

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

Pre-processing of Waste Silicon Carbide Refractory bricks from Pot Lining Waste generated from primary Aluminium smelters



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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

**Pre-processing of waste Silicon Carbide Refractory bricks from Pot Lining Waste
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Procedure for grant of authorization by State Pollution Control Boards (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 utilization have been circulated by Central Pollution Control Board (CPCB) ensuring the following:
 - a. The waste (intended for utilization) should have 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. Authorisation shall be granted only after verification of details and minimum requisite facilities as given in SoP.
 - 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 compliance of checklist and SOPs on quarterly basis for initial 02 years; followed by random checks in subsequent period for at least once in every 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 SoP 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 a half yearly basis i.e. by July and January respectively.
- 5) Authorisation for utilization 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 utilization) or its complete utilization 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 SoPs are based on the E(P)A notified and OSHA standards respectively, however, SPCBs/PCCs may impose more stringent standards based on the location or process specific conditions.



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72.0 Pre-processing of waste Silicon Carbide Refractory bricks:

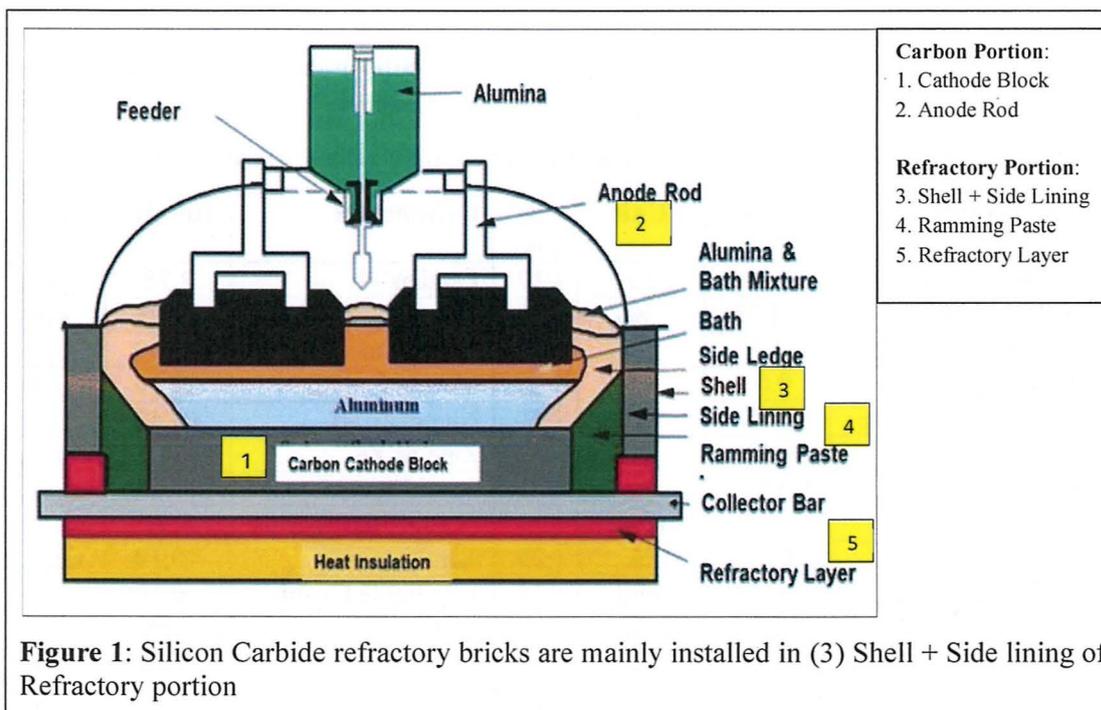
Type of HW	Source of generation	Recovery/Product
Silicon Carbide Refractory bricks from Pot lining Waste Category 11.2 of Schedule I of HOWM Rules, 2016)	Primary Aluminium smelters	Silicon carbide refractory powder for use as raw material for silicon carbide and other refractory bricks manufacturing.

72.1 Source of Waste

In aluminium smelting process, there is a refractory liner between the carbon layer and steel casing of melting pot for insulation. After the end of pot life, the liners are discarded as pot liner waste, which is classified as hazardous waste due to high leaching potential for fluoride, cyanide and release of harmful gases in reaction with water. The refractory layers including silicon carbide bricks are categorized as hazardous waste - category 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 for resource/energy recovery.

There is a possibility of utilising waste refractory material for producing renewed refractory material, especially the silicon carbide bricks, DIM (Al_2O_3 castable refractory), calcium silicate bricks, insulating bricks (both refractory and clay bricks), etc.

72.1.1 Steps to identify and segregate silicon carbide from refractory layers of SPL



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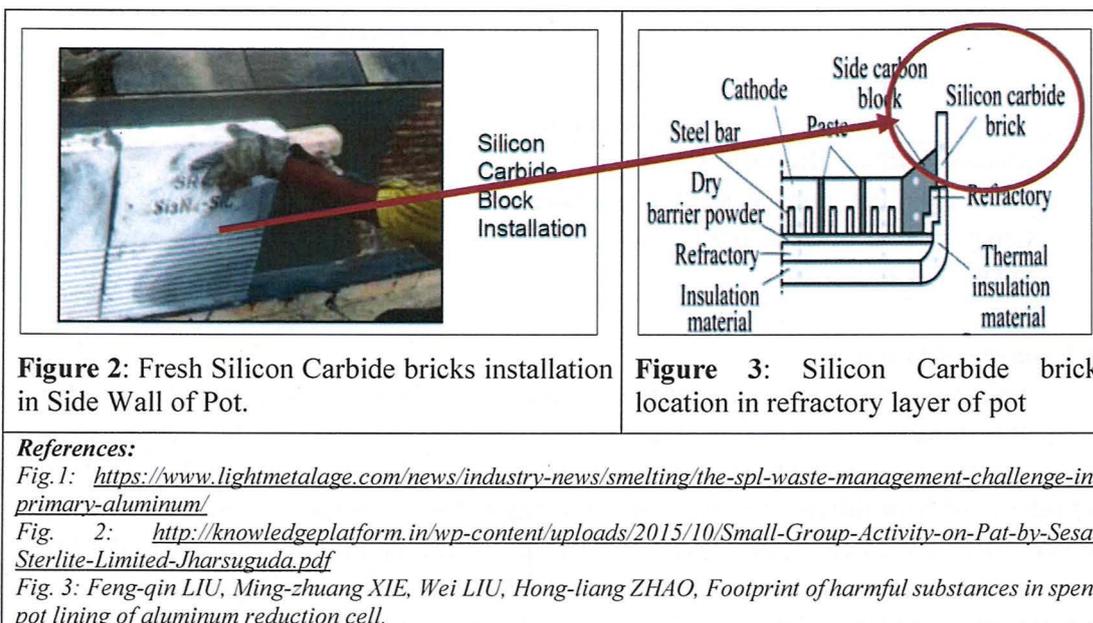


Figure 2: Fresh Silicon Carbide bricks installation in Side Wall of Pot.

Figure 3: Silicon Carbide brick location in refractory layer of pot

References:

Fig. 1: <https://www.lightmetalage.com/news/industry-news/smelting/the-spl-waste-management-challenge-in-primary-aluminum/>

Fig. 2: <http://knowledgeplatform.in/wp-content/uploads/2015/10/Small-Group-Activity-on-Pat-by-Sesa-Sterlite-Limited-Jharsuguda.pdf>

Fig. 3: Feng-qin LIU, Ming-zhuang XIE, Wei LIU, Hong-liang ZHAO, Footprint of harmful substances in spent pot lining of aluminum reduction cell.

- 1) Waste silicon carbide refractory bricks shall only be procured from primary aluminium smelting industries excluding carbon portion and other refractory liners of cathode residue (pot liner waste). Separation of other refractory parts shall be done at generator premises before transportation to the pre-processor.
- 2) It is the responsibility of cathode residue generator (Primary Aluminium Smelters) and pre-processors to ensure proper segregation of waste Silicon carbide bricks from other refractory layers which should not exceed 5% of total quantity.

Table 1: - Typical Characteristics of waste Silicon carbide refractory bricks:

S. no.	Parameters	Results	Unit
1	Carbon	5.50	%
2	Silica as SiO ₂	74.25	%
3	Alumina as Al ₂ O ₃	15.75	%
4	Iron as Fe	0.60	%
5	Magnesium as Mg	0.13	%
6	Phosphorus as P	0.22	%
7	Potassium as K	0.95	%
8	Sodium as Na	1.23	%
9	Titanium as Ti	0.38	%
10	Cadmium as Cd	<0.10	ppm
11	Antimony as Sb	<0.10	ppm
12	Chromium as Cr	14.32	ppm
13	Copper as Cu	21.21	ppm
14	Cobalt as Co	2.57	ppm
15	Arsenic as As	<0.10	ppm
16	Boron as B	20.78	ppm
17	Lead as Pb	2.78	ppm
18	Manganese as Mn	40.88	ppm
19	Beryllium as Be	<0.10	ppm
20	Mercury as Hg	<0.10	ppm
21	Nickel as Ni	14.42	ppm
22	Zinc as Zn	639.3	ppm
23	Total Fluoride	49.68	mg/Kg
24	Leachable Fluoride	6.93	mg/L
25	Total cyanide	<0.10	mg/Kg
26	Leachable Cyanide	<0.10	mg/L
27	Fe ₂ O ₃	8.58	%
28	Volatile Matter	0.88	%
29	Fixed Carbon	0.44	%
30	Gross calorific value	<200	Kcal/Kg

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72.2 Pre-processing of waste silicon carbide refractory bricks

The waste silicon carbide refractory bricks procured from primary Aluminium smelting industries are charged into crusher preferably jaw crusher manually. The crushed material passed through separator to collect in different sizes (<5 mm). This powdered form of pre-processed Silicon Carbide is packed and sold to authorized users for manufacturing of refractory bricks.

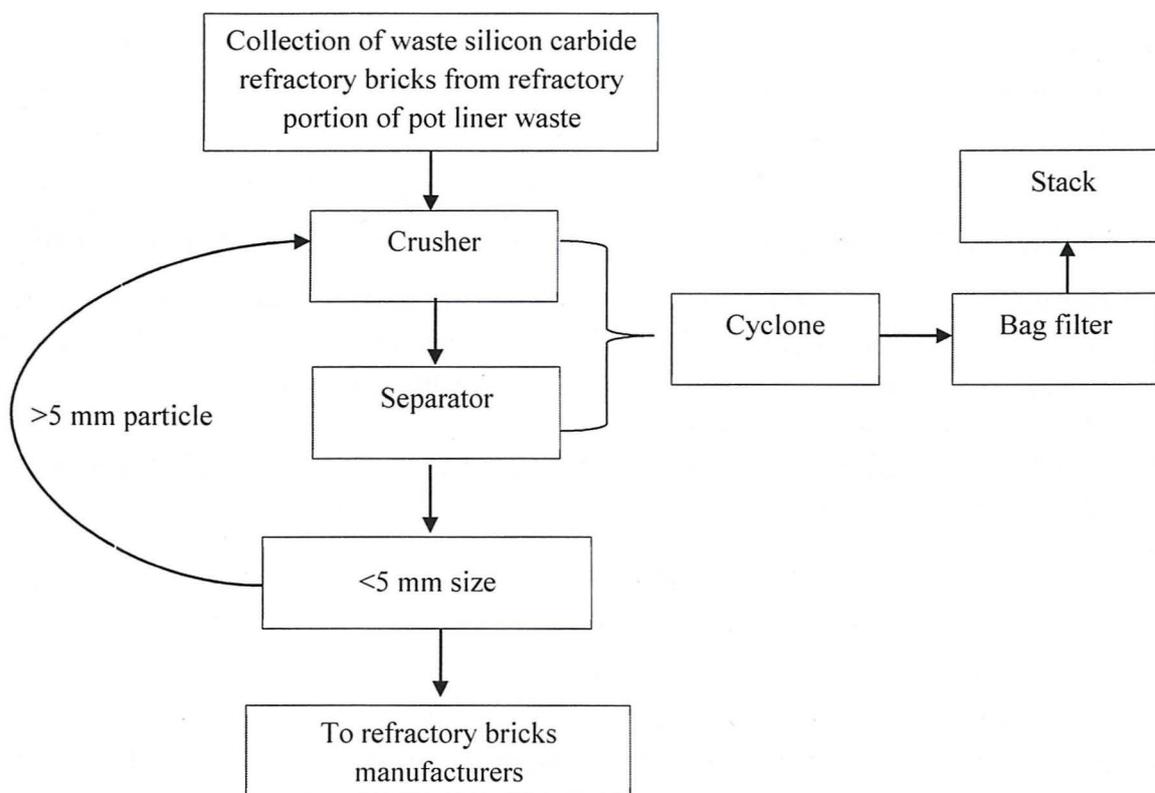


Figure 4: Process flow diagram for pre-processing of waste silicon carbide refractory bricks

72.3 Product Usage / Utilization

The product (Silicon Carbide powder) shall be utilized as raw material in manufacturing of silicon carbide and other refractory bricks only.

72.4 Standard Operating Procedure for utilization

This SoP is applicable only for Pre-processing of waste silicon carbide refractory bricks generated from primary Aluminium smelters.

- 1) The waste silicon carbide refractory bricks shall be transported in covered container mounted on vehicles fitted with requisite safeguards ensuring no spillage of waste in accordance with provisions stipulated under HOWM Rules, 2016.

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- 2) The unit shall store waste silicon carbide refractory bricks in a designated storage area having concrete flooring with shed and proper ventilation ensuring no rain water intrusion.
- 3) The transfer of waste silicon carbide refractory bricks to crusher as well as separator shall be through mechanised system i.e. covered conveyer belt with minimal manual intervention. In case of manual transfer proper personal protective equipment (PPEs) such as mask, gloves, safety shoes and helmet shall be provided to the workers.
- 4) Dust is expected to be formed at crusher and mechanical separator. Therefore, near crusher and separator the unit shall provide dust cyclone with proper suction and bag filter followed by stack of height 30 m or as prescribed by concerned SPCB/PCC.
- 5) The entire system of operation i.e. crusher and separator shall be in a closed system.
- 6) The unit shall earmarked all machineries, storage areas and APCDs with sign board.
- 7) The unit shall ensure that hazardous waste i.e. waste silicon carbide refractory bricks procured as well as product i.e. silicon carbide after pre-processing shall comply with cyanide and fluoride concentration of <0.10 and 7 mg/L respectively based on Toxicity Characteristic Leaching Procedure (TCLP)/Soluble Threshold Limit Concentration (STLC). Silicon carbide shall not exceeds concentration limit as specified in Schedule II of HOWM Rules, 2016

Cyanide – 20 mg/L [Based on TCLP]

Fluoride – 180 mg/L [Based on STLC]

In case the TCLP and STLC values of grinded silicon carbide refractory exceeds the prescribed standard for Cyanide and Fluoride, the material shall not be sent for further processing and the same shall be treated as hazardous waste and sent to TSDF for disposal.

Processed samples shall be tested every month for leaching concentration of CN and F and the records of the same shall be maintained for verification.

- 8) The hazardous wastes generated (if any) during utilization process shall be collected and temporarily stored in non-reactive drums under a dedicated hazardous waste storage area and be 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. Such storage shall be done under covered storage area with proper ventilation.
- 9) Prior to pre-processing of waste silicon carbide refractory bricks, the unit shall obtain authorization for transportation, storage and pre-processing of silicon carbide from the concerned SPCB/PCC under the HOWM Rules 2016.
- 10) The unit shall maintain proper ventilation in the work zone and process areas. All personnel involved in the plant operation shall wear proper PPEs specific to the process operations involved and type of chemicals handled as per MSDS. The safety precautions of the worker shall be in accordance with the Factory Act, 1948, as amended from time to time.

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- 11) 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.
- 12) The unit shall provide suitable fire safety arrangements and flame proof electrical fittings.
- 13) During the handling and pre-processing of hazardous waste, the unit shall comply with requirements in accordance with the Public Liability Insurance Act, 1991 as amended, wherever applicable.

72.5 Record>Returns Filing

- 1) The unit shall maintain a passbook issued by the concern SPCB/PCC and maintain details of each procurement of silicon carbide 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 generation/procurement of silicon carbide, quantity, date wise utilization of the same, quantity of product manufactured, 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 record of hazardous waste generated, utilized and disposed as per Form 3 & also file annual returns in Form 4 as per Rule 20 (1) and (2) of the HOWM Rules, 2016, to concerned SPCB/PCC.
- 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.

72.6 Standards

- 1) Source emissions from the stack connected to APCD shall comply with the following Emission standards or as prescribed by the concerned SPCB/PCC, whichever is stringent;

Particulate Matter	50 mg/Nm ³
Total Fluoride	25 mg/Nm ³

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

PM ₁₀	5.0 mg/m ³ TWA*
Total Fluoride	2.5 mg/m ³ TWA*
Cyanide	5 mg/m ³ TWA*

*time-weighted average (TWA)- measured over a period of 8 hours of operation of process.

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 ISO 17025 accredited or EPA, 1986 approved laboratories and the results shall be submitted to the concerned SPCB/PCC on a quarterly basis.

72.7 Siting of Industry

Facilities for pre-processing of waste silicon carbide refractory bricks 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.

72.8 Size of Plant & Efficiency of utilization

99 % recovery of material shall be achieved during pre-processing of waste silicon carbide refractory bricks. i.e. 1 MT of waste silicon carbide refractory may generate 990Kg of product (silicon carbide refractory powder).

Therefore, requisite facilities of adequate size of storage shed and other plants & machineries as given in para 72.9 below shall be installed accordingly.

72.9 Checklist of Minimal Requisite Facilities

Sl. No	Particulars
1.	Cool, dry, well-ventilated storage areas (separate for hazardous wastes and product) earmarked with signs and concrete flooring & shed.
2.	Mechanized and closed system for transfer of waste silicon carbide refractory bricks.
3.	Closed system of operation i.e. crusher & separator
4.	Crusher and Separator
5.	Cyclone with bag filter followed with stack of height 30m or as prescribed by SPCB/PCC.

