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 Flue gas cleaning residue generated from Steel Scrap Melting Induction Furnace, for zinc extraction

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Central Pollution Control Board

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

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

(i) 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 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 be granted only after verification of utilization process and minimum requisite facilities as given in SoPs.

e. Issuance of passbooks (similar to the passbooks issued for recycling of used oil, waste oil, non-ferrous scrap, 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 on quarterly basis for initial 2 years; followed by random checks in the subsequent period for atleast once a year.

In-case of lack of requisite infrastructures with the SPCB/PCC, 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.

(iii) SPCBs 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 uploadthe same on SPCB website,periodically. Such updated list shall be sent to CPCB on a half yearly basis i.e by July and January respectively.

(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 (generated during utilisation) or its complete utilisation or arrangement of sharing with any other authorised disposal facility.

(v) 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.

(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.

37.0 Utilization of Flue gas cleaning residue

Type of HW	Source of generation	Recovery/Product
Flue gas Cleaning Residue (Category 35.1 of schedule-I of HOWM Rules, 2016)	Bag filter connected to the Steel Scarp Melting Induction Furnace	Zinc Metal

37.1 Source of Waste

Flue gas cleaning residue is generated from the Bag Filter used as Air Pollution Control Device (APCD) attached to the Induction furnace of Steel Scrap melting process. The dust captured in the Bag filter house is collected in bags at the bottom of the hopper through Rotary air lock valve. These dust collected from the Bag filter house is categorized as hazardous waste at S.No. 35.1 of Schedule-I of the HOWM Rules, 2016, which are required to be disposed in authorized disposal facility in accordance with authorization condition, when not utilized.

37.2 Utilisation Process

The said hazardous waste i.e Flue gas cleaning residue (APCD dust) containg Zinc (> 30 %) first undergoes calcination in a closed chamber to remove carbon and sulphur content.

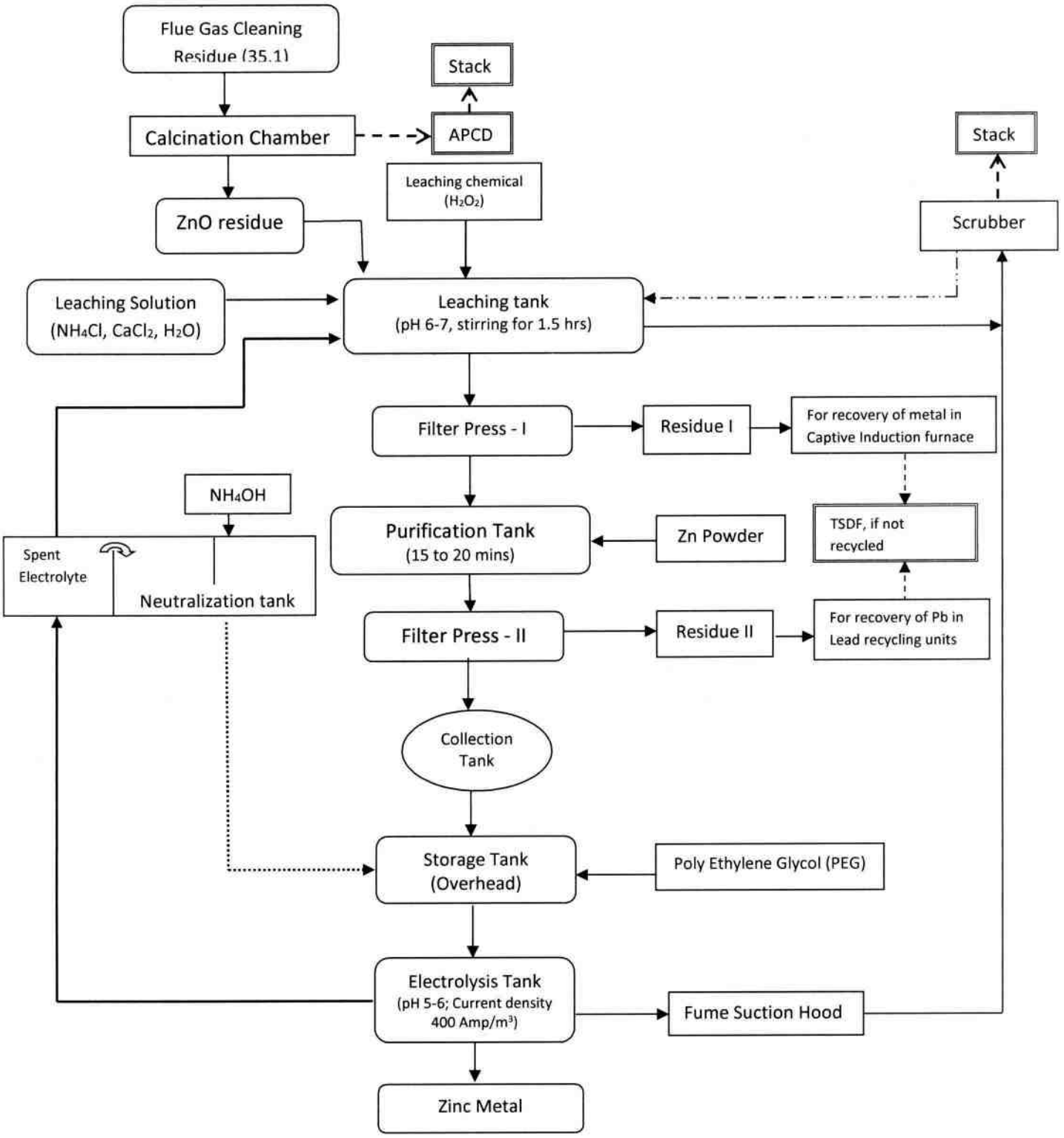
The calcined APCD dust is utilised to recover Zinc metal using Hydrometallurgical process. The utilization process involes preparation of leaching solution by mixing Ammonium Chloride and Calcium Chloride in Water. The flue gas cleaning residue is mixed with the said leaching solution with constant stirring for about 60-90 minutes in a leaching tank where pH raises to about 5.8 followed by addition of H_2O_2 to form zinc complex and precipitate water insoluble oxides. The mixture is passed through filter press-I to remove precipitates and other undissolved materials. The filter press-I residue contains iron and other metals which may be used to recover the same in the induction furnace.

The leachate from the filter press-I is collected in the purification tank, where Zinc powder is added and agitated for about 15 minutes. The Zinc powder reduces oxides of lead and copper which gets precipitated. The reaction mixture from the purification tank is passed through filter press-II to remove the precipitates. The filter press-II residue contains lead which may be used to recover the same in a lead recycling unit having rotary kiln.

The filtrate from the filter press-II is collected in a collection tank and sent to a Overhead Collection tank which further channelizes to the Electrolysis Cells (arranged in parallel manner) at a equal flow rate. Additive like Poly ethylene glycol is added to the Overhead tank for efficient deposition of zinc on the electrodes. The electrolysis tanks consists of Cells having anodes (of Aluminium) and cathodes (of Carbon/graphite) where Zinc ions (Zn^{2+}) gets deposited to the cathode. Zinc metal deposited on the cathode plate is taken out and zinc strips are peeled out after complete electrolysis. The Zinc strips, which has purity of about 99% may further be processed to make Zinc metal items like zinc sheets or other products.

The Flow chart of the utilization process is provided as below;

Fig 1. Flow diagram of Utilization of Flue Gas Cleaning Residue for extraction



The spent electrolyte (having pH about 3-4) is added with ammonium hydroxide to increase pH and recirculated into electrolysis tank through the aforesaid Overhead tank. Part of the spent electrolyte is also used in the leaching tank along with the aforesaid leaching solution.

The leaching tank, purification tank and electrolysis tanks are provided with suction hood, where dust, chemical and acid mist emissions are captured to control fugitive emissions. The hood is connected to scrubber where water is used as scrubbing medum to capture dust and vapours of HCl and ammonia. The bleed water from the scrubber is recycled in the leaching tank of the process.

37.3 Product Usage / Utilization

The zinc metal extracted from the above utilization process, shall be utilized for industrial applications such as zinc coating/galvanization/electroplating and batteries.

37.4 Standard Operating Procedure for utilization

This SoP is applicable only for utilization of Flue gas cleaning residue generated from Steel scrap melting plant using induction furnace, as a raw material for extraction of Zinc metal.

(1) The said Flue gas cleaning residue shall contain Zinc more than about 30%, to be viable for economic recovery.

(2) The Flue gas cleaning residue shall be collected in dry condition from the Bag filter connected to the steel scrap induction furnace, using bags at the bottom of the hopper through rotary air lock valve.

(3) Labelling, packaging and transportation of the hazardous waste (i.e Flue gas cleaning residue) and residue generated during utilization process shall be carried out by sender or receiver as per authorization issued by the concerned SPCB under the HOWM Rules, 2016, with requisite safeguards ensuring no pilferage of the wastes.

(4) The flue gas cleaning reside shall be stored in a covered designated storage place and the same shall be under cool, dry, well ventilated and under covered storage shed, as authorized by the concerned SPCB/PCC under the HOWM Rules, 2016, so as to eliminate water intrusion.

(5) The flue gas cleaning residue shall be calcined in a closed chamber by igniting remotely using a gas burner (only to initiate ignition). Calcination of the same shall be carried out in a closed chamber under negative pressure, with a provision of APCD like Bag filter followed by stack of adequate height as prescribed by the concerned SPCB/PCC.

(6) The dust collected in the bag filter connected to the calcination chamber may be used in the leaching tank.

(7) Chemicals and additives shall be procured in non-reactive containers/drums and stored under cool, dry, well ventilated and covered storage shed.

(8) Such storage sheds for chemicals and additives shall have impervious lined floor, adequate slope and seepage collection pit. The loading/unloading space for chemicals and additives shall also be under the covered shed.

(9) The flue gas cleaning residue shall be loaded using a mechanised conveyor system for transfer of the same (with no manual handling) to the leaching tank.

(10) Mixing of Flue gas cleaning residue with chemicals and additives in leaching tank and mixing of chemicals in purification tank shall be achieved using appropriate mechanized mixing systems.

(11) The chemicals, additives, leachate and filtrate of the utilization process shall be transferred to the appropriate reaction/storage tanks through mechanized conveyor system using chemical process pumps.

(12) Residue generated from filter press-I may be used in captive induction furnace for recovery of metals.

(13) Residue generated from filter press-II may be sent to only those lead recycling units having rotary kiln for lead recovery. Such recycling units shall have authorization for recycling of lead residue from the concerned SPCB/PCC under the HOWM Rules, 2016.

(14) If not recycled/recovered, filter residues generated from both filter press-I and filter press-II shall be disposed in authorized TSDF in accordance with the provisions stipulated in Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016.

(15) Fume suction hood systems made of fibre reinforced plastic or other suitable non-corrosive material shall be installed above the leaching reactor, electrolysis tanks and neutralization tank at appropriate height to control source & fugitive emissions. The fume hoods shall be connected with common ducting system to scrubber where water shall be used as scrubbing medium and the scrubbed gases shall be vented through a stack. The bleed water shall be used in the leaching tank

(16) Utilization of Flue gas cleaning residue shall not be carried out during unstable/breakdown conditions in process units / any of the emission control systems of the waste utilization process.

(17) The entire process area shall have leak-proof pipelines with adequate slope to collect runoff/spillage, if any, into the collection pit. The spillages from the collection pit shall be transferred to ETP or Leaching tank, as the case may be, through chemical process pump.

(18) The scrubbed gases/vapours from the stack shall comply with the emission norms and shall be dispersed into atmosphere through stack of height as prescribed by the concerned SPCB/PCC.

(19) Sources of Wastewater: The following are the sources of wastewater from utilization process;

a) Bearing cooling water (pump sealing water)

b) Bleed water from scrubber

c) Floor washing/reactor wash/vehicle wash/spillages etc.

Pump sealing water, scrubber bleed water and reactor wash shall be reused in the leaching tank, wherever possible, whereas waste water generated from floor washing/ vehicle wash/spillages etc. shall be treated in Effluent Treatment Plant (ETP). Further, spent electrolyte may begenerated during unstable/breakdown conditions, which shall also be treated in ETP. Therefore, an ETP shall be installed for the same.

(20) Treatment and disposal of wastewater: The above wastewater shall be treated in ETP and management of treated effluent or its discharge shall be carried out in accordance with the conditions stipulated in the Consent to Operate issued by respective SPCB/PCC under the Water (Prevention and Control of Pollution) Act, 1974.

(21) Prior to utilization of Flue gas cleaning residue, the unit shall obtain authorization for generation (wherever applicable), storage and utilisation of Flue gas cleaning residue from the concerned State Pollution Control Board under the HOWM Rules, 2016.

(22) The unit shall ensure proper ventilation in the work zone and process areas. All the personnel involved in the waste utilization process shall wear proper personal protective equipment (PPE) such as protective eye goggles, full face shield/ aspirator mask, body suits/aprons and/or coverall of chemical resistant material and impervious boots/shoes etc. The safety precautions of the worker shall be in accordance with the Factory Act, 1948, as amended from time to time.

(23) The unit shall provide suitable fire safety arrangements and flame proof electrical fittings.

(24) In case of environmental damages arising due to improper handling of hazardous wastes (viz., accidental spillage during generation, storage, processing, transportation and disposal), the unit shall be liable to implement immediate corrective 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.

(25) The unit shall become member of common hazardous waste treatment, storage and disposal facility, incase residues from the filter presses are not recycled as above.

(26) 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.

37.5 Record/Return Filing

(1) The unit shall submit quarterly and annual information on Flue gas cleaning residue generated, quantity utilized, resources conserved (specifying the details like type and quantity of resources conserved) to the concerned SPCB.

(2) A log book shall be maintained with information on source, quantity, date wise utilization of Flue gas cleaning residue and record of analysis report of emission monitoring & effluent discharged, as applicable shall be maintained.

(3) The unit shall maintain record of hazardous waste generated/utilised 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 SPCB.

37.6 Standards

(i) Source Emissions from the stack connected to calcination chamber shall comply with the following standards or as prescribed by the concerned SPCB/PCC, whichever is stringent;

PM : 50 mg/Nm^3

Note: Other parameters as prescribed by SPCB/PCC, if any, shall be complied.

(ii) Source Emissions from the stack connected to scrubber shall comply with the following standards or as prescribed by the concerned SPCB/PCC, whichever is stringent;

PM	: 50 mg/Nm^3
Acid mist (HCl)	: 50 mg/Nm^3
Ammonia	: 75 mg/Nm^3

Note: Other parameters as prescribed by SPCB/PCC, if any, shall be complied.

(iii) Fugitive emissions in the work zone shall comply with the following standards;

Ammonia	: 25 PPM (18 mg/ m^3) TWA*
	: 35 PPM (27 mg/ m^3) STEL
Zinc Oxide	: Total Dust (15 mg/m^3) TWA*

Respirable fraction – 5 mg/m^3 TWA*

Lead : 50 µg/m^3 TWA*

Cadmium : 5 µg/m^3 TWA*

Nickel : 0.5 mg/m^3 TWA*

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

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

(iv) Monitoring of the above specified source emission parameter shall be carried out quarterly. The monitoring shall be carried out by NABL accredited or ISO17025 /EPA approved laboratories and the results shall be submitted to the concerned SPCB/PCC on a quarterly basis.

(v) Standards for wastewater discharge: The treated waste water shall be discharged in accordance with the conditions stipulated in the Consent to Operate issued by respective 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 the Common Effluent Treatment (CETP), zero discharge shall be met.

37.7 Siting of Industry

Facilities for utilization of Flue gas cleaning residue (from bag filter house connected to Induction furnace) shall be located in a notified industrial area or industrial park/estate/cluster and cited in accordance with Consent to Establish issued by the concerned SPCB/PCC.

37.8 Size of Plant & Efficiency of utilisation

100 MT of Flue gas cleaning residue yields about 30 MT of zinc metal or more depending upon zinc content in the Flue gas cleaning residue. Hence, requisite facilities of adequate size shall be installed accordingly as mentioned under para 35.10 below.

37.9 On-line detectors / Alarms / Analysers

Online emission analysers for Particulate Matter in the stack shall be installed and the online data be connected to the server of the concerned SPCB/PCC and CPCB within the time frame as prescribed by the concerned SPCB/PCC.

37.10 Checklist of Minimal Requisite Facilities:

S.No	Requisite Facilities
1.	Designated space for loading, unloading and storage of Flue gas cleaning residue under cool, dry, well ventilated and covered storage shed, so as to eliminate water intrusion.

2.	Closed calcination chamber having Gas burner (Only to initiate ignition)
3.	APCD like Bag filter attached to the calcination chamber followed by stack of height as prescribed by the concerned SPCB/PCC
4.	Mechanised conveyor system for transfer of Flue gas cleaning residue to the leaching tank
5.	Chemicals and additives shall be procured/stored in non-reactive drums/containers in cool, dry, well ventilated and covered storage shed so as to eliminate water intrusion. The storage shed shall be with impervious lined floor and have adequate slope with seepage collection pit.
6.	Leaching Tank
7.	Purification Tank
8.	Two Filter Press units for filtering the liquid from leaching tank and purification tank
9.	Electrolysis tank
10.	Separate storage facility for residues from Press-I and Filter Press-II
11.	Collection tank for collecting filtrate from Filter press-II
12.	Overhead Storage tank for transfer and channelizing of filtrate to Electrolysis tank
13.	Spent Electrolyte Storage tank with neutralization facility
14.	Fume Suction hood system with ducting attached to leaching reactor, electrolysis tanks and neutralization tank
15.	Scrubber connected to the said Fume Suction hood system followed by stack
16.	Stacks of height as prescribed by SPCB shall have easy access to port hole and arrangement of platform, ladder, etc. for conducting stack monitoring
17.	Effluent Treatment Plant
18.	Provisions for Proper ventilation in the entire process area
19.	Fire safety arrangements and flame proof electrical fittings
20.	PPEs to the worker suitable for acidic emissions, ammonia vapours and acidic spillages on floor

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