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ZhTec

HZL's greener steps towards sustainable operation

Research & Development Division,
Hindustan Zinc Limited,
Udaipur, Rajasthan

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CII innovation Award| Brief overview

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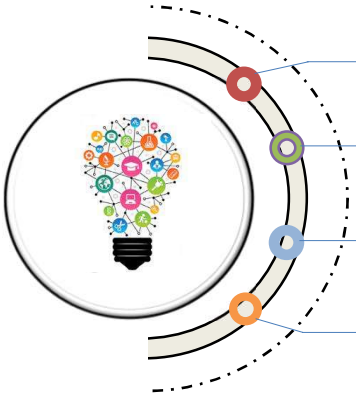

1. HZL Process Description
2. Mill initiative
3. Smelter initiative
4. Major Learnings

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CII innovation Award| HZL's Process chain & Projects description

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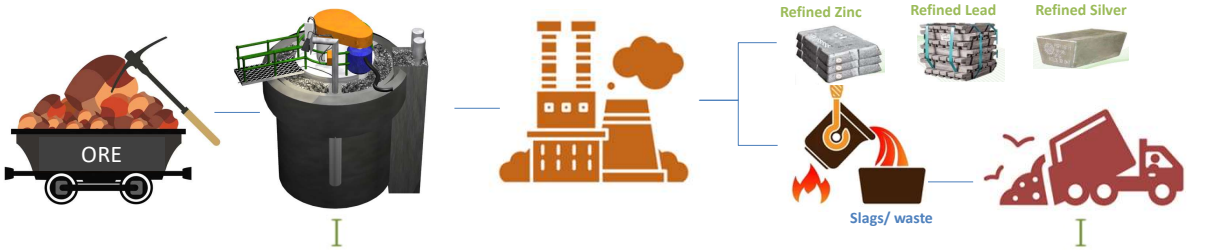
HZL's FY'25 stats

- ~1095 kT Metal mined
- ~1052 kT Refined Metal
- ~20 Billion US $ Market Capitalization
- Ranked 1st S&P Global corporate Sustainability assessment
- 75% lower Carbon footprint vs industry average

Mine-to-Metal process flow

Mining	Min. Processing	Smelting	Outputs	Waste processing
Ore Extraction	Metal concentrate	Conc → Metal	Ingots & Slags	Dump/ sales



From Harmful to Harmless: Eco-Friendly Innovation in Lead-Zinc Beneficiation

Zinc recovery from Lead smelting slag via pyrometallurgical secondary treatment

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From Harmful to Harmless: Eco-Friendly Innovation in Pb-Zn Beneficiation

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Today, environmental responsibility is no longer optional rather socially requisite.
Relying on toxic flotation reagents like **Cyanide is not just unsustainable—it's unacceptable**.
This project idea blossomed in our R&D lab with a clear purpose:

Humic acid salt

To replace NaCN with eco-friendly alternative (Humic acid salt) for Fe depression without compromising with the metallurgical performance.

- **Ideation (Apr 23):** Identification of reagents-Literature & Vendor's portfolio
- **Experimentation (May 23):** Lab testing-Batch Rougher, Stage cleaning and LCT
- **Technical recommendation (Jun 23):** Chemical procurement
- **Plant trial at RAM (Sept 23):** Continuous & On-off trial
- **Implementation (Oct 23):** Mill-wise phase out

Greening the supply chain: An ESG initiative

- Transforming a **conventionally hazardous process** into a **model of green innovation.**
- Technical robustness

Apr-Oct'23

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Project 1: Eco-friendly reagent | Project benefits

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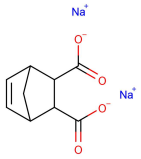
Hazardous cyanide ($Na^+ C^- \equiv N$) → Eco-friendly Humic acid salt



- Process benefit
  - 0.2-0.3% lower Fe in Pb & Zn circuit
  - +6% Ag in Pb circuit
- Toxicity benefit
  - Improvement on ESG front by elimination of hazardous chemical from use.
  - Can be disposed with non-hazardous waste.
- Cost benefit
  - Annual Savings: Rs 73 Lakhs (Lower reagent cost)

- People/society benefits:
  - Lower health risk during handling and reagent preparation: NaCN requires specialized manpower training.
  - No need for extra safety PPEs, antidote and emergency response team.

Reagent combination filed as:
IN Patent 202311038974
(Status: Published)

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Project 1: Eco-friendly reagent | Replication Potential, Challenges and Benchmarking

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Replication

Learning dissemination

Within HZL: Recognized under **"Star Team of the Month"**
Within Scientific community: Presented at **IC4M 2025 (IIMT, BBI)**

Spreading Benefit

Parallel implementation at other HZL mills.

Replication potential to other sectors

Textiles: Replacing toxic dyes with biodegradable alternatives can reduce water pollution.

Pharmaceuticals: Green solvents can minimize hazardous waste.

Wastewater treatment: Eco-friendly coagulants and flocculants can improve safety and reduce sludge toxicity.

Best Practices

Use feedback loops for continuous reagent optimization.

Update control logic in DCS/PLC to accommodate new reagent behavior.

Challenges

Feed variability → Evaluation on range of ores

Lab-to-Plant scale up → Dosage optimization

Benchmarking

	Before (NaCN)	After (Humic acid salt)
Toxicity	Toxic	Non-toxic
Manpower	Specialized handling and severe health concerns	No associated handling and health concerns
Material	Disposed as hazardous waste	No specific disposal concerns

Global examples

Bio-degradable cellulose derived Frother (CellFroth) by **Aalto University** for Cu, Zn, Au ores.
Barrick Gold Canada: Bioleaching for Au. 80% reduction in cyanide consumption
Dow Chemical developed a bio-based plasticizer for PVC, replacing toxic phthalates.

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Zinc recovery from Lead smelting slag via pyrometallurgical secondary treatment

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A techno-commercial cross-functional initiative

Metal value from waste "Awareness and Planning"

Jan-May'25

Inventory concern: Dec'24
- Slag salability due to low realization and 2x handling cost
- Slag→ 12%Zn ; 5% lead

Sample Analysis- R&D : Jan'25
- Chemical analysis
- Phase determination from X-ray Diffraction*
- Seen Zn in fumable form

Lab Processing: Jan'25
- Lab scale experiment

Plant implementation Feb-May'25
- Plant processing of 1.3kT slags

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*Safe radiation certification from Atomic Energy Regulatory Board

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Project 2: Slag Processing| Project benefits & replication potential

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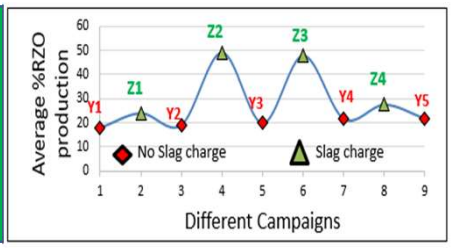
- ***Amount of slag treated***: 1320.64 MT;
- ***Cost of Production (COP):***
- Rs. 129 Lakhs
- ***Zinc metal realisation:*** Rs. 322 lakhs
- ***Overall savings/ EBIDTA earnings:*** Rs. 193 Lakhs
- ***Zinc production:*** 2x
- ***Less LDO [Diesel oil] consumption***

- ***Environment***:
  - Reduced waste dumping
  - Lowered soil/water contamination.
- ***Resource saving:***
  - Less LDO consumption
- ***Safety:***
  - Less oil input → low field man exposure to high temperature zones.
- ***Motivation:***
  - High Zn production→ also a source of motivation to field men to work.

Industry trial analysis



Benchmarking

Parameters	Before	After
Manpower & resource	High LDO consumption	Consumption decreased by 15%
Material	Disposed as waste	No disposal concerns + metal values

Examples
- Almost major steel industries **(Tata, Jindal, POSCO)** use such secondary treatment
- Can explore H2 based processing: **Aalto University** for Cu slag treatment
- Eco friendly processes: Eg., **Metso Outotec (GREENY Project)**. Slags → sec. raw materials

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Project 2: Slag Processing| Project Challenges

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Technical challenges

- Scale up of lab scale experiments to plant trial
- Optimization in furnace feed

Maintenance challenges

- Slag charging → Increased furnace temperature→ Steps considered for proper water cooling system.

PRIORITIES

- Theory incorporation within all high temperature processing units within HZL
- Proper optimization planning is needed
- Resource: It (waste/ slag) is continuously getting generated in Lead Pyro units

Best Practices

- Proper understanding of process exo/endothermicity → furnace cooling capacities
- Knowledge of the sample chemistry and form.
- Prior inventory, workshop for workmen

PLANS

Intra- metal processing sector

- Discussed within HZL [won Star performance Jun'25]
- Within unit: waste processing with proper analysis presently going
- Cross-unit workshops.

Inter- metal processing sector

- Discussed in conference [ICNF 2025]
- Written an article on its success story [under review]

CII innovation Award| Major learnings

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Focused lab test work to explore, optimize & develop reagent/waste combinations to ensure human & environmental safety with better metal values.

Focus on operational discipline to minimize the dosage and use of toxic reagents.

Focus on public awareness about cons of waste dumping and toxic reagents usage.

Collaborations with vendors and academic institute to develop operational and chemical safety improvements


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THANK YOU
Sensitivity: Public (C4)

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