

NICKEL



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NICKEL

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**GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES**

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12 Nickel

Nickel, when added in small quantity to iron, increases its properties manifold and makes the product hard and stainless. The reason behind the demand of primary nickel all over the world is for the production of stainless steel. When it is used in plating, it makes the surface tarnish-resistant and provides polished appearance.

Nickel is not produced from primary sources in the country and the entire demand is met through imports. However, it is being recovered as nickel sulphate crystals, a by-product obtained during copper production.

OCCURRENCES & RESOURCES

Important occurrence is nickeliferous limonite in the overburden of chromite in Sukinda Valley, Jajpur district, Odisha, where it occurs as oxide. A suitable process is being developed for its utilisation. Nickel also occurs in sulphide form along with copper mineralisation in East Singhbhum district, Jharkhand.

In addition, it is found associated with uranium deposits at Jaduguda, Jharkhand and process is being developed for its recovery. Other reported occurrences of nickel are from Karnataka, Kerala and Rajasthan. Polymetallic sea nodules are another source of nickel.

As per UNFC, as on 1.4.2010, the total resources of nickel ore have been estimated at 189 million tonnes. About 92% resources; i.e., 175 million tonnes are in Odisha. The remaining 8% resources are distributed in Jharkhand (9 million tonnes) and Nagaland (5 million tonnes). Nominal resources are reported from Karnataka (0.23 million tonnes) (Table - 1).

INDUSTRY

Nickel sulphate is produced as a by-product at the Ghatsila Copper Smelter of HCL in Jharkhand. The sulphide copper ore from Ghatsila area contains nickel in small quantity along with other important metals like gold and cobalt. The installed annual capacity of the plant to produce nickel sulphate is 390 tonnes. However, the production of nickel sulphate has not been reported since 2004-05. Ronuk Industries, Mumbai is also reported to produce nickel sulphate. Sterlite (Thoothukudi) had developed innovative method to produce pure commercial grade nickel sulphate from electrolyte by solvent crystallisation. The pilot-scale trials are in progress. Jhagadia Copper Ltd also has plans to recover nickel sulphate at its copper metal plant at Jhagadia, Bharuch district, Gujarat.

**Table –1: Reserves/Resources of Nickel Ore as on 1.4.2010
(By Grades/States)**

(In million tonnes)

Grade/State	Total reserves (A)	Remaining resources					Total (B)	Total resources (A+B)
		Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333		
		STD221	STD222					
All India : Total	–	21	21	31	53	63	189	189
By Grades								
+ 0.9% Ni	–	13	8	–	18	3	42	42
0.5 to 0.9% Ni	–	8	13	31	21	21	94	94
(+)0.5% Ni, unclassified	–	–	–	–	14	39	53	53
Not-known	–	–	–	–	–	–	–	–
By States								
Jharkhand	–	–	–	–	2	7	9	9
Karnataka	–	–	–	–	–	++	++	++
Nagaland	–	–	–	–	–	5	5	5
Odisha	–	21	21	31	51	51	175	175

Figures rounded off.

Nickel sulphate is an important compound used commercially in the country in nickel plating, in dip baths for enamelling, in preparation of nickel compounds and as a catalytic nickel.

RESEARCH & DEVELOPMENT

Department of Ocean Development

The Department of Ocean Development, under its Polymetallic Nodules (PMN) Programme, has set up on behalf of HZL; a semicontinuous demonstration pilot plant to process 500 kg per day polymetallic nodules for extraction of metal values at Udaipur. The Department of Ocean Development collected 45 tonnes nodules for this purpose. Regional Research Laboratory (RRL) (now IMMT), Bhubaneswar and HZL, Udaipur, are pursuing the R&D efforts for optimising the metal recovery/processing steps.

Institute of Minerals and Materials Technology (formerly RRL), Bhubaneswar

The Nickel Technology Proving Plant set up at Institute of Minerals and Materials Technology, Bhubaneswar, is a joint (R&D) pilot project of Council of Scientific & Industrial Research (CSIR) and HZL. In this project, all the experimental studies on nickel plant have been completed.

IMMT is also engaged in extraction of nickel and cobalt from lateritic nickel/chromite overburden of Odisha through microbial route using acidophilic micro-organism. Up to 35% Ni and 50% Co recovery was achieved through mechano-chemical activation and pelletisation of chromite overburden. In a span of 60 days, 70% Ni and 60% Co recovery was achieved. The technology could be exploited in ultramafic complexes of Sukinda Valley. At present, it is to be scaled up to 10-tonne scale to generate process data and basic engineering details with support from OMC Ltd for its commercial implementation at Sukinda mine site.

During the year 2011, IMMT, had undertaken R&D project by a way of dry beneficiation studies to enrich the nickel content from the waste lateritic nickel bearing chromite overburden materials of Sukinda. It has also undertaken amenability study of nickel ore for physical beneficiation for M/s CDE Asia Ltd. Kolkata.

IMMT developed a process for production of nickel concentrate from chromite overburden nickeliferous lateritic ores. A process was also developed for extraction of nickel from solutions containing nickel and sodium sulphate and an improved process for dissolution of nickel-cobalt mixed sulphides. Patents were granted for all the three processes in India.

IMMT had carried out and completed beneficiation studies on low grade nickel ore for M/s Jindal Stainless Ltd, Bhubaneswar, Odisha.

USES

The most important use of nickel is in production of stainless steel and other corrosion-resistant alloys. Nickel/chrome plating is still the most widely used decorative electroplated finish on metals. Conventional plating is still much in favour but other techniques such as electrolytic coating or sintered slurry coating are used for applications like turbine blades, helicopter rotors, rolled steel strips and extrusion dies. Nickel is an important ingredient in coins. Finely divided nickel is used as a catalyst in hydrogenation. Other commercial uses are in ceramics, special chemical vessels, rechargeable nickel-cadmium storage batteries, electronic circuits, in computer hard discs, jewellery, green colouring of glass and preparation of nickel compounds.

CONSUMPTION

World over stainless steel is the major end-use sector of nickel having over 66% consumption share. Other uses include non-ferrous alloys (12%), electroplating (11%), other steel alloys, including casting (10%) and other chemical applications, like nickel-cadmium battery (6%). Domestic reported consumption of ferro-nickel during 2009-10, 2010-11 and 2011-12 was 2,124 tonnes, 2,200 tonnes and 2,235 tonnes, respectively, all in alloy-steel industry.

SUBSTITUTES

Aluminium, coated steels, plain chromium steels and plastics can replace stainless steel to a limited extent in many construction and transportation applications. Nickel-free speciality steels are sometimes used in place of stainless steel within the power-generating, petrochemical and petroleum industries. Titanium alloys or speciality plastics can substitute nickel metal or nickel-based alloys in highly corrosive chemical environments.

TRADE POLICY

As per Foreign Trade Policy, 2009-2014, imports of nickel ores & concentrates (heading no. 2604) and metal (heading no. 7503) are allowed freely. However, some forms of metal waste & scrap (ITC-HS Code No. 7503 0090) are restricted.

WORLD REVIEW

The world reserves of nickel are estimated at 75 million tonnes of metal content. Australia (27%), New Caledonia (16%), Brazil (10%), Russia (8%), Cuba (7%), Indonesia & South Africa (5% each) and Canada & China (4% each) together accounted for around 87% nickel reserves (Table-2). The identified land-based reserves analysing on an average of 1% nickel or more contain at least 130 million tonnes nickel. About 60% of nickel reserves are in laterites and 40% in sulphide deposits. In addition, extensive deep-sea resources of nickel are in manganese crusts and nodules, covering large areas of the ocean floor, particularly in the Pacific Ocean.

**Table – 2 : World Reserves of Nickel
(By Principal Countries)**

(In '000 tonnes of nickel content)

Country	Reserves
World: Total (rounded)	75000
Australia	20000
Botswana	490
Brazil	7500
Canada	3300
China	3000
Colombia	1100
Cuba	5500
Dominican Republic	970
Indonesia	3900
Madagascar	1600
New Caledonia	12000
Philippines	1100
Russia	6100
South Africa	3700
USA	7
Other countries	4600

*Source: Mineral Commodity Summaries, 2013.***Table – 3 : World Mine Production of Nickel
(By Principal Countries)**

(In '000 tonnes of metal content)

Country	2009	2010	2011
World: Total	1359	1540	1826
Australia	166	169	215
Brazil	57	66	74
Canada	135	158	220
China	82	80	90
Colombia	52	49	38
Cuba	60	66	66
Dominican Republic	-	-	13
Indonesia	184	217	226
New Caledonia	96	131	131
Philippines	137	184	319
Russia	262	270	270
South Africa	35	40	43
Other countries	93	110	121

Source: World Mineral Production, 2007-2011.

In 2011, world mine production of nickel increased to 1.83 million tonnes (by 19%) as compared to 1.54 million tonnes in the previous year. Philippines (17%), Russia (15%), Indonesia, Australia & Canada (12% each), New Caledonia (7%), China (5%) and Brazil & Cuba (4% each) were the principal producers (Table-3). Almost all nickel producing countries showed increase in production, significant among them are Philippines, Canada and Australia.

FOREIGN TRADE**Exports**

Exports of nickel and alloys including waste & scrap increased substantially to 5,340 tonnes in 2011-12 from 1,429 tonnes in the previous year. Out of the total alloys and scrap exported in 2011-12, nickel alloys were 5,218 tonnes, while nickel waste & scrap were 122 tonnes. Exports were mainly to UAE (68%), USA (5%), Latvia (3%), UK & Japan (2% each) (Tables-4 to 7).

Imports

During 2011-12, imports of nickel ores & concentrates increased manifold to 41,729 tonnes in comparison to only 219 tonnes in the previous year. Imports were mainly from Indonesia, USA and Australia. Imports of nickel & alloys including scrap were 34,787 tonnes in 2011-12 compared to 33,306 tonnes in the previous year. Out of total alloys and scrap imported in 2011-12, nickel alloys were 33,658 tonnes, while nickel waste & scrap was 1,129 tonnes as compared to 1042 tonnes in the previous year. Imports in 2011-12 were mainly from Russia (34%), Australia (12%), Norway (11%) and UK (6%) (Tables - 8 to 12).

**Table – 4 : Exports of Nickel ores and conc.
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	-	-	450	128258
Ghana	-	-	380	123102
Singapore	-	-	70	5156

**Table – 5 : Exports of Nickel and Alloys Incl. Scrap
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1429	1500386	5340	5886670
UAE	10	15828	3640	4119391
USA	223	254045	270	381662
Latvia	161	197123	147	188447
UK	44	28017	124	89569
Japan	72	57387	101	86428
Thailand	99	118233	71	82786
Netherlands	92	84229	62	72410
Turkey	56	57635	64	71234
Italy	20	17787	58	62240
Singapore	7	16088	43	53631
Other countries	645	654014	760	678872

NICKEL

**Table – 6 : Exports of Nickel & Alloys
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1260	1424425	5218	5842047
UAE	10	15697	3640	4119369
USA	202	245196	254	377444
Latvia	161	197123	147	188447
Thailand	99	118233	71	82786
UK	24	18559	78	77798
Netherlands	78	79542	62	72410
Turkey	56	57635	64	71234
Japan	22	26871	72	69875
Italy	20	17787	58	62240
Singapore	7	16088	43	53631
Other countries	581	631694	729	666813

**Table – 7: Exports of Nickel Waste & Scrap
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	169	75961	122	44623
Japan	50	30516	29	16553
UK	20	9458	46	11771
Spain	–	–	10	7581
USA	21	8849	16	4218
Belgium	2	814	4	1773
Germany	11	2845	14	1457
Korea, Rep. of	1	466	2	907
Malawi	–	–	1	331
UAE	++	132	++	23
Bangladesh	–	–	++	9
Other countries	64	22881	–	–

**Table – 8: Imports of Nickel Ores & Conc.
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	219	143868	41729	2008548
Indonesia	–	–	40900	1380375
USA	94	27023	468	275381
Australia	–	–	234	231344
China	–	–	66	31364
Canada	100	95771	61	60084
Other countries	25	21074	–	–

NICKEL

**Table – 9: Imports of Nickel and Alloys Incl. Scrap
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	33306	32130836	34787	39121536
Russia	7617	8960268	11292	12512664
Australia	8713	6724080	3901	4352679
Norway	2722	3157862	3603	3863241
UK	1444	1515437	1908	2303601
Canada	1533	1780861	1716	2033424
China	635	824034	1549	1817296
Japan	319	377885	1539	1683518
South Africa	919	950422	1186	1439778
Finland	2213	2437819	1281	1418750
USA	1072	1211727	1044	1306467
Other countries	6119	4190441	5768	6390118

**Table – 10: Imports of Nickel & Alloys
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	32264	31797943	33658	38729885
Russia	7617	8960268	11292	12512664
Australia	8679	6710696	3901	4352679
Norway	2722	3157862	3603	3863241
UK	1370	1488071	1907	2303171
Canada	1533	1780861	1716	2033424
China	635	824008	1538	1806617
Japan	319	377885	1539	1683518
South Africa	919	950422	1186	1439778
Finland	2213	2437819	1281	1418750
Germany	449	665767	743	1251904
Other countries	5808	4444284	4952	6064139

**Table – 11: Imports of Nickel Waste & Scrap
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	1042	332893	1129	391651
UAE	390	134296	296	128362
Italy	++	3093	333	88123
USA	80	20080	204	77654
Saudi Arabia	88	23611	53	24302
Singapore	4	2154	25	14634
China	++	26	11	10679
Pakistan	-	-	17	9677
Spain	-	-	41	9002
Netherlands	20	4179	24	7152
Israel	-	-	24	6781
Other countries	460	145454	101	15285

NICKEL

**Table – 12 : Imports of Nickel
(By Items)**

All Items	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Items	33306	32130836	34787	39121536
Nickel & alloys	32264	31797943	33658	38729885
Nickel & alloys: unwrought	2839	3429767	2957	3479620
Nickel except electroplated anode	24461	24842709	27225	29871575
Nickel: worked	8	7984	2	5440
Nickel & alloys: worked	613	686971	747	1062367
Bars, rods, plates, sheets foils of nickel	663	824564	505	783656
Bars, rods, plates, sheets foils of nickel alloys	1267	1618292	1750	2892051
Electroplated anode of nickel	19	26244	12	15959
Nickel Mattes	6	8814	++	1
Nickel oxide/sinters	1	692	7	6673
Nickel & alloys, worked NES	2387	351906	453	612543
Nickel scrap	1042	332893	1129	391651

FUTURE OUTLOOK

Over 60% of world nickel demand is for the production of stainless steel. Nickel accounts for 10 to 20% input cost in stainless steel production depending on the nickel content. The future outlook for nickel depends mainly on the production of stainless steel which is one of the main drivers for nickel produced. The production

of stainless steel is estimated to be 5 million tonnes by 2016-17 as per the 12th Five Year Plan Report.

India will have no option but to depend on imports for this metal till a technology to recover nickel from the overburden of chromite ore in Odisha is established on a commercial scale.