in boilers. Such cement kiln, iron, steel & ferrous alloy industries shall comply with the emission standards notified vide notification G.S.R. 497 (E) dated 10/05/2016 under Environment Protection Act, 1986.

32.4 Standard Operating Procedure (SoP) for utilization

This SoP is applicable only for the utilization of spent pot lining (SPL) generated from Primary Aluminium Smelting Industries.

- 1) The SPL of size 200-500 mm shall be transported in covered container mounted on vehicles fitted with requisite safeguards ensuring no spillage of waste in accordance with provisions stipulated under Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016.
- 2) Transportation of SPL shall be carried out by the sender (generator) or receiver (utilizer) as per the authorization issued by concerned SPCB under Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016.
- 3) The sender and receiver shall ensure that procured SPL should be carbonaceous fraction of SPL and free from refractory material.
- 4) The unit shall store SPL under cool, dry and well-ventilated covered storage shed(s) within premises having impervious RCC flooring, as authorized by the concerned State Pollution



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Control Board/ Pollution Committee under Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016, so as to eliminate rain water intrusion.

There shall be a designated space for unloading of SPL within the said covered storage shed(s).

- 5) Breaking and loading of large chunks (200-500 mm) of SPL to hopper shall be done through mechanical breaker/ loader within the premises.
- 6) From feeding hopper, the chunked SPL shall be conveyed to enclosed crushing chamber system to hopper through a closed conveyer.
- 7) The SPL from said hopper shall be crushed in crusher (suitably designed to crush SPL which has high crushing index) and be screened to less than 30 mm size through vibro double deck screen. The oversized SPL shall be again fed to the hopper of crushing chamber through closed conveying system.
- 8) The entire system of crushing and screening shall be in a closed system. Such closed system shall be maintained under negative suction and be connected to cyclone, pulse jet bag filter and ID fan followed by stack of height as prescribed by concerned SPCB/PCC.
- 9) The screened SPL(of size less than 30 mm) shall be transferred to rotary kiln for direct heat treatment maintaining temperature not less than 430°C. The flue gas from rotary kiln shall be treated in separate system of cyclone, pulse jet bag filter and ID fan followed by individual/ common stack of height as prescribed by concerned SPCB/PCC.

SPL shall be fed into the rotary kiln through automatic feeding system with electronic control panel to control the feed rate.

- 10) Heat treated SPL shall be fed into a rotary hydro mist reactor through a closed chute in red hot condition along with lime and controlled water mist. Retention time in rotary hydro mist reactor shall be maintained as 15-20 minutes. Rotary hydro mist reactor shall be connected through ID fan connected to an individual/ common stack of height as prescribed by concerned SPCB/ PCC.
- 11) There shall be automated system (may operate under gravitational force from lime hopper) for lime powder addition into the reactor. High pressure nozzles with pump arrangement shall be used for water mist formation to be added in the reactor. Water tank with water flow meter and emergency re-circulating tank shall be connected with hydro mist reactor.
- 12) The rotary hydro mist reactor shall have an arrangement of hood over it for collection of fumes. Such hoods shall be maintained under suction through ID fan and be connected individual/ common stack of height as prescribed by concerned SPCB/PCC.
- 13) Product i.e. carbon mineral shall meet the following concentration limits based on Toxicity Characteristic Leaching Procedure (TCLP)/ Soluble Threshold Limit Concentration (STLC) as specified in Schedule II of HOWM Rules, 2016

Cyanide- 20 mg/L [Based on TCLP]
Fluoride-180 mg/L [Based on STLC]

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- 14) Residue collected from cyclone and pulse jet bag filter shall be re-used in the utilization process.
- 15) 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 goggles, face mask, gloves, gum boot etc.
- 16) The unit shall provide suitable fire safety arrangements and flame proof electrical fittings.
- 17) It shall be ensured that spent pot lining is procured from the industries who have valid authorization for generation/ storage of the same from the concerned SPCB/PCC as required under Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016.
- 18) Prior to utilization of spent pot lining, the unit shall obtain authorization for generation, storage and utilization of spent pot lining from the concerned State Pollution Control Board under Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016.
- 19) In case of environmental damages arising due to improper handling of hazardous waste 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.
- 20) 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.

32.5 Record>Returns Filing

- 1) The unit shall submit quarterly and annual information on hazardous waste consumed, its source, products generated or resources conserved (specifying the details like type and quantity of resources conserved) to the concerned SPCB.
- 2) The unit shall maintain a passbook issued by concern SPCB wherein the following details of each procurement of SPL shall be entered:
 - Address of the sender
 - Date of dispatch
 - Quantity procured
 - 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 SPL, quantity, date wise utilisation 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

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Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, to concerned SPCB/PCC.

32.6 Standards

- 1) Fugitive emission in the work zone shall comply with the following standards:

PM ₁₀	5mg/m ³ TWA
Ammonia	25ppm (18mg/m ³) TWA 35ppm (27 mg/m ³) STEL
Fluoride as F	2.5 mg/m ³ TWA
Cyanide as CN	5 mg/m ³ TWA

Reference: Occupational Safety and Health Standard 1910:1000

TWA: time-weighted average*

The permissible Exposure Limit is 8-hours TWA

STEL- short term exposure limit (measured for 15 minutes duration of exposure)

- 2) Emission from common stack connected to rotary kiln and crushing & screening followed by APCD shall comply with the following:

PM	50 mg/Nm ³
Total Fluoride	25 mg/Nm ³
Hydrogen Fluoride	4 mg/Nm ³
Ammonia	75 mg/Nm ³
Hydrogen Cyanide	10 mg/Nm ³

- 3) Monitoring of the specified parameters for source emission shall be carried out quarterly for the first year followed by at least 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 the results shall be submitted to the concerned SPCB/PCC quarterly.

32.7 Siting of Industry

Facilities for processing of SPL shall preferably 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.

32.8 Size of Plant & Efficiency of utilisation

100 kg of SPL would produce 109.5kg treated SPL as carbon mineral fuel, which will be used as energy/ resource recovery in cement kiln. Therefore, requisite facilities of adequate size of storage shed and other plants & machineries as given in para 32.10 below shall be installed accordingly.

32.9 On-line detectors / Alarms / Analysers

Online emission monitoring systems for PM emission should be installed in stacks attached to screening & crushing section and rotary kiln and the online data be connected to the server of the concerned SPCB/PCC and CPCB.

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32.10 Checklist of Minimal Requisite Facilities

Sl. No	Requisite Facilities
1	Designated space for storage of SPL only under cool, dry, well – ventilated covered storage shed with concrete RCC flooring within premises, so as to eliminate water intrusion.
2	Mechanized handling system for loading and unloading of spent pot lining.
3	Closed crushing and screening chamber with crusher, Double deck closed vibro screen (screen size 30 mm) with cyclone, pulse jet bag filter and ID fan followed by common stack of height as prescribed by SPCB/PCC. The crusher shall be suitably designed to crush SPL which has high crushing index.
4	Stack with 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.
5	Rotary kiln with automated feeding system of SPL.
6	Thermocouple in the rotary kiln along with temperature display system.
7	APCD (cyclone, pulse jet bag filter and ID fan) with the rotary kiln. The outlet of APCD shall be attached to common stack of height as prescribed by SPCB/PCC with easy access to port hole, for conducting stack monitoring.
8	Closed conveying system for feeding of SPL into crushing & screening unit, rotary kiln and hydro mist reactor.
9	Rotary Hydro mist reactor with arrangement of hood over it for collection of fumes. Such hoods shall be maintained under section through ID fan and be connected to an individual/ common stack height as prescribed by concerned SPCB/ PCC with easy access to port hole, for conducting stack monitoring.
10	Lime feeding tank, water tank and emergency re- circulating tank.
11	Separate hopper for lime powder with automatic control system.
12	High pressure nozzles with pump arrangement for water mist formation in reactor. Water tank with valve for automatic control system for mist formation
13	Separate storage shed/ space for storage of product.
14	Online analysers for PM emission monitoring in stack and the online data be connected to the server of the concerned SPCB/PCC and CPCB

Note: To protect the patent rights the utilizers of this SoP should take the permission from patent holder as per the provisions of patent Act.

