

59 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 66% primary nickel in the entire 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, Orissa, 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 1.4.2005, the total resources of nickel ore have been estimated at 189 million tonnes. About 92% resources; i.e., 174.48 million tonnes are in Orissa. The remaining 8% resources are distributed in Jharkhand (9 million tonnes), Nagaland (5 million tonnes) and 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. Sterlite (Tuticorin) has developed innovative method to produce pure commercial grade nickel sulphate from electrolyte by solvent crystallisation. The pilot-scale trials are in progress.

**Table -1 : Reserves/Resources of Nickel as on 1.4.2005
(By Grades/States)**

Grade/State	(In '000 tonnes)							
	Total reserves (A)	Remaining resources					Total (B)	Total resources (A+B)
		Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333		
STD221	STD222							
All India : Total	-	20840	20620	30700	53060	63490	188710	188710
By Grades								
+ 0.9% Ni	-	13380	7370	-	17900	3480	42130	42130
0.5 to 0.9% Ni	-	7460	13250	30620	21440	20760	93530	93530
(+)0.5% Ni, unclassified	-	-	-	-	13720	39250	52970	52970
Not known	-	-	-	80	-	-	80	80
By States								
Jharkhand	-	-	-	-	2000	7000	9000	9000
Karnataka	-	-	-	-	-	230	230	230
Nagaland	-	-	-	-	-	5000	5000	5000
Orissa	-	20840	20620	30700	51060	51260	174480	174480

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Nickel sulphate in the country is the most important compound used commercially in nickel plating, in dip baths for enameling, 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 (formerly RRL), 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 Orissa 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.

USES

The most important use of nickel is in production of stainless steel and other corrosion-resistant alloys. It is used in plating to make hard,

tarnish-resistant, polished surfaces. 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, green colouring of glass and preparation of nickel compounds.

CONSUMPTION

World over stainless steel is the major end-use sector of nickel having over 61% 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%).

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, 2004-09 as amended with effect from 1.4.2008, imports of nickel ores & concentrates and metal are allowed freely. However, some forms of waste & scrap are restricted.

WORLD REVIEW

The world reserve base of nickel is estimated at 150 million tonnes of metal content. Australia (18%), Cuba (15%), Canada and New Caledonia (10% each), Indonesia (9%), , South Africa (8%), Brazil and Russia (6% each), and China (5%) together accounted for around 87% nickel resources (Table-2). The identified land-based resources analysing on an average of 1% nickel or more contain at least 130 million tonnes nickel.

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About 60% of nickel resources 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 Resources of Nickel
(By Principal Countries)**

(In '000 tonnes of nickel content)

Country	Reserve base
World : Total	150000
Australia	27000
Botswana	920
Brazil	8300
Canada	15000
China	7600
Colombia	1100
Cuba	23000
Dominican Republic	1000
Greece	900
Indonesia	13000
New Caledonia	15000
Philippines	5200
Russia	9200
South Africa	12000
USA	150
Venezuela	630
Zimbabwe	260
Other countries	5900

Source: Mineral Commodity Summaries, 2008.

**Table – 3 : World Mine Production of Nickel
(By Principal Countries)**

(In '000 tonnes of metal content)

Country	2005	2006	2007
World : Total	1470	1567	1632
Australia	189	185	184
Brazil	74	82	58
Canada	199	233	255
China	73	82	70
Colombia	89	94	100
Cuba	74 ^(e)	74	75
Dominican Republic ^(e)	46	47	46
Indonesia	150	150	188
New Caledonia	112	103	125
Russia ^(e)	300	300	300
South Africa#	42	42	38
Other countries	122	175	193

Include metal content of sulphite and concentrates.

Source : World Mineral Production, 2003-2007.

In 2007, world mine production of nickel was about 1.63 million tonnes as compared to 1.57 million tonnes in the previous year. Russia (18%), Canada (16%), Australia and Indonesia (11% each), New Caledonia (8%) and Colombia (6%) were the principal producers (Table-3).

FOREIGN TRADE

Exports

Exports of nickel and alloys including waste & scrap increased to 1,670 tonnes in 2007-08 from 1,550 tonnes in the previous year. Out of the total alloys and scrap exported in 2007-08, nickel alloys were 1,548 tonnes, while nickel waste & scrap were 122 tonnes. Exports were mainly to USA (21%), Netherlands (18%), Japan (9%) and Hungary (8%) (Tables - 4 to 7).

Imports

During 2007-08, imports of nickel ores & concentrates increased to 280 tonnes from 85 tonnes in the previous year. Imports were mainly from Indonesia. Imports of nickel & alloys including scrap were 22,785 tonnes in 2007-08 compared to 23,249 tonnes in the previous year. Out of total alloys and scrap imported in 2007-08, nickel alloys were 20,814 tonnes, while nickel waste & scrap were 1,971 tonnes. Imports in 2007-08 were mainly from Russia (33%), Canada (12%), Finland (9%), Brazil (7%) and UK (5%) (Tables - 8 to 11).

**Table – 4 : Exports of Nickel and Alloys
Incl. Scrap : Total
(By Countries)**

Country	2006-07		2007-08	
	Qty. (t)	Value (Rs. '000)	Qty. (t)	Value (Rs. '000)
All Countries	1550	1183176	1670	1097023
Netherlands	399	397943	295	167795
USA	136	81993	355	160261
Hungary	100	100973	139	139863
Japan	60	37139	154	111573
Thailand	53	51764	78	71811
Turkey	31	29973	51	46042
Germany	106	48531	71	28151
UK	72	45528	55	26233
UAE	185	93904	25	16289
Latvia	67	62955	24	12861
Other countries	341	232473	423	316144

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**Table – 5 : Exports of Nickel & Alloys
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	1439	1146241	1548	1026286
Netherlands	399	397943	295	167795
USA	136	81993	353	158903
Hungary	100	100973	139	139863
Thailand	53	51764	78	71787
Japan	30	23520	60	52225
Turkey	31	29973	51	46042
Colombia	19	20014	38	33710
Germany	91	45248	71	28151
UAE	185	93904	25	16289
Latvia	67	62955	24	12861
Other countries	328	237954	414	298660

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

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	111	36935	122	70741
Japan	30	13619	94	59348
UK	38	15775	26	10011
USA	-	-	2	1358
Thailand	-	-	++	24
Colombia	28	4258	-	-
Germany	15	3283	-	-

**Table - 7 : Imports of Nickel Ores & Conc.
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	85	5163	280	53836
Indonesia	53	2668	176	16945
Belgium	-	-	43	13320
Uganda	-	-	9	6136
UAE	-	-	21	5979
Canada	-	-	5	4865
Kenya	-	-	3	3974
Japan	-	-	23	2617
Malaysia	32	2495	-	-

**Table – 8 : Imports of Nickel and Alloys
Incl. Scrap : Total
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	23249	26724927	22785	29832667
Russia	6680	8726983	7509	10270941
Canada	3433	3769353	2662	2742624
Finland	253	368819	1955	2656958
Brazil	1631	1938815	1704	2504086
Australia	1094	1315653	1380	1840383
UK	1072	1122681	1114	1663661
Norway	1317	1457714	886	1281472
USA	404	512996	543	714139
China	654	884022	349	569080
South Africa	1712	2295554	408	521502
Other countries	4999	4332337	4275	5067821

**Table – 9 : Imports of Nickel & Alloys
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs.'000)	Qty (t)	Value (Rs.'000)
All Countries	20987	26182441	20814	29130690
Russia	6644	8711366	7462	10240657
Canada	3433	3769353	2660	2742003
Brazil	1631	1938815	1704	2504086
Finland	199	316314	1657	2390364
Australia	1094	1315653	1349	1832949
UK	812	1055757	988	1636630
Norway	1317	1457714	886	1281472
USA	376	510515	433	674247
China	647	883659	349	569080
South Africa	1712	2295554	408	521502
Other countries	3122	3927741	2918	4737700

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**Table - 10 : Imports of Nickel Waste & Scrap
(By Countries)**

Country	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
All Countries	2262	542486	1971	701977
Finland	54	52505	298	266594
Germany	43	6061	578	145576
USA	28	2481	110	39892
UAE	245	84495	139	39210
Russia	36	15617	47	30284
UK	260	66924	126	27031
Netherlands	75	32317	17	15071
Italy	227	34797	50	8298
Egypt	675	118874	13	5007
Korea, Rep. of	169	48471	-	-
Other countries	450	79944	593	125014

**Table - 11 : Imports of Nickel
(By Items)**

Item	2006-07		2007-08	
	Qty (t)	Value (Rs. '000)	Qty (t)	Value (Rs. '000)
All Items	23249	26724927	22785	29832667
Nickel & alloys	20987	26182441	20814	29130690
Nickel & alloys : unwrought	1060	1517967	643	1023416
Nickel except electroplated anode	17406	21635770	17740	24733617
Nickel : worked	12	39272	17	39024
Nickel & alloys : worked	150	254426	236	426447
Bars, rods, plates, sheet, foils of nickel	413	526505	699	475030
Bars, rods, plates, sheets, foils of nickel alloys	1014	1334664	1119	1857281
Electroplated anode of nickel	19	28580	33	46215
Nickel mattes	103	52844	16	27317
Nickel oxide / sinters	13	9054	12	21846
Nickel & alloys, worked, NES	797	783359	299	480497
Nickel scrap	2262	542486	1971	701977

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FUTURE OUTLOOK

About 60 to 70% 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 demand, the world over. A significant rise in stainless steel production is expected because of extremely large capacity additions going on in the

world. Increased production of stainless steel worldwide would boost nickel consumption. Growth at 3 to 5 % in production of stainless steel and consequently in nickel consumption is envisaged.

The estimated demand for nickel in the country is expected to grow at 5% per annum. 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 Orissa is established on a commercial scale.