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minerals2metals

QUARTERLY EZINE | METALLIC MINERALS | INDIA

GLOBAL IRON ORE MARKET TRENDS

Technology
Decarbonizing the
Steel Industry

Refractories
Best Refractories Practices
For Iron Ore Pellet Plant

Sustainability
Fertilizers From
Steel Slag

A PUBLICATION OF INDIAN MINERALS INFOMEDIA



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As I See It

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Welcome to the inaugural issue of Minerals2Metals. In strict sense of the term, it is not an inaugural issue as we have decided to split the content of our existing magazine **INDIAN MINERALS**. While the existing magazine will focus on industrial minerals as well as rare earth minerals, the new magazine Minerals2Metals will focus on metallic minerals and intermediaries/processed inputs required to produce crude steel. Indian crude steel production is increasing at a steady rate and will easily cross 160 million tonnes for the financial 2025-26. We need to remember that when we speak of crude steel production, it does not only mean iron, coke and coal but a complete value chain comprising limestone, refractories, ferro alloys, slag conditioners and many more.

In this edition, we analyse the causes for revision of iron ore prices of NMDC, we take a look at the various decarbonization paths of steel industry. We all know slag splashing increases converter life but many of us were possibly unaware of the fact that Japanese steel makers do not prefer slag splashing. We feature an article on this topic as well as we flag the best practices of maintaining lining life of iron ore pellet plant.

Trust you will find our content useful and we eagerly look forward to your feedback.

A. Dasgupta

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OUR STRENGTHS



- A well equipped modern plant with fully automatic heavy duty Swiss make BUCHER PRESSES of 1600MT & 900MT capacity.
- High Temperature Tunnel Kilns.
- A state of the art laboratory for material testing.
- Annual Capacity of producing 36000MT of refractory bricks.
- Annual Capacity of producing 24,00,000 pieces of insulating bricks.
- Annual Capacity of producing 24000MT of Castables and mortar.
- Own calcination units for manufacturing high quality raw materials and high alumina binders.

OUR PRODUCTS



- High alumina dense refractory bricks ranging from 30% to 96% Alumina content.
- Light weight and high temperature insulating bricks with low thermal conductivity.
- High strength mortars for high temperature applications with alumina content up to 96%.
- Conventional Castables upto 96% Alumina.
- Low Cement Castables upto 96% Alumina.
- Low Iron Insulating Castables .
- Dense and Insulating mortars.
- Plastic Refractories with high abrasion resistance.
- Special refractories like Silicon Carbide, andalusite and mullite based.
- High alumina refractory binders.
- Pre Cast Pre Fired blocks and shapes.
- 19 Hole & 7 Hole Hexagonal checker bricks for Blast Furnace Stoves.
- Anti acid refractories.

INDUSTRIES WE ARE WORKING WITH



- **IRON & STEEL**
 - Pellet Plant
 - Sponge Iron
 - Blast Furnaces Stoves
 - Coke Ovens
 - Torpedo Ladles
 - Reheating Furnaces
 - HSM/ CRM
- **POWER**
 - CFBC Boilers
 - AFBC Boilers
 - Combustion Chambers
- **ALUMINIUM**
 - Anode Baking Furnaces
- **CEMENT**
 - Preheater Calciner
 - Rotary Kiln
 - Kiln Hood
- **REFINERIES**
 - Sulphur Recovery Unit
 - CDU
 - VDU
- **FERTILISER**
- **CERAMIC & REFRACTORIES**

Name	Source	Port	Price (USD/mt)	Month
Iron Ore Lump 10-40 mm(+62% Fe) CLO	India (Daitari)	N.A.	64	Dec 2025
Iron Ore Lump 10-40 mm(+62% Fe) BF Grade CLO	India (Barbil)	N.A.	75	Dec 2025
Iron Ore Fine 62-65% Fe Fines (-10 mm)	India (Daitari)	N.A.	63	Dec 2025
Iron Ore Fine 60-62% Fe Fines (-10 mm)	India (Daitari)	N.A.	64	Dec 2025
Cajaras Iron Ore Fines	Brazil	Ponta Da Madeira	114	Dec 2025
Iron Ore Pellets Fe content:63%	India	N.A.	109	Dec 2025
Chrome Ore 54%+	India	N.A.	284	Dec 2025
Chrome Ore 46-48%	India	N.A.	237	Dec 2025
Chrome Ore (-)40% sub grade	India	N.A.	110	Dec 2025
Chromite Sand AFS 45-50	South Africa	Durban	535	Dec 2025
Chromite Sand AFS 50-55 (Orange Grade)	South Africa	Durban	583	Dec 2025
Chrome Ore Lumps Cr ₂ O ₃ :28.56%	Oman	Sohar	180	Dec 2025
Metallurgical Grade CBG Bauxite	Guinea	Port Kamsar	77	Dec 2025
Standard Metallurgical Grade CBG Bauxite	India	N.A.	37	Dec 2025
Laterite (Loose Grade II) (Bauxitic material)	India	N.A.	5.6	Dec 2025
Limestone Lumps (5 – 30 cm)	Egypt	Port Said	33	Dec 2025
CP Grade Limestone in bulk	Oman	Salalah	20	Dec 2025
Limestone Size 0-50 mm	UAE	Mina Saqr	11	Dec 2025
Lime Stone Lumps 240 mesh	Bhutan	Phuntsholing	39	Dec 2025
Manganese Ore Lumpy 43.24% Mn	South Africa	Saldanha Bay	177	Dec 2025
Manganese Ore (MMD)(Mn: 34.05%)	Gabon	Libreville	130	Dec 2025
Lake Vermont Premium Hard Coking Coal	Australia	Abbot Point	187	Jan 2026
EVR Standard Coking Coal	Canada	Vancouver	205	Jan 2026
Low Ash Metallurgical Coke	Indonesia	Poso	234	Jan 2026





NMDC Reduces Price of Iron Ore to Respond to Market Dynamics



NMDC

NMDC has reduced prices of Iron Ore w.e.f. 09th January 2026. The prices of Iron Ore w.e.f. 09th January 2026 has been fixed as under:

- Baila Lump (65.5%, 10-40 mm) – ₹ 4,600/- Per Ton.
- Baila Fines (64%, -10 mm) – ₹ 3,900/- Per Ton.

The price movement in last one year is as follows:

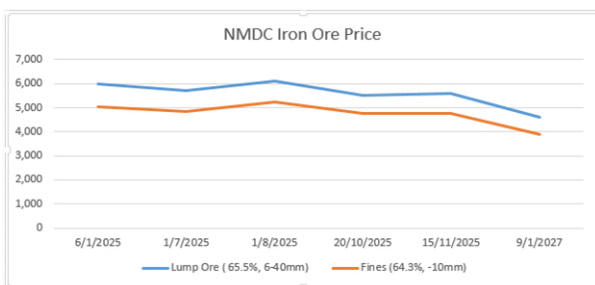


Fig 1

In contrast, we see a slight increase in iron ore prices of iron ore lump and fines prices from OMC.

NMDC iron ore prices differ from OMC (Odisha Mining Corporation) prices because the two sellers operate under different cost structures, ore characteristics, regulatory regimes, and market objectives

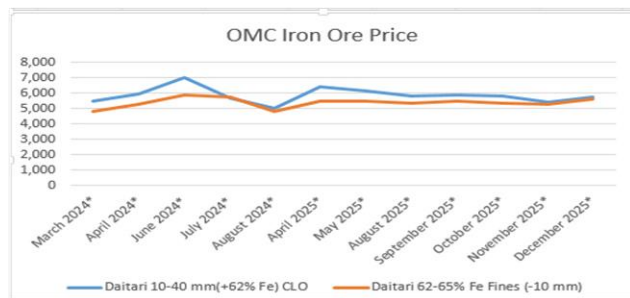


Fig 2

Key reasons include:

1. Competitive pressure

Reducing prices was a way for NMDC to support offtake by local mills, maintain sales volumes, and keep inventory moving amid strong import of the raw material. Due to a shortage of high-grade iron ore and increased demand, India's imports of iron ore have increased significantly, hitting a 6-year high in late 2025. The increase in supplies was facilitated not only by low prices, but also by favorable supply opportunities for steel mills near ports, such as the JSW Steel plant in Maharashtra. JSW Steel, the country's largest steel producer in terms of capacity, was the main buyer of imported ore in January-October.

The country imports iron ore mainly from Brazil, Oman, and Australia.

2. Inventory Pressure

High inventory levels at domestic ports or in the supply chain may lead to downward price pressure.

3. Change in price reporting practice

NMDC's revised pricing excluded statutory charges such as royalty and GST in the published figures — a shift from previous practice. This change made the headline prices look lower even though the delivered costs may include those charges separately.

Using an INR→USD rate \approx ₹91.56 / US\$ (22–23 Jan 2026 market level).

Direct currency conversion (back-of-envelope)

- Baila Lump: ₹4,600 ÷ 91.56 \approx US\$50.24 / t.

- Baila Fines: ₹3,900 ÷ 91.56 \approx US\$42.60 / t.

RELEVANT INTERNATIONAL BENCHMARKS (LATE JAN 2026):

- Iron ore 62% Fe CFR China (IODEX / TSI / futures): \sim US\$106 / t (20–23 Jan 2026 range \approx US\$106–108/t).
- 65% Fe (SGX/other indices) generally sits higher (roughly US\$120–121/t in the same window).

So NMDC domestic FOR prices convert to roughly US\$42–50/t (not landed, not including export costs).

PRICE MOVEMENT OF NMDC IRON ORE & LUMPS:

Grade (Fe %)	1/7/2025	1/8/2025	20/10/2025	15/11/2025	9/1/2026 *
Lump Ore (65.5%, 6-40mm)	5,700	6,100	5,500	5,600	4,600
Fines (64.3%, -10mm)	4,850	5,250	4,750	4,750	3,900

Table 1 (excluding statutory taxes)

Component	Rate	Basis
Royalty	15%	On basic price
DMF	30% of royalty	Effective 4.5%
NMET	2% of royalty	Effective 0.3%
Total mining levies	19.8%	On base price
GST	18%	On (Base + mining levies)

Table 2

Effective multiplier

Total payable \approx Base Price \times 1.413

(This multiplier is the same for Nov 2025 and Jan 2026, so comparison is clean.)

NMDC revised base prices (Jan 2026)

- Lump (65.5%): ₹4,600 /t
- Fines (64%): ₹3,900 /t

CALCULATIONS

Lump – Jan 2026

- Base: ₹4,600
- Mining levies: ₹911
- Sub-total: ₹5,511
- GST @18%: ₹992

- Total payable: ₹6,503 /t

Fines – Jan 2026

- Base: ₹3,900
- Mining levies: ₹772
- Sub-total: ₹4,672
- GST @18%: ₹841
- Total payable: ₹5,513 /t

Final Price Comparison Table (Rs/MT):

Product	15/11/2025	9/1/2026	Change
Lump (65.5%)	5,600	5,511	(-)89
Fines (64%)	4,750	4,672	(-)78

Table 3

Hence there is slight decrease in iron ore price. Earlier too, NMDC charged 18% GST on rack rates for which we have not considered it while calculating the price.

Decarbonizing the Steel Industry

Decarbonizing the steel industry is critical, as it accounts for ~7-9% of global CO₂ emissions, largely due to its reliance on coal in blast furnaces.

India, the second-largest steel producer, has clearly outlined its intention to reduce the emissions intensity of its GDP by 33-35% by 2030 from 2005 levels at COP21 (UNFCCC, NDCs, 2015). At COP26, India made a commitment to achieve net-zero emissions by 2070, an ambitious goal for its rapidly expanding steel industry (COP26, 2022). At the event, the Government of India presented five nectar elements (Panchamrit) of India’s climate action plan:

- i. Reach 500GW non-fossil energy capacity by 2030.
- ii. 50% of its energy requirements from renewable energy by 2030.
- iii. Reduction of total projected carbon emissions by one billion tonnes from now to 2030.
- iv. Reduction of the carbon intensity of the economy by 45% by 2030, over 2005 levels.
- v. Achieving the target of net zero emissions by 2070.

STEEL MAKING PATHWAY IN INDIA

RAW MATERIALS	IRON MAKING	STEEL MAKING
Coal	Blast Furnace	Basic Oxygen Furnace (43%)
Iron Ore	DRI	Electric Arc Furnace (22%)
Lime Flux	Smelting	Induction Furnace (35%)
Scrap		
Others		

The iron and steel sector are highly energy consuming and high emissions industry. It accounts for 8% of global energy use and 7% of direct CO₂ emissions and 3% indirect CO₂ emission (IEA, 2020). In India, total CO₂ emissions from this sector is 250 MtCO₂ which is around 10% of total emission and this will further increase to 800 MtCO₂ by 2050, if no concerted action to decarbonise is taken. Iron and steel production alone is responsible for around 95% of overall emissions in the Iron and Steel value chain, from mining to steel making.

“In India, Green Steel is defined by its carbon emissions relative to the established threshold. Steel must emit less than 2.2 tonnes of CO₂ per tonne to be considered green. The rating system categorizes steel by its emissions reductions, with five stars awarded to steel emitting less than 1.6 tonnes.”



GREEN STEEL MAKING PATHWAYS

Green Hydrogen: Using hydrogen produced from renewable energy as a reducing agent in direct reduced iron (DRI) processes. Projects like HYBRIT in Sweden aim for fossil-free steel by 2035, with pilot plants already operational. Hydrogen-based DRI could cut emissions by up to 95% compared to traditional blast furnaces.

Electrification: Electric arc furnaces (EAFs) powered by renewable energy, paired with recycled scrap steel, emit significantly less than coal-based methods. EAFs are already widely used (e.g., ~70% of U.S. steel production), but scaling requires more scrap availability and clean energy grids.

Carbon Capture and Storage (CCS): Retrofitting blast furnaces with CCS can capture 65–90% of CO₂ emissions. Projects like ArcelorMittal's Ghent plant in Belgium are testing large-scale CCS, though high costs and energy demands remain challenges.

Alternative Fuels and Processes: Biomass (e.g., charcoal) or synthetic gases like syngas can replace coal in some processes. Emerging tech like molten oxide electrolysis (e.g., Boston Metal) could produce steel without emissions but is still in early stages.

GLOBAL EMISSIONS:

Steel production accounts for 7–9% of global CO₂ emissions, ~2.6–3.4 billion tons annually (IEA, 2023).

- **Energy Intensity:** Traditional blast furnaces emit ~1.8–2.2 tons of CO₂ per ton of crude steel; electric arc furnaces (EAFs) using scrap emit ~0.4–0.6 tons (World Steel Association, 2024).
- **Production Volume:** Global steel output is ~1.9 billion tons/year, with China producing ~54% (~1 billion tons, 2023).

CHALLENGES:

- **Cost:** Green steel production is 20–40% more expensive due to higher energy and tech costs.
- **Scale:** Global steel demand (~1.9 billion tons/year) requires massive infrastructure shifts.
- **Energy:** Decarbonized processes need vast amounts of renewable electricity (e.g., 4,000 TWh globally for hydrogen-based steel by 2050).
- **Energy Demand:** Shifting to hydrogen-based steel could require 4,000 TWh of renewable electricity globally by 2050, ~10% of current global electricity production (Bloomberg NEF, 2024).
- **Cost Premium:** Green steel production costs 20–40% more than conventional methods (\$600–800/ton vs. \$400–500/ton, 2024 estimates).

PROGRESS:

- Over 50 global projects are piloting low-carbon steel (e.g., H₂ Green Steel in Sweden, targeting 5M tons by 2030).

- Policy support like the EU's Carbon Border Adjustment Mechanism and U.S. clean energy incentives are driving investment.
- Companies like SSAB and Tata Steel aim for net-zero by 2045–2050.

DECARBONIZATION POTENTIAL:

- **Hydrogen-based DRI:** Up to 95% emissions reduction compared to blast furnaces (HYBRIT, 2024).
- **CCS:** Captures 65–90% of blast furnace emissions, with pilot projects achieving 1.5 tons CO₂ captured per ton of steel (ArcelorMittal, 2023).
- **EAF with renewables:** ~70% lower emissions than coal-based methods when using 100% scrap and clean energy (IEA, 2022).
- **Investment Needs:** \$1.4 trillion required by 2050 for net-zero steel, including \$600 billion for hydrogen infrastructure (IEA, 2023).
- **Project Scale:** Over 50 low-carbon steel projects globally, e.g., H₂ Green Steel (Sweden, 5M tons/year by 2030) and SSAB (1M tons fossil-free steel by 2026).
- **Policy Impact:** EU's Carbon Border Adjustment Mechanism (CBAM) could add €50–100/ton to high-carbon steel imports by 2026 (European Commission, 2023).

PROGRESS TIMELINE:

- 2030: Industry aims for 10–15% emissions reduction (IEA Net Zero Roadmap).

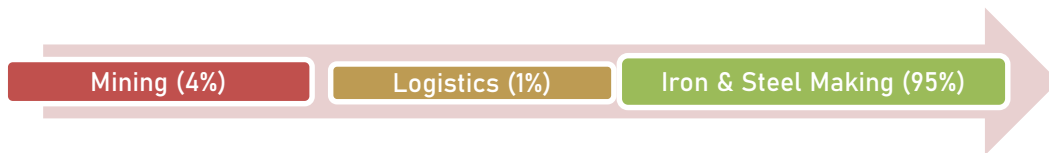
- 2050: 50% emissions cut needed for 1.5°C pathway, with 25% of global production from

low-carbon methods (Mission Possible Partnership, 2024).

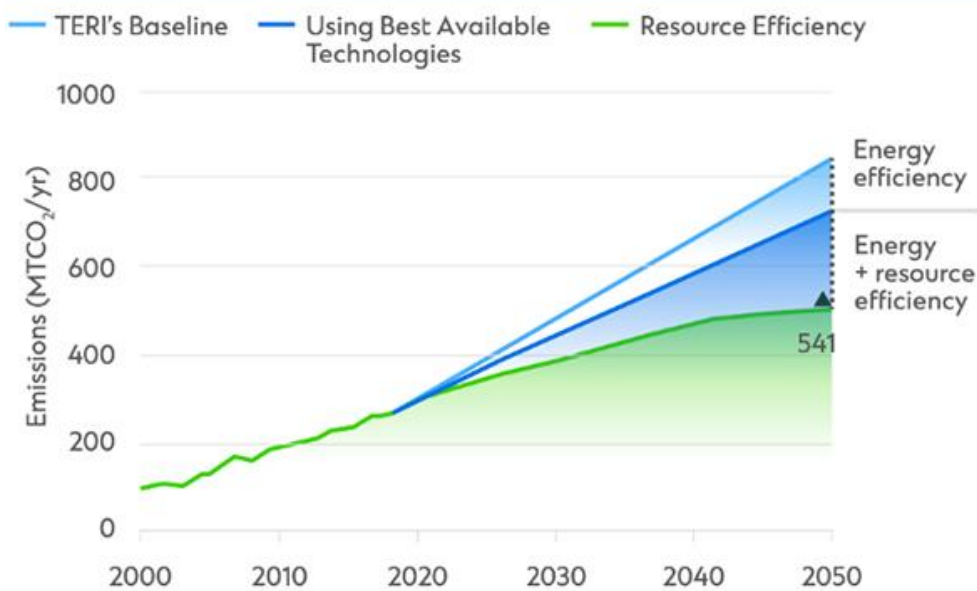
Fuel and Feedstocks	BF-BOF (actual)		BF-BOF (assuming DRI-EAF energy intensity)		NG DRI-EAF		H ₂ DRI-EAF
	Energy (GJ/ton steel)	Emissions (kgCO ₂ /ton steel)	Energy (GJ/ton steel)	Emissions (kgCO ₂ /ton steel)	Energy (GJ/ton steel)	Emissions (kgCO ₂ /ton steel)	Energy (GJ/ton steel)
Electricity In DRI In EAF	0.7	87	0.5	58	2.5	312	2.9 1.2 1.8
Coal	18.0	1592	12.0	1059	0.5	44	
Natural Gas	1.0	50	0.7	33	10.1	508	
Hydrogen							8.2
Biomass In EAF In Other (Pellets, Lime)							2.0 1.4 0.6
Total Energy and CO₂	19.7	1730	13.1	1150	13.1	864	13.1

(Source: Sources: IEA 2019; HYBRIT 2018; EIA 2020e, 2020g)

Emission Share of Iron & Steel Value Chain



Emissions Impact of Energy Efficiency and Resource Efficiency in India Steel Production



Source: The Energy and Resource Institute (TERI)

THE DECARBONIZATION PATH

P
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SMART CARBON USAGE (SCU)

PROCESS INTEGRATION
WITH REDUCED USE OF
CARBON
(+ CCS)

CARBON VALORIZATION/
CARBON CAPTURE &
USAGE (CCU)
(+ CCS)

CARBON DIRECT AVOIDANCE (CDA)

HYDROGEN

ELECTRICITY

D
E
S
C
R
I
P
T
I
O
N

PROCESS INTEGRATION
& INTERNAL USE OF
GASES

USE CO / CO₂ FROM
STEEL MILL AS RAW
MATERIAL
(CONVERSION TO
HYDROCARBON)

RENEWABLE
ELECTRICITY IN BASIC
STEELMAKING, EG:
PRODUCTION OF H₂ TO
REPLACE CO.

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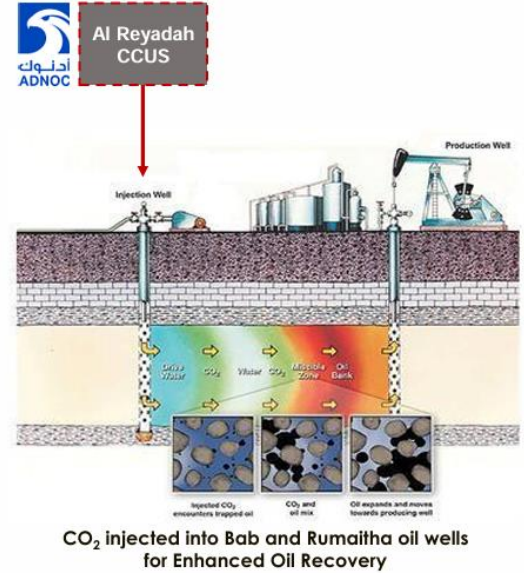
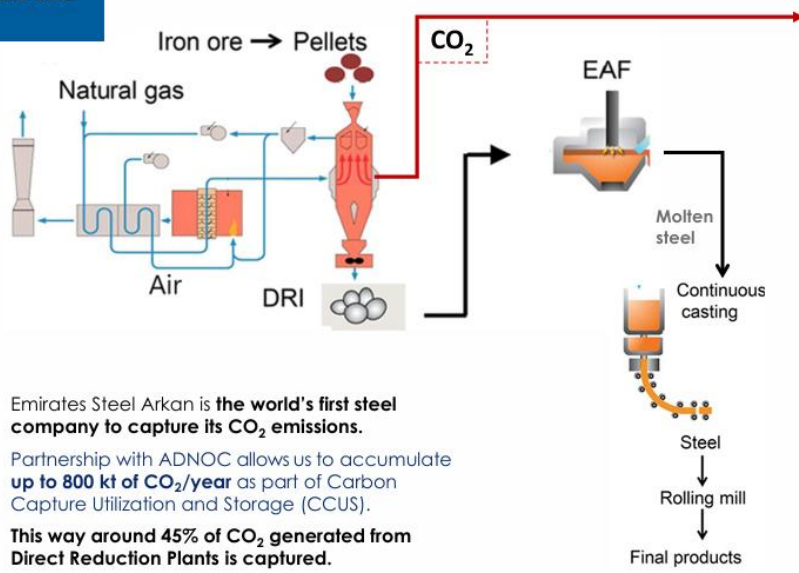
HISARNA
TGR-BF-PLASMA, PEM
STEPWISE, TORERO

STEELANOL,
CARBON2CHEM,
iUPGRADE, FReSMe
EVERSET
CARBON2VALUE

H2FUTURE, SUSTEEL
HYBRIT, GrInHy,
SALCOS, HYDROGEN,
HAMBURG, SIDERWIN



FIRST STEELMAKER WORLDWIDE TO CAPTURE ITS CO₂ EMISSIONS



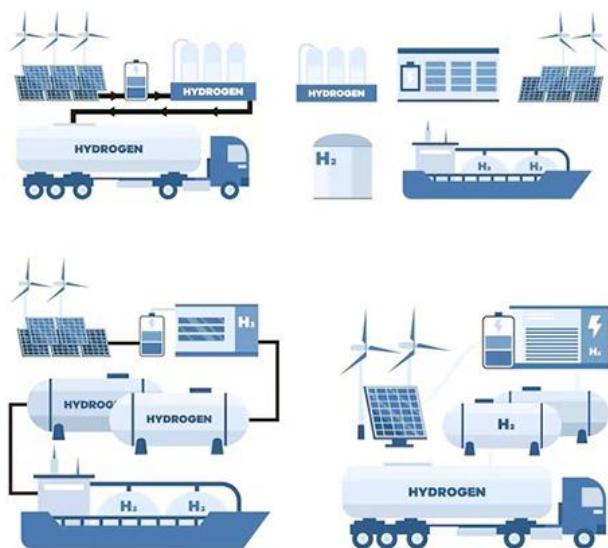
Emirates Steel Arkan is the world's first steel company to capture its CO₂ emissions.

Partnership with ADNOC allows us to accumulate up to 800 kt of CO₂/year as part of Carbon Capture Utilization and Storage (CCUS).

This way around 45% of CO₂ generated from Direct Reduction Plants is captured.

CO₂ injected into Bab and Rumaitha oil wells for Enhanced Oil Recovery





- Solar thermochemical or wind-based methods: \$3.6–3.7/kg, but less common.
- Geologic (white) hydrogen: Potentially under \$0.5/kg in resource-rich areas, though not yet widely commercialized.

COST OF HYDROGEN VS COST OF GASOLINE IN INTERNATIONAL MARKET:

Item	Green Hydrogen	Gasoline
Source	Water	Crude Oil
Supply	Infinite	Finite
Renewable	Yes	No
Carbon Footprint	No	Yes
Cost	\$3.00 –8.0kg (gge)	\$2.32/gallon
Source cost	\$0.0015/gallon	\$1.98/gallon
Refinery Costs	\$700 – \$3,500/bpd	\$1,000 – \$5,000/bpd
Mileage	81/kg	18–31/gallon

COST OF HYDROGEN PRODUCTION

Hydrogen can be produced through numerous methods, but current production is dominated by just two, steam reforming of methane and gasification of coal. Both of these production processes emit significant quantities of CO₂, but they can be decarbonized if combined with CCUS. The leading alternative low-carbon production method is electrolysis using power from nuclear or renewable energy sources.

COST OF HYDROGEN:

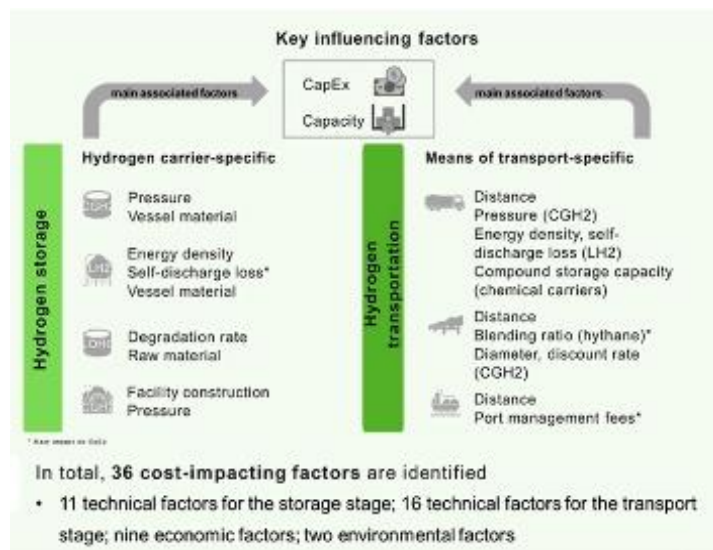
Cost-effective hydrogen supply chains are crucial for accelerating hydrogen deployment and decarbonizing economies, with the storage and transportation sectors representing major challenges. The cost of hydrogen production in 2025 varies significantly depending on the production method, energy source, and region.

TYPES OF HYDROGEN:

Sl. No.	Name	Comment
1.	Grey Hydrogen	from natural gas via steam methane reforming, SMR, without carbon capture
2.	Brown Hydrogen	from Coal (without CCUS)
3.	Blue Hydrogen	from natural gas with carbon capture, utilization, and storage, CCUS
4.	Green Hydrogen	from renewable electricity via electrolysis

Other Methods:

- Electrolysis using grid electricity or nuclear power: \$4–6/kg in the US, depending on energy costs.



(Source: Xing Lu AnneCharlotte Krutoff , Mona Wappler , Anja Fischer)

The Cost Component:

Items	Grey Hydrogen	Blue Hydrogen	Green Hydrogen
Cost:	Approximately €1–2 per kilogram (kg) or \$0.98–2.93/kg, depending on regional natural gas prices	Around \$1–4.7/kg, typically \$2.8–3.5/kg with gas prices of \$6–11/MMBtu.	Currently \$3–8/kg, with some estimates at \$4.5–6.5/kg. In regions with abundant renewables (e.g., Middle East, Australia), costs can be \$3–5/kg.
Factors:	Cheapest option due to low-cost natural gas in regions like the Middle East, Russia, and North America. Costs are driven by fuel prices (45–75% of total cost) and capital expenses	Costs include carbon capture and storage, which add to expenses but reduce emissions. Competitiveness depends on carbon pricing and regulations.	Electricity cost is the largest driver (50–70% of LCOH), requiring ~50 kWh/kg H ₂ at \$0.03–\$0.10/kWh for competitive pricing. Electrolyzer CAPEX has dropped 60% since 2010 (from \$10–\$15/kg to \$4–\$6/kg), but rose 50% from 2021–2024 due to higher capital costs.

Other Methods:

- Electrolysis using grid electricity or nuclear power: \$4–6/kg in the US, depending on energy costs.
- Solar thermochemical or wind-based methods: \$3.6–3.7/kg, but less common.
- Geologic (white) hydrogen: Potentially under \$0.5/kg in resource-rich areas, though not yet widely commercialized.

Regional Variations:

- EU: Green hydrogen costs are high (\$3–8/kg) but expected to drop with policy support (e.g., EU Green Deal).
- US: Benefits from low natural gas prices (\$3.89/MMBtu in 2018) for grey/blue hydrogen (\$1.06–2.4/kg) and tax credits (up to \$3/kg) for green hydrogen under the Inflation Reduction Act.
- Australia/Middle East: Emerging as low-cost green hydrogen producers (\$1–3/kg by 2030) due to abundant solar/wind resources.
- Japan/Korea: Higher costs (\$>2/kg by 2050) due to limited renewables, likely relying on imports.

GREEN HYDROGEN

costs could fall 30–50% by 2030, potentially reaching \$1–2/kg in optimal regions by 2030–2050, driven by cheaper renewables, electrolyzer advancements, and policies like the US Hydrogen Shot (\$1/kg by 2031)

BLUE HYDROGEN

price may stabilize or slightly decrease with improved CCUS, but its role depends on stricter emissions regulations.

GREY HYDROGEN

cost advantage may diminish as carbon pricing increases.

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- U.S. Environmental Protection Agency (U.S.EPA)
- Key influencing factors on hydrogen storage and transportation costs: A systematic literature review
- **Author links open overlay panel: Xing Lu**





Although there is an increased focus on scrap based steel making due to emission concerns, fact of the matter remains that iron ore is the primary raw material for steelmaking. The year 2026 marks a transition phase as China's steel output plateaus while India and Southeast Asia expand capacity.

Factors Pushing Down the Price

China: 2025 crude-steel fell (to ~960 Mt), a ~4% drop vs 2024; Beijing is actively managing capacity and the property sector weakness continues to weigh on construction steel demand. Nevertheless China imported record iron-ore volumes in 2025 as some mills rebuilt stocks. Expect Chinese demand to be the single largest swing factor for prices in 2026.

Factors Boosting the Price

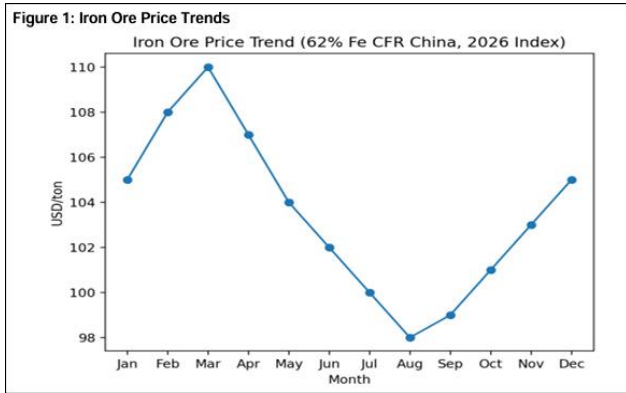
India & developing Asia: India's crude-steel production grew strongly in 2025 (double-digit % growth reported), and the region's capacity additions/supportive infrastructure policy are a durable demand source for seaborne ore.

Shaped by such factors such as supply, demand, geopolitics and sustainability, it presents continuous challenges for iron ore producers and traders.

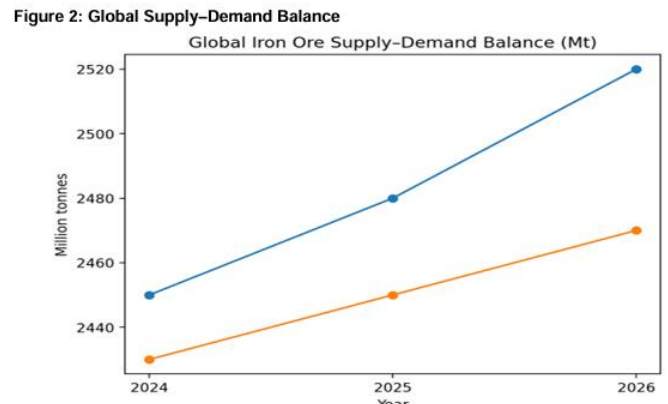
SALIENT FEATURES OF THE MARKET:

- Major miners expanded production in 2025: Vale posted a multi-year high in 2025 output, and Rio Tinto reported record Pilbara quarterly production/shipments in Q4 2025. That increased seaborne availability is a structural cap on price upside absent a demand shock.
- New/larger projects to watch (upside supply risk): ramp of Simandou (Guinea) and other West African projects — these can materially add high-grade volumes over 2026–late-2020s if funding and logistics advance.
- Australia remains the largest seaborne supplier (Pilbara shipments ~320+ Mt in 2025); Brazil is a strong #2 (Vale expansions). Vessel availability, Cape-size freight rates, and port congestion continue to affect delivered CFR China economics.

- Benchmark 62% Fe CFR China (commonly quoted for seaborne fines) is trading around USD 100–110/ton end-Jan 2026 (daily data points show



~105–106 USD/t). This is a modest decline from mid-2024 spikes but well above 2020 lows.



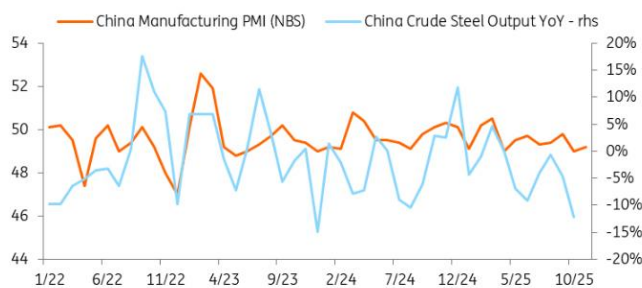
PRICE DRIVERS & RISK FACTORS OF IRON ORE:

Price Sensitivity Summary

Driver	Short-Term Impact	Long-Term Impact
Chinese steel output	Very High	Moderate
New mine supply	Low	Very High
Freight rates	Moderate	Moderate
Ore grade preferences	Moderate	High
Decarbonization policies	Low	Very High

While Mainland China’s domestic demand for steel and iron-ore remains weak, BMI highlights reduced appetite from Beijing for large-scale stimulus with the focus on boosting consumption, as opposed to supporting heavy industries, remaining unchanged, to the detriment of iron-ore.

China manufacturing PMI remains in contraction



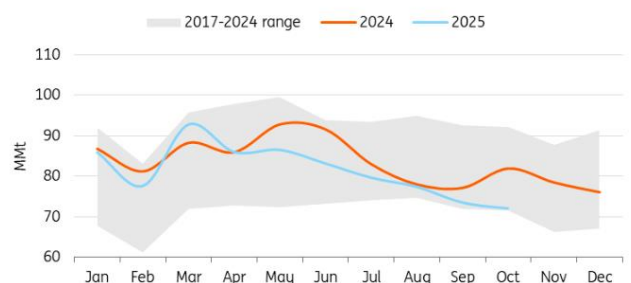
Source: NBS, China Federation of Logistics and Purchasing, ING Research

Fig 3

Fitch Solutions unit BMI expects iron-ore prices to settle at a yearly average of \$95/t in 2026, slightly down from \$97/t this year, as prices come under pressure from additional supply coming online from the Simandou project, in Guinea, while Mainland Chinese domestic demand remains weak on the back of the struggling construction industry.

It effectively implies that the iron ore market will enter 2026 facing a more challenging fundamental backdrop of Chinese weaker demand and global political tensions.

China crude steel output falls to lowest since 2023



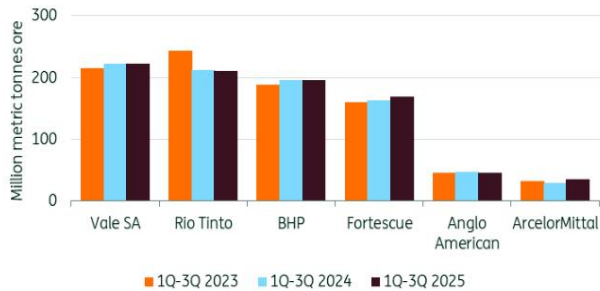
Source: NBS, ING Research

Fig 4

China’s manufacturing activity (NBS PMI) edged higher in November but remained stuck in contraction for the eighth consecutive month, underscoring persistent softness in external demand and ongoing domestic headwinds. Broader macro indicators point to continued weakness as policymakers appear to be delaying further policy support. Looking ahead, without stronger policy

support or a clearer rebound in demand, China's industrial cycle will struggle to regain momentum, the impact of which will be directly felt on global iron ore pricing.

Iron ore output from majors is up this year



Source: BNEF, Vale SA, Rio Tinto, BHP, Fortescue, Anglo American, ArcelorMittal, ING Research

Fig. 5

As per Think ING, one of the potential game-changers in iron ore supply is Guinea's Simandou project – one of the largest sources of potential new high-grade supply in decades. Even partial volumes entering the market would contribute to a more comfortably supplied balance. As additional tonnes come through, higher-cost producers, particularly low-grade Chinese domestic mines, may face renewed profitability pressure, reinforcing the dominance of large, low-cost exporters. The giant Simandou iron ore mine made its first shipment in November, marking a major milestone after nearly three decades of development, and is expected to arrive in China between January and February 2026. The mine is expected to send around 20 million tonnes of iron ore in 2026, with full capacity of 120 million tonnes per year expected by 2030.

Simandou's ramp-up could shift the global market's power dynamics, reducing China's reliance on major miners and strengthening its leverage in the iron ore market, as well as providing it with greater ability to influence global prices.

THE INDIAN CONTEXT:

As of January 2026, Indian largest iron ore producer NMDC has set Baila Lump (65.5%, 10-40mm) prices at ₹4,600 per tonne and Baila Fines (64%, -10mm) at ₹3,900 per tonne, effective January 9, 2026. However NMDC has also shifted its pricing structure from a tax inclusive model to one that excludes royalty, DMF and NMET. In July 2023,

Although steel output has been disappointing, China's iron ore imports have been strong in 2025, hitting 113.3 million tonnes in October. That's around 7% more than a year earlier, and above 100 million tonnes for the fifth month straight.

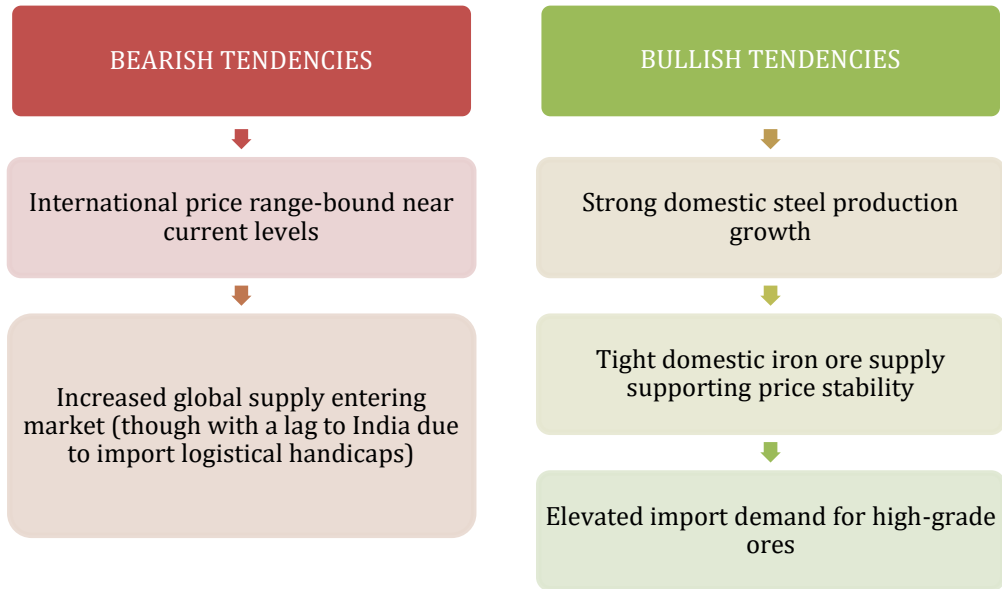
NMDC had moved to a tax inclusive in July 2023. If we include the tax component, then we see some decrease in the ore prices, calculations of which have been given in a previous article. This is because tax components vary from state to state. The factors that are currently affecting Indian iron ore prices are:

- India's crude steel production is steadily increasing. In the CY 2025, it stood at 163 million tonnes (a 10% y-o-y increase) while the iron ore production was 295 million tonnes (a 4% y-o-y increase). This mismatch of crude steel and iron ore production is supporting a high price of iron ore.
- Recent hike in iron ore price (Fig 1) due to restocking by steel mills ahead of Chinese New Year.
- Increase in prices of finished steel. Hot rolled coils increased by Rs 1000-2000/tonne while rebar prices went up by Rs 4000/tonne in early January 2026. India has imposed a three-year staggered safeguard duty of 12% on steel imports as the government aims to curb cheap shipments, especially from China. This has led to stronger demand for local steel in the domestic market thereby boosting the overall market sentiment.

Iron ore imports are at a seven-year high, with steel makers increasingly sourcing foreign ore due to domestic shortfalls and attractive international prices. Analysts expect elevated import levels to persist into 2026, particularly for high-grade ores.

Iron ore prices are expected to hold firm in India in the near term, strongly supported by India's crude steel production growth and accelerating momentum across India's infrastructural, real estate, automobile sector's growth, which continues to lend solid support to the market and reinforces a broadly positive price outlook.

SHORT-TERM MARKET OUTLOOK IN INDIA:



Ferro Nickel

Market Brief

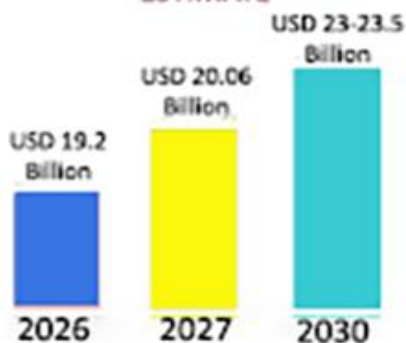
Ferronickel is commonly used as a combining agent in steelmaking, nickel together with chromium is a guiding metal element found in stainless steel. India does not produce any significant amount of Ferronickel due to absence of nickel ore.

India ferronickel market was estimated at around USD 0.8 billion in 2025. It's projected to grow at a moderate CAGR (~6%). Growth is driven by increased demand of stainless steel in construction, automotive, consumer appliances, and industrial equipment etc.



In FY25, the overall consumption of stainless steel reached 4.8 million tonnes, showing a YoY growth of about 8%. The per capita steel consumption in India is currently around 3.4 kg, compared to the world average of over 6 kg.

GLOBAL FERRO NICKEL MARKET ESTIMATE

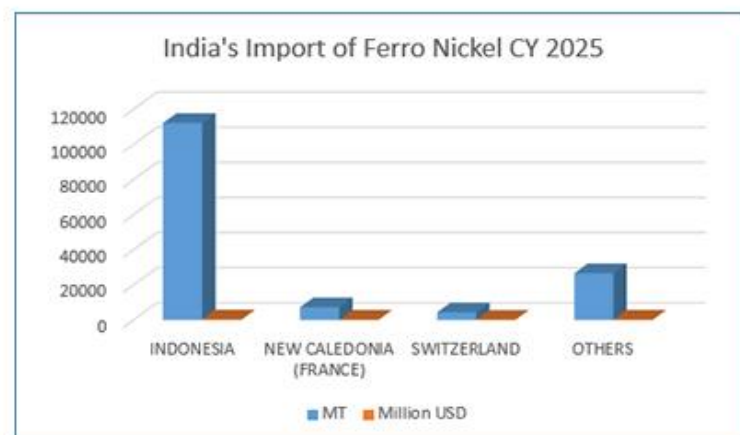


Source: Internal Research

TOP INDIAN IMPORTERS:
Jindal Stainless Limited
Kothari Metals Limited
MTC Business Private Limited
Rimjhim Ispat Limited
Saatvik Ferro Limited
Shyam Sel & Power Limited
Viraj Profiles Private Limited



Ferro Nickel Price Movement in International Market





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(A Mittal Group)



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High Alumina & Monolithic Refractories for Critical Industries

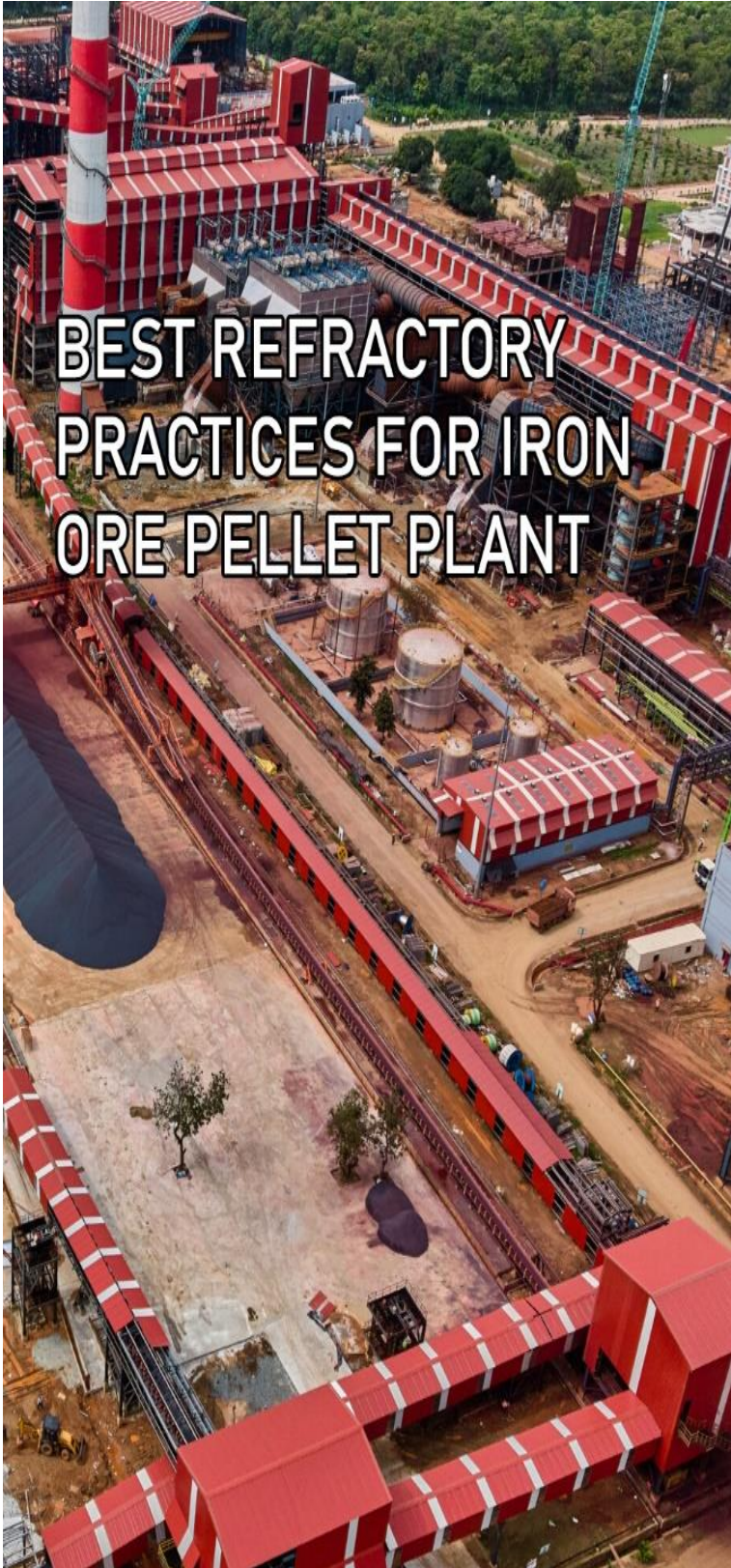
Fireclay Bricks | Castables | Insulation | Bed Supports

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ABS Refractories Private Limited
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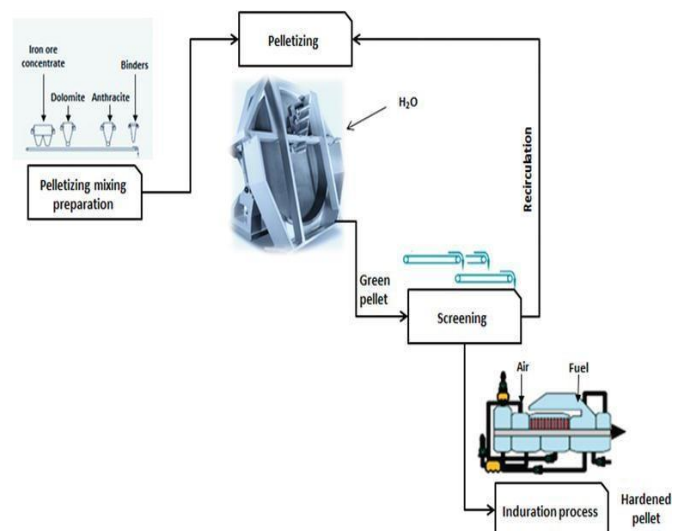




Iron ore and iron ore pellets are important sources of iron for manufacturing steel. The iron ore fines resulting from the enrichment by separation after liberation by size reduction are agglomerated in a pelletizing plant.

The iron ore pelletizing process consists of three main steps:

- Pelletizing feed preparation and mixing: the raw material (iron ore concentrate, additives—anthracite, dolomite—and binders are prepared in terms of particle size and chemical specifications, dosed, and mixed together to feed the pelletizing process;
- Balling process: the green pellet is the rolled pellet without any thermal process. It is obtained under strict control of moisture and has a spherical shape and diameter of 8–16 mm;
- Induration process: the green pellets are hardened in a high temperature processing at controlled heating rates, and aiming to achieve the physical and metallurgical requirements for handling, transportation, and final application.



The key process related problem inherent to pellet plant is severe thermal spalling. This leads to frequent start-stop, load changes etc leading thermal shock and resultant spalling and cracking. The worst affected zones are preheating zones, kiln transition zones and burner hoods. The next issue is ring formation & coating instability. Pellet fines combined with ferrous oxides and alkalis form sticky accretions. When rings break, sudden brick pull out happens leading to emergency shutdowns due to kiln choking.

The next issue is alkali attack (Na_2O , K_2O). Alkalis vaporize and condense in cooler zones. They react with aluminosilicates leading softening and bloating. The key reasons

behind it are high alkali ore and bentonite / coal ash variability. Lining life of refractories suddenly drops without any refractory composition change but change in iron ore chemistry.

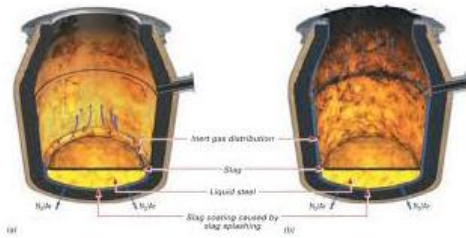
Iron oxide ($\text{Fe}_2\text{O}_3/\text{FeO}$) penetration is another challenge. Iron oxide acts as a flux and lowers melting point of refractory matrix. It leads to glassy phases & strength loss of lining. High abrasion from pellet dust erodes lining of gas ducts, cyclones and cooler zones.

Another important issue that seldom attracts attention is the installation aspect. Even the best of the refractories may fail if installation is undertaken in improper way.

Sl. No.	Present Practice	Problem	Solution
1.	There are two designs for pellet plants which operate in India, Chinese and Indian. Chinese design uses bricks and castables while Indian design uses only castables.	However, the problems are same for both the designs. The linings erode much faster than expected because poorer quality refractory materials with less abrasion resistance are used. Earlier pellet plants used to give 2-3 years life, now it is merely 7-8 months.	Good abrasion resistant materials are available at almost thrice the price for which the pellet plant owners opt for cheaper products leading to production disruption and increased downtime. Hence the solution is overall commercial prudence and not technological.
2.	Ideally 800 kg of coal is needed to produce one ton of pellet. As cost cutting measure, coal consumption has been reduced to around 600 kg for a ton of pellet.	The coal bed formed within the kiln acts as a protective lining of the kiln. Thinning of the coal bed lining causes more abrasion of the lining	Usage of higher abrasion resistant material based on Zirconia or Silicon Carbide will give better result.
3.	Nowadays both locally procured coal as well as imported coal from Indonesia/South Africa contain high percentage of volatile materials.	This leads to chemical corrosion of refractory lining.	Prefer high purity alumina bricks.

SUMMARY TABLE:

Zone (typical)	Temp range (°C)	Recommended refractory(s)	Typical Al ₂ O ₃ / chemistry	Key properties required	Common failure modes	Comments
Drying / Preheat (grate, preheater)	200–700	Low-iron aluminosilicate bricks; insulating castable backing	45–60% Al ₂ O ₃ , low Fe, low Na/K	Thermal shock resistance, low thermal conductivity	Thermal spalling from rapid heat-up; erosion by dust	Use insulating backup to reduce shell temp; avoid high-alkali bricks if pellet mix has high alkalis.
Firing / Induration (grate firing zone / kiln burning zone)	1100–1350 (up to 1400)	High-alumina bricks (≥70–85% Al ₂ O ₃); SiC-reinforced castables where abrasion high	70–85% Al ₂ O ₃ ; SiC 5–20% for abrasion	Chemical resistance to alkali & Fe, high density to resist penetration, thermal shock	Chemical/alkali attack, penetration, ring formation, abrasion	For coal/petcoke fuels expect higher alkali vapour — prefer high-purity Al ₂ O ₃ or andalusite in critical zones.
Rotary kiln transition zones (burner mouth, nose, tail)	900–1200	Anti-spalling bricks (andalusite/and-based), mullite bricks	55–75% Al ₂ O ₃ or andalusite	Low thermal expansion, good adhesion, good anchor system	Spalling due to shell ovality & expansion; mechanical anchor failure	Ensure correct expansion gaps and flexible anchors for Indian kiln ovality issues.
Kiln backup / insulation	up to shell temp	Microporous insulation, calcium silicate boards, insulating castables	N/A (insulating)	Very low thermal conductivity, compressive strength	Compression, moisture ingress, loss of insulation	Use moisture-sealed installation and sacrificial outer lining to limit corrosion.
Cooling zone (pellet cooler / grate cooler)	200–600	Lightweight insulating castable behind hot face; abrasion-resistant castable or SiC bricks on hot face	45–70% Al ₂ O ₃ ; SiC as needed	Abrasion resistance, thermal shock, low heat storage	Abrasion wear, mechanical fracture	For counter-flow coolers include replaceable wear plates in high-impact zones.
Burner hoods / combustion chamber / burner throat	800–1400	High-alumina or mullite bricks; castable at throat; SiC where erosion extreme	60–85% Al ₂ O ₃ ; mullite 45–60% if thermal shock priority	Thermal and abrasion resistance, low creep	Localized spalling, flame impingement erosion	Design hood geometry to avoid flame impingement on hot face; consider ceramic fiber seals for gaps.
Hot gas ducts, cyclones & risers	300–900	Abrasion-resistant castables (SiC, high-chrome additions if needed); ceramic tiles in elbows	SiC 5–25% blended with alumina	Abrasion resistance, adhesion to steel, modest temp capability	Erosion in elbows, anchor loss	Use replaceable tile sections in high-erosion elbows; control gas velocities to <30–35 m/s where feasible.
Charge & discharge chutes, hoppers	ambient–200	Alumina-based tiles; Ni hard overlays not recommended	45–70% Al ₂ O ₃	Impact & abrasion resistance, ease of replace	Erosion, local cracking	Design for easy plate replacement; use liners in high-angle zones.
Grate bars / grate segments	<300 (surface high impact)	Heat-resistant castable with SiC; or ceramic composite bars	SiC-reinforced castables	High abrasion & thermal shock tolerance	Abrasion wear, fatigue cracking	Keep spare grate bars on site; manage pellet size to reduce impact.
Seal joints, expansion joints, anchors	-	High-temp ceramic fiber modules + flexible anchors; stainless anchors (heat-resistant)	N/A	Flexibility, low thermal conductivity, resistance to oxidation	Loss of seal, fiber degradation, anchor corrosion	Use anchors with sacrificial sleeves; protect fibers from dust ingress.
Repair / emergency patch materials	-	Rapid set refractory mortars (hydraulic + phosphate), cold patch for short term	40–80% Al ₂ O ₃ depending product	Fast cure, workable at low temp	Poor bond if applied to greasy/dirty surface	Keep >48 h emergency kit on site for hot-patching during campaigns.



WHY JAPANESE STEEL MAKERS DON'T PREFER SLAG SPLASHING

Slag splashing technology is a process to prolong the life of steelmaking converter. After steel tapping, slag is left in converter and magnesium oxide is added and supersaturated. Then it is solidified on the inner surface of furnace lining by blowing of nitrogen to form a protective layer. The protective layer formed by slag splashing reduces the erosion of furnace lining materials during steelmaking, inhibit oxidation and decarburization of furnace lining bricks, thus protect furnace lining refractory bricks, reduce the consumption of gunning materials, prolong the service life of furnace lining, and improve the operation rate of converter steelmaking. (Source: Slag Splashing Technology, Liu Liu, Central Iron & Steel Research Institute, Beijing, China, ECPH) However, Japanese steelmakers generally do not practice slag splashing as a routine BOF refractory-life extension technique because their operating philosophy, vessel design, and cost structure make alternative lining-management methods more effective and predictable.

Another reason is to prevent non-metallic intrusion in crude steel so that the steel produced is of purer quality. Slag splashing leaves:

- Irregular frozen slag layers
- Higher risk of slag skulls and inclusions
- Increased slag carryover to the next heat
- Higher maintenance complexity

It enhances the possibility of Nitrogen pickup from N_2 gas and re-entrainment of P-rich slag. Japanese steel manufacturers follow

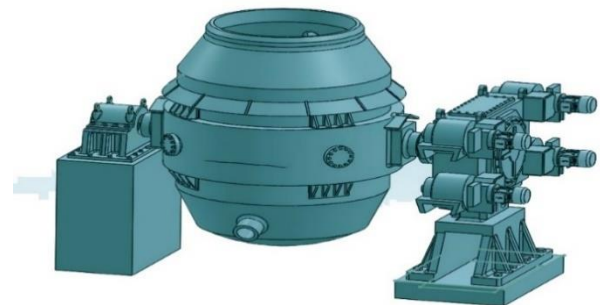
- Very tight inclusion limit
- Low tolerance for rephosphorization and MgO–FeO fluctuations

Slag splashing increases variability, which they avoid. Japanese converters typically use:

- High-purity MgO–C bricks
- Optimized slag MgO saturation
- Precise FeO control (<15–18%)

As a result, natural slag coating forms uniformly, refractory wear is minimized and converter life targets are met without aggressive splashing.

Slag splashing is attractive where process control is less precise, goal is maximum heats per lining and quality of finished steel allows some room for tolerance because of end usage.



Japanese steelmakers instead optimize:

- Blow consistency
- End-point chemistry accuracy
- Minimal downtime variability

Slag splashing causes slag dusting & aerosol emissions while Japan's steel plants operate under very strict environmental norms with high penalties for dust and fugitive emissions.

Combining all these factors, this operational practice isn't practiced in Japan.



FERTILIZERS FROM STEEL SLAG

Steel slags—especially Basic Oxygen Furnace (BOF) and Electric Arc Furnace (EAF) slags—are increasingly used as soil amendments and fertilizers because they contain calcium, magnesium, silicon, iron, and trace nutrients.

Key agronomic properties of steel slag are as follows:

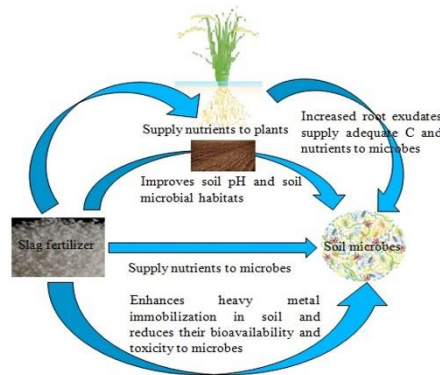
- High CaO & MgO → Acts like agricultural lime, correcting acidic soils
- Silicon (SiO₂) → Strengthens plant cell walls (especially rice, sugarcane)
- Iron & micronutrients → Corrects latent deficiencies
- Slow-release nature → Long-term soil conditioning, unlike chemical fertilizers

The advantages of using steel slag as fertilizers are manifold. It reduces steel industry waste, cuts fertilizer imports, improves soil health &

resilience and supports ESG and circular economy mandates.

Typical composition (BOF slag, wt%)

Component	Role in Soil
CaO (35–45%)	pH correction, root growth
SiO ₂ (10–20%)	Disease resistance, yield boost
MgO (5–10%)	Photosynthesis
FeO	Micronutrient
P ₂ O ₅ (1–3%)	Supplementary phosphorus



Although the concept of producing fertilizers from steel slag is not new globally, it is gaining renewed importance in India in the context of doubling farmers income, low pesticides farm produce, sustainability and carbon reduction.

The fertilizer, produced from domestically available steel slag, has

the potential to meet the agricultural demands of the country to a great extent. Because of its rich mineral content as discussed, it enhances soil health, crop yield, and pest resistance, thereby reducing the dependence on chemical Fertilizer and pesticides. It also improves the quality and aroma of farm produce. When used in combination with cow dung or farm manure the resulting crops can be considered organic. Furthermore, it reduces the required doses of conventional NPK fertilizers.

Unlike many chemical fertilizers, the steel slag fertilizer does not sublimate or leach away with rainwater. It remains in the soil until it is fully absorbed by crops, ensuring long-lasting benefits and contributing to sustainable agricultural productivity.



THE SOIL HEALTH

Soil pH is a critical parameter influencing nutrient availability, microbial activity, and overall soil fertility. Both excessively acidic and saline soils hinder plant growth and nutrient absorption.

Effect of Excessive Rainfall

Heavy or prolonged rainfall often leads to the leaching of alkalinity and essential soil nutrients, resulting in acidic and nutrient-deficient soils. Such low-pH conditions are generally unsuitable for most agricultural crops.

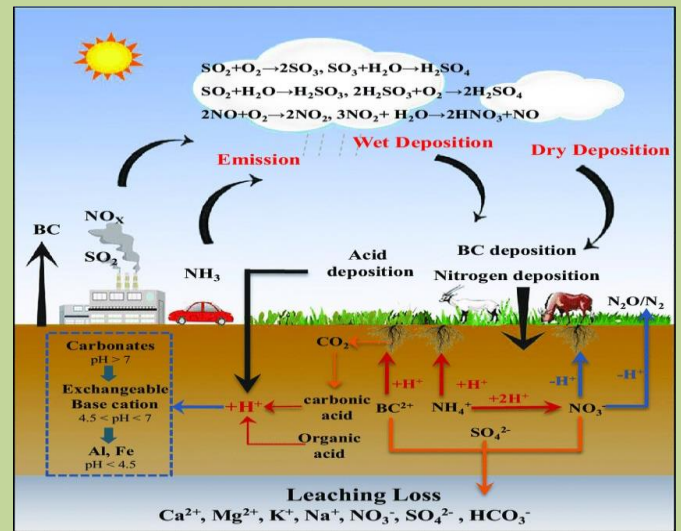
Effect of Excessive Use of Groundwater

In many parts of northern India, groundwater used for irrigation contains high concentrations of sodium. Continuous irrigation with such water increases sodium accumulation in the soil, leading to soil degradation. Over time, sodium ions replace essential nutrients, reducing soil productivity. Farmers often attempt to mitigate this by adding sand or chemical fertilizers, though these measures provide only temporary relief.

Role of Lime (CaO) and Slag in Soil Reclamation

Lime and industrial by-products such as slag can play an important role in restoring soil health. Both materials help to regulate soil pH by neutralizing acidity or reducing alkalinity, depending on soil conditions. Lime (CaO) is one of the most effective and economical agents for pH correction.

In acidic soils, lime application can raise the pH toward neutrality (around 7.0). In saline or sodic soils with high pH, lime facilitates ion exchange, replacing sodium (Na⁺) ions with calcium (Ca²⁺). The displaced sodium ions are subsequently leached deeper into the soil profile through irrigation, beyond the root zone, thereby improving soil structure and fertility



Lift Irrigation and Use of Groundwater

In several regions of North India, groundwater is commonly used for lift irrigation. However, such underground water often contains high concentrations of sodium ions (Na⁺). Continuous use of this water for irrigation gradually leads to the accumulation of sodium in the soil. Over time, this results in elevated soil pH (alkalinity) and a corresponding decline in soil fertility, as essential nutrients become less available to plants. Consequently, farmers are often compelled to compensate by applying additional fertilizers, which only provides temporary relief and increases input costs.

The application of lime (CaO) or lime-bearing slag can effectively address this issue. The calcium ions (Ca²⁺) present in lime and slag replace the sodium ions in the soil through an ion-exchange process. The displaced sodium ions are then leached out of the root zone with irrigation water, improving soil structure and restoring nutrient availability. Lime is one of the most economical and effective materials for balancing soil pH. Its use helps increase the pH of acidic soils toward neutrality (around 7.0) and reduce the alkalinity of saline soils, thus creating favorable conditions for crop growth.

Steel plant slag, when processed and applied appropriately, can significantly improve soil quality and enhance crop productivity. Its benefits include the following:

1. **pH Control:** Slag contains calcium oxide (CaO) and magnesium oxide (MgO), which help neutralize soil acidity and balance pH levels. This creates favorable conditions for nutrient uptake and microbial activity.
2. **Nutrient Enrichment:** Slag serves as a slow-release source of essential plant nutrients such as calcium (Ca), magnesium (Mg), silicon (Si), iron (Fe), manganese (Mn), and phosphorus (P). These elements contribute to stronger plant structure, improved photosynthesis, and better overall crop health.
3. **Enhanced Plant Immunity:** The silicon content in slag strengthens plant cell walls, making crops more resistant to diseases, pests, and environmental stress. This leads to improved resilience and reduced dependency on chemical pesticides.
4. **Reduction in Methane Emissions:** Studies have shown that the use of steel slag in paddy fields can reduce methane (CH₄) emissions by approximately 15–20%. This reduction occurs due to the oxidation-reduction reactions promoted by iron compounds in slag, contributing to more sustainable and climate-friendly agriculture.

NUTRIENT REQUIREMENT AND ROLE OF STEEL SLAG IN SOIL ENRICHMENT

Modern commercial farming practices, characterized by intensive monocropping and limited crop rotation, often lead to the depletion of essential soil nutrients. Out of the 18 essential elements required for healthy plant growth, steel slag can supply five key nutrients: calcium (Ca), magnesium (Mg), silicon (Si), iron (Fe), and manganese (Mn). Each of these elements plays a crucial role in plant development and soil health.

1. **Calcium (Ca)** Calcium is vital for maintaining cell wall integrity, improving root development, and enhancing fruit quality. Crops such as banana, cucurbits, and papaya particularly benefit from

calcium supplementation. Steel slag provides a steady source of CaO, which not only supports plant nutrition but also helps neutralize soil acidity.

2. **Silicon (Si)** Silicon accumulates in plant leaves and strengthens plant tissue, thereby improving photosynthetic efficiency. It promotes the photolysis of water into hydrogen and oxygen during photosynthesis, facilitating nutrient exchange between soil and roots.
3. In cereal crops such as rice and wheat, silicon's abrasive properties naturally deter pests like stem borers. The silicon particles wear down the mandibles (mouthparts) of these insects, leading to reduced pest activity without the need for chemical pesticides. Additionally, silicon application has been shown to suppress fungal diseases such as brown spot in rice, improving yield and grain quality.
4. **Magnesium (Mg)** Magnesium, primarily in the form of magnesium oxide (MgO) in steel slag, helps neutralize soil acidity and serves as a central element in chlorophyll, the pigment responsible for photosynthesis. Its presence ensures efficient light absorption and energy conversion, which are essential for plant growth and productivity.
5. **Iron (Fe) and Manganese (Mn)** Iron and manganese are crucial micronutrients that enhance enzymatic activity, flowering, fruiting, and root development. Their availability from steel slag supports overall plant metabolism and growth.
6. **Integrated Benefits and Organic Farming Applications:** The use of steel slag not only improves nutrient availability but also enhances pest resistance and stress tolerance (biotic and abiotic). Healthier plants, in turn, yield higher productivity with reduced pesticide residues. When mixed with two to three parts of cow dung manure, steel slag accelerates the composting process, producing mineral-fortified organic manure. This combination is particularly suitable for sustainable and organic farming practices.
7. **Environmental & Sustainability: Considerations:** Effect of absorbing CO₂ by steel Slag. Theoretically speaking, 1 mol of CO₂ (44 g) is

absorbed by 1 mol of CaO (56 g) when solidifying steelmaking slag by carbonation. The main sources of CaO in the slag are calcium silicate compounds such as $2\text{CaO}\cdot\text{SiO}_2$ and $3\text{CaO}\cdot\text{SiO}_2$. They form calcium carbonate and silica gel as a result of the carbonating reaction (11). Steelmaking slag can have a wide variety of compositions dictated by the steel-making process applied. When the slag has a CaO content of 50 mass% and the reaction rate is 50%, 1 ton of slag can absorb 200 kg of CO₂. If 4 million tons

out of all the slag produced each year in Japan were used for absorbing CO₂, 800 thousand tons of CO₂ would be fixed. This amount corresponds to 220 thousand tons in carbon-equivalent terms and is one-tenth of the CO₂ emissions reduction target (base year: 1995) established by the Japan Iron and Steel Federation in response to the Kyoto Protocol of 1997 and the Paris Agreement of 2015.



CASE STUDIES:

Smallholder paddy systems in subtropical Asia often suffer from acidic, silicon-poor soils, heavy-metal mobility (e.g., Cd), and variable yields. Steel-making produces large quantities of steel slag — a Ca/Si/Mg-rich by-product that, when processed and applied correctly, can act as a liming agent, a silicon source, and a slow-release mineral amendment. Recycling slag to agriculture offers both circular-economy value and a potential agronomic solution.

A Farmer applied steel slag based fertilizer in his paddy field which cost him Rs. 1400 per acre. His yield increased by 350 kg/acre. PRICE REALISTION 350 kg x Rs. 25 per kg = Rs. 8750
Return on Investment to the farmer = $(8750-1400) \times 100/1400 = 525\%$ in 120 days.

A proper steel based fertilizer can give long life (no need to apply every crop) = $(8750 \times 2 - 1400) \times 100/1400 = 1050\%$ in a year (2 crop in a year)

An additional environmental benefit is the potential for carbon credit generation by farmers. The use of slag-based fertilizers in flooded paddy fields can reduce methane emissions by approximately 20%, contributing to lower greenhouse gas emissions and more sustainable agricultural practices.

How the intervention was done (typical protocol)

SLAG SELECTION & PROCESSING

Use steelmaking slags graded for agricultural use (LD/BOF slags are commonly used). Remove metallic iron, crush and grind to a specified

particle size (finer powder → faster release). Test for heavy metals (Pb, Cd, As, Cr) and free CaO content.

Rate & timing:

Typical field applications in trials: 2–10 Mg ha⁻¹ (many effective trials around 4–8 Mg ha⁻¹). Apply once per season or once per 1–3 years depending on soil buffering and crop rotation. Apply pre-transplant or pre-flooding for paddy rice to allow partial neutralization and Si release.

Integration with nutrient management:

Maintain balanced NPK; slag is a mineral amendment (liming and Si) but supplies limited N. Best results when used with normal fertiliser practice rather than replacing primary NPK.

Monitoring & safety checks:

Soil pH, plant-available Si, and heavy-metal concentrations in soil and grain are monitored pre- and post-application to ensure food safety and long-term soil health.

Several multi-season field trials and controlled studies (China, Vietnam, Indonesia and elsewhere) consistently show that well-prepared steel-slag amendments:

- Increase rice yields: reported yield gains range between ~5–15% at typical application rates (e.g., ~4–8 Mg ha⁻¹) in multiple trials. One China paddy trial reported ~9% yield increase at 8 Mg ha⁻¹.

disease/stress tolerance (silicon uptake increased measurably after slag application).

- Reduce soil acidity and raise plant-available silicon, improving plant strength and
- Lower heavy-metal transfer to grain: some trials showed reduced Cd uptake into rice grain after slag application, improving food safety.
- Cut greenhouse-gas emissions from paddy fields: trials observed significant reductions in CH₄ and N₂O fluxes (e.g., reductions of ~56% CH₄ and large reductions in N₂O in some studies), delivering a climate co-benefit alongside yield gains.

CAVEAT:

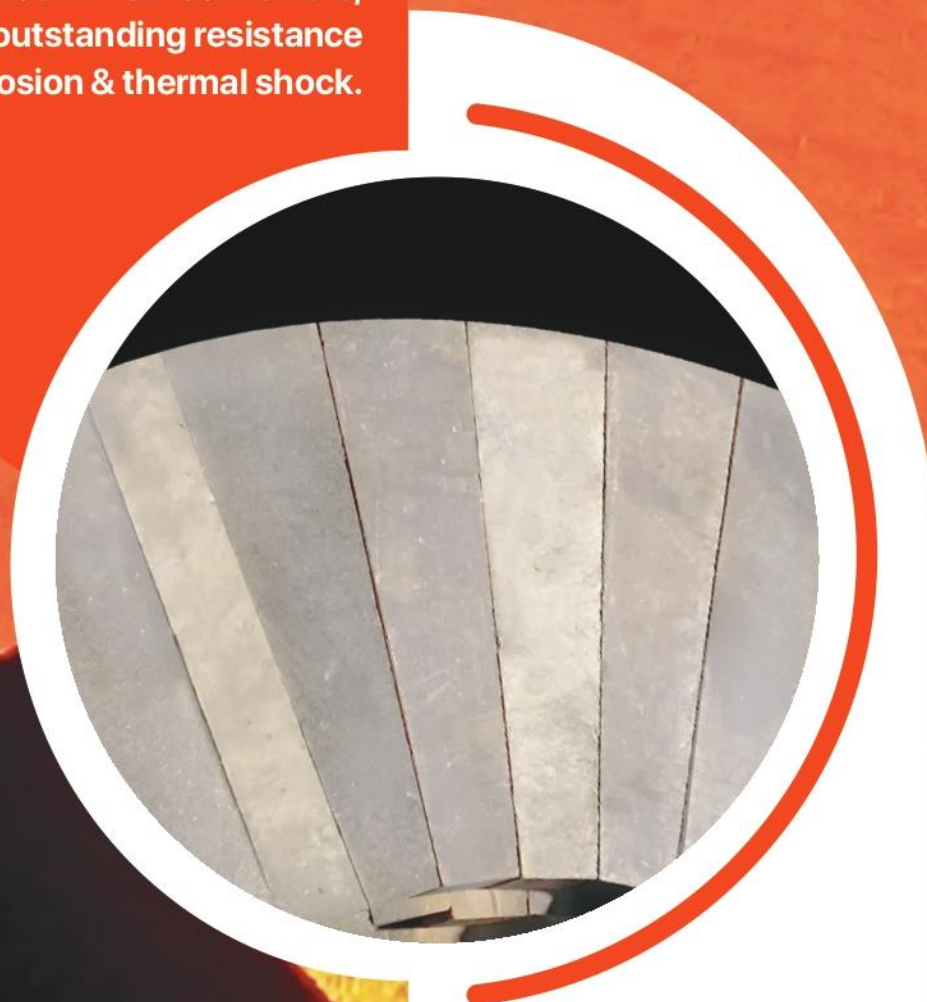
Further studies are encouraged to evaluate the heavy metal content in vegetation grown over steel slag dumps, especially by major steel producers such as SAIL and others. Independent verification by agricultural and environmental scientists in India and abroad would help establish the safety profile of slag-based fertilizers and confirm the absence of adverse effects on human health due to Heavy Metal if presence like Chromium, Mercury and Lead. Presence of Nickel, Boron, Cobalt, Zinc are beneficial as micro nutrients to the Soil.



With inputs received from Mr. Anil Passary. He has 30 years of experience in mineral processing and is Director of Passary Minerals Pvt. Ltd and Urvarak industries Pvt. Ltd. He can be reached at anilpassary@gmail.com

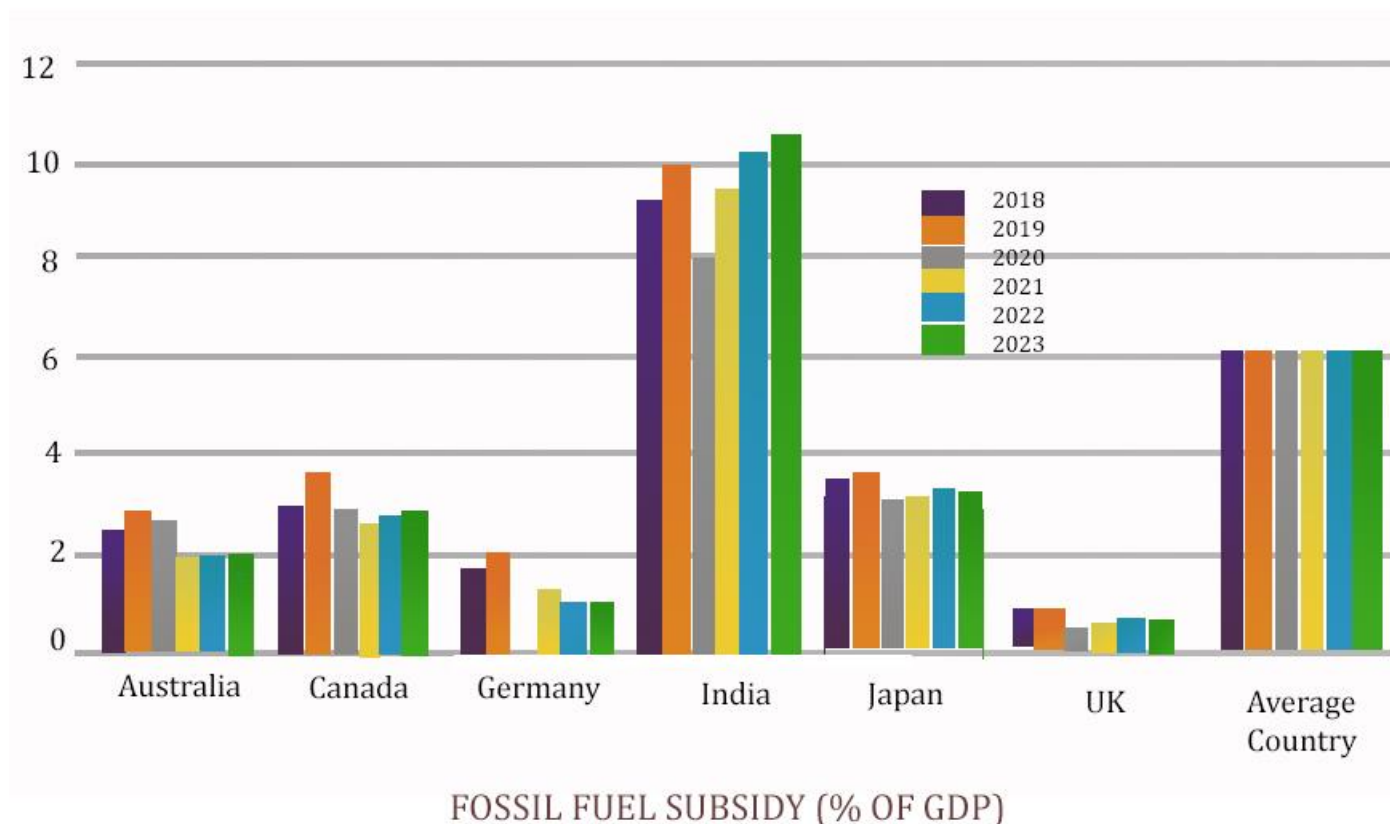
DOLOMITE REFRACTORIES FOR AOD CONVERTER

are designed for exceptional performance in AOD converters, ensuring outstanding resistance to slag corrosion & thermal shock.



What sets SARVESH apart is its focus on innovation & consistency.
Our AOD Dolomite Refractories offer:

- Superior resistance to chemical attacks from **basic slags**
- Reduced maintenance downtime through **high durability**
- Enhanced **thermal shock resistance** for longer -lasting performance



Here total subsidy means sum of explicit subsidies (undercharging for the supply costs of fossil fuels) and implicit subsidies (undercharging for environmental costs and forgone consumption tax revenues). The full gap between efficient prices (the sum of supply, environmental, and other costs) and retail prices multiplied by consumption equals the total fossil fuel subsidy. (Source: IMF)

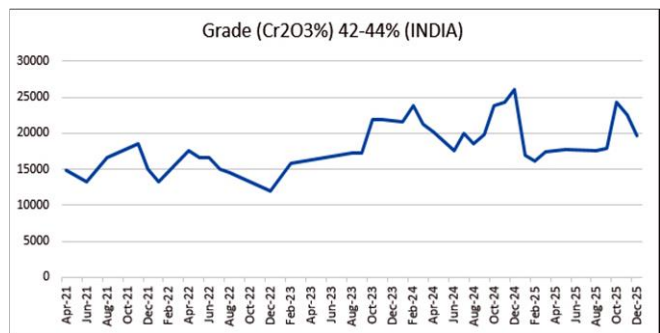
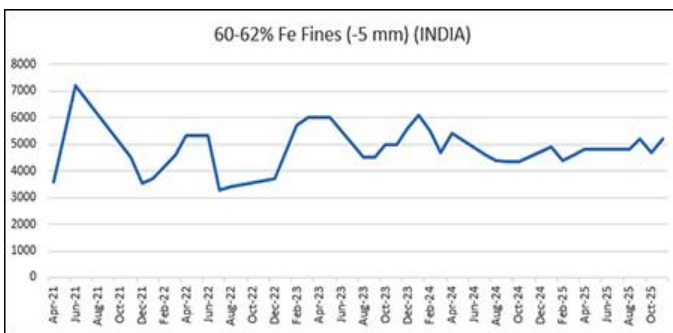
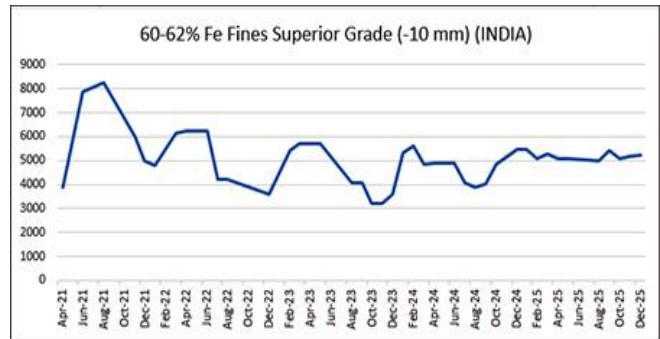
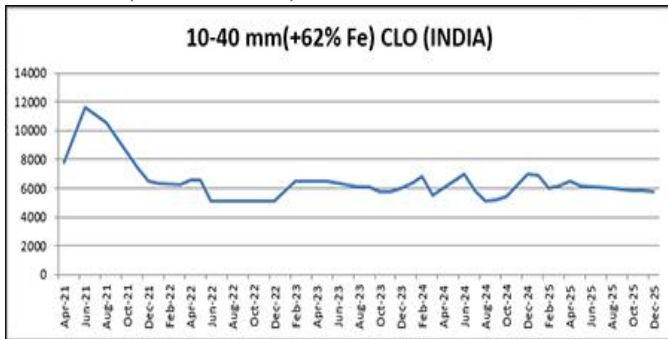




INDIA PRODUCTION SUMMARY						('000 tonnes)
ITEM	2020-21	2021-22	2022-23	2023-24	2024-25	
SPONGE IRON						
Production	34376	39200	43621	51560	55764	
Import	55	35	300	608	583	
Export	511	788	1085	1309	1516	
Consumption	33852	38321	42710	50835	54636	
PELLETS						
Production	69626	79021	79327	96523	103228	
Import	379	170	0	0	354	
Export	14459	11392	6427	12114	6870	
Consumption	55248	67054	72981	84140	96411	

(Source: JPC)

PRICE CURVE (Price in INR/mt):



Total Tundish Management Solutions



- ❑ Continuous Casting Refractories - Tailor-made design as per users requirements
- ❑ Slag Arresting Dart, Pre Tap Plugs for Converter
- ❑ Tap Hole Sleeves for Converter
- ❑ Precast Shapes - Tailor-made Designs
- ❑ Monolithic Lances
- ❑ All Types of Castables
- ❑ Basic Monolithics - Spray Mass, Dry Vibro Mass
- ❑ Mudgun Mass
- ❑ Trough Mass (Tar and Resin Bonded)
- ❑ Slag Arresting Dart, Pre Tap Plugs for Converter



**VISHVA VISHAL
REFRACTORY LIMITED**

QUALITY REFRACTORIES

Regd. Off: 612, 6th Floor, Plot No. 221, Maker Chamber-5, Nariman Point, Mumbai-400 021

Works: 4/5 Industrial Estate, Nandini Road, Bhilai, Durg - 490 026 Chattisgarh, India

