

NICKEL EXTRACTION: SCIENCE & TECHNOLOGY

NEWS: How extracting and producing nickel can be made more sustainable

WHAT'S IN THE NEWS?

A new hydrogen plasma-based method developed by the Max Planck Institute offers a carbon-free, energy-efficient way to extract nickel, significantly reducing emissions compared to traditional extraction processes.

This breakthrough supports sustainable metallurgy and is crucial amid rising global nickel demand driven by electric vehicles and renewable energy sectors.

Context

A study published in *Nature* by the Max Planck Institute highlights a new carbon-free method to extract nickel using hydrogen plasma, offering a sustainable alternative to conventional carbon-intensive processes.

About Nickel

- **Physical Properties:** Nickel is a silvery-white, corrosion-resistant, and ductile metal, known for its strength and capacity to form alloys.
- **Natural Occurrence:** Rarely found in native form; primarily extracted from sulfide and laterite ores.
- **Main Ores:**
 - Sulfide ores: Pentlandite.
 - Laterite ores: Garnierite (a green, nickel-rich mineral).

Nickel in India

- **Sukinda Valley, Odisha:** Rich in nickeliferous laterite; India's primary source of nickel.
- **East Singhbhum, Jharkhand:** Sulphide nickel associated with copper mineralization.
- **Jaduguda, Jharkhand:** Nickel linked with uranium ores.
- **Other states:** Karnataka, Kerala, Rajasthan – smaller occurrences.
- **Deep-sea Source:** Polymetallic nodules in the ocean bed also contain nickel.

Top Global Producer

- **Indonesia:** Holds over 50% of global production; focus on value-added domestic processing using laterite ores.

Applications of Nickel

- **Energy Sector:** Integral to lithium-ion batteries, especially in EVs and renewable storage.
- **Alloys:** Added to iron/steel to improve hardness and corrosion resistance (e.g., stainless steel).

- **Other Uses:** Ceramics, chemical vessels, rechargeable batteries (Ni-Cd), electronics, jewelry, green glass coloring, nickel compounds.

Rising Demand

- As per IEA projections, global demand is expected to exceed 6 million tonnes annually by 2040 due to energy transition needs.

Traditional Extraction Methods

- **Steps:** Calcination → Smelting → Reduction → Refining.
- **Reducing Agent:** Carbon (coal/coke), leading to large-scale CO₂ emissions.
- **Environmental Impact:** High energy consumption, substantial carbon footprint.

Hydrogen Plasma-Based Extraction

- **One-step Process:** Carried out in an electric arc furnace.
- **How It Works:** Hydrogen gas is energized to a plasma state (high-energy, ionized gas). This hydrogen plasma reduces nickel from its ore.
- **No Carbon Involved:** Entire process excludes carbon, leading to a cleaner output.

Significance of Hydrogen Plasma Method

- **Carbon-Free:** Eliminates CO₂; only byproduct is water vapor.
- **Emission Reduction:** Up to 84% lower carbon emissions compared to traditional methods.
- **Energy Efficient:** Estimated 18% more energy efficient.
- **Kinetically Superior:** Plasma's reactivity accelerates and favors reduction reactions.
- **Sustainability Edge:** Offers a green metallurgical pathway for critical mineral supply chains.

Source: <https://www.thehindu.com/sci-tech/energy-and-environment/how-extracting-and-producing-nickel-can-be-made-more-sustainable/article69674974.ece>