

NICKEL



# Indian Minerals Yearbook 2020

(Part- II : Metals & Alloys)

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**NICKEL**

**(ADVANCE RELEASE)**

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

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# 12 Nickel

Nickel is a lustrous, silvery-white metal. It is the fifth most common element of earth's crust. Nickel does not occur in native state. Pure nickel is obtained by reduction of its oxides or by the Mond process which consists of the formation of volatile nickel carbonyl produced by passing carbon monoxide over heated nickel oxide, and the dissociation of this compound at a higher temperature into nickel and carbon monoxide, which can be used again. It has a melting point of 1,453 °C, relatively low thermal & electrical conductivities, high resistance to corrosion & oxidation, excellent strength & toughness at high temperatures and capable of getting magnetised. It is attractive and very durable as a pure metal and alloys readily with other metals.

Nickel is not produced from primary sources in the country and the entire demand is met through imports. However, aided by latest technology HCL is carrying out recovery of nickel, copper and sulphuric acid from the spent electrolyte (waste stream) of ICC refinery at Ghatsila, Jharkhand.

## OCCURRENCES AND RESERVES & RESOURCES

Nickel occurs principally as oxides, sulphides and silicates in India. Important occurrence is

nickeliferous limonite in the overburden of chromite in Sukinda Valley, Jajpur district, Odisha. In addition, nickel is found associated with uranium deposits at Jaduguda, Jharkhand and a process is being developed for its recovery. Resources are spread over in Singhbhum East district of Jharkhand and Jajpur, Keonjhar & Mayurbhanj districts of Odisha.

As per NMI database as on 1.4.2015, based on UNFC, Resources of nickel are estimated at 189 million tonnes. The entire resources fall under Remaining Resources category. The State of Odisha is endowed with the largest share of resources of nickel ore in the country at 175 million tonnes (93%) followed by Jharkhand and Nagaland. These resources are mainly found to occur in three districts, namely, Jajpur (140 million tonnes), Mayurbhanj (27 million tonnes) and Keonjhar (8 million tonnes). Jharkhand has 9 million tonnes (5%) resources most of which are in Singhbhum (East) district. Nagaland has 5 million tonnes (3%) resources which predominantly are in Kiphire district (Table- 1).

## EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are covered in the Review on "Exploration & Development" under "General Reviews".

**Table –1: Reserves/Resources of Nickel Ore as on 1.4.2015  
(By Grades/States)**

(In million tonnes)

Grades/States	Total Reserves (A)	Remaining Resources					Total (B)	Total Resources (A+B)
		Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333		
		STD221	STD222					
<b>All India : Total</b>	–	<b>21</b>	<b>21</b>	<b>31</b>	<b>53</b>	<b>63</b>	<b>189</b>	<b>189</b>
<b>By Grades</b>								
+ 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	–	–	–	–	–	–	–	+
<b>By States</b>								
Jharkhand	–	–	–	–	2	7	9	9
Karnataka	–	–	–	–	–	+	–	+
Nagaland	–	–	–	–	–	5	5	5
Odisha	–	21	21	31	51	51	175	175

Figures rounded off

## INDUSTRY

HCL produced nickel sulphate as a by-product at its Ghatsila Copper Smelter in Jharkhand. The sulphide copper ore from Ghatsila area contains nickel in small quantity along with other important metals like gold and cobalt. HCL, by means of imported EMEW technology from Canada, developed capabilities to recover LME-Nickel, a grade cathode from lower concentration of copper in spent electrolyte, which otherwise was not possible by conventional means. Besides this, the technology also enabled HCL to recover nickel from the spent electrolyte at ICC refinery. Another technology of Acid Purification Unit (APU) again imported from Canada, and that which is an eco-friendly technology allowed reduction of liquid effluent and facilitates recovery of nickel in the downstream process. HCL has installed capacity of 390 MT to recover nickel sulphate. However, production of nickel sulphate has not been reported since 2004-05. The Nicomet Industries Ltd located at Goa is presently engaged in production of nickel metal and their derivatives and its annual production capacity from its Goa plant is about 5,400 MTPA.

## RESEARCH & DEVELOPMENT

India's first facility to produce nickel, a metal for which the country is completely dependent on imports, has been launched by the Hindustan Copper Limited (HCL) at its Indian Copper Complex (ICC) at Ghatsila in Jharkhand. The new facility "Nickel, Copper and Acid Recovery Plant" is the first facility in India to produce nickel metal of London Metal Exchange (LME) grade from primary resource.

NMDC has submitted application to DMG, Govt. of Odisha for proposal to reserve 8 sq. km area in Jajpur district, Odisha, under Section 17 A (2A) of MM(D&R) Amendment Act, 2015 for prospecting and mining operation of Nickel.

An Indian delegation led by Dr V.K. Saraswat, Member, NITI Aayog visited Chile, Argentina and Bolivia to explore opportunities for sourcing lithium for manufacture of advanced chemistry batteries in India. Discussions were held with Western Australian Premier and the delegation on strategic partnerships for sourcing raw materials, such as, lithium, cobalt and nickel to support manufacturing of battery. The mobility mission held consultations with industry to

develop battery recycling as a sustainable method for ensuring up to 95% recovery of critical minerals, such as, lithium, nickel, cobalt etc.

Considering the need and significance of the problem related to energy materials, CSRI-IMMT has developed suitable process flow sheets for the processing of resources, such as, alloy scrap and spent catalyst to produce precursor materials that can be used for battery application particularly in preparing electrodes of Li-ion batteries.

## USES

Sectoral uses of nickel metal are in the areas of stainless steel making; catalysis chemical industries, as an electroplating material; heat resistant alloys; alloying element for non-ferrous metals; space, defence & rocket industries; and nickel cadmium batteries. Nickel is used in many specific and recognisable industrial and consumer products including stainless steel, alnico magnets, coinage, for filters & binders, rechargeable batteries, foundry, electric guitar strings, microphone capsules and special alloys. It is also used for plating and as green tint in glass. Nickel is predominantly an alloy metal & its chief use is in the nickel steel & nickel cast iron of which there are many varieties. It is also widely used in many other alloys, such as, nickel bronze & brasses and alloys with copper, chromium, aluminium, lead, cobalt, silver & gold. It is used as catalyst which is key to several important reactions including the hydrogenation of vegetable oils, reforming of hydrocarbons and in the production of fertilizers, pesticides and fungicides.

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. Nickel based alloys, like stainless steel with higher nickel content are used for more demanding applications, such as, in gas turbines and some chemical plants.

## CONSUMPTION

World over about 65% of nickel is used in the manufacturing of stainless steel and 20% in other steel and non-ferrous (including super alloys) components often used for highly specialised industrial, aerospace and military applications. About 9% is used in plating and 6% in other uses, including coins and a variety of nickel chemicals.

## SUBSTITUTES

Aluminium, coated steels, plain chromium steels and plastics are the common substitutes that could replace stainless steel to a limited extent in many construction and transportation applications. Low-nickel, duplex, or ultra-chromium stainless steels are being substituted for austenitic grades in construction. 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 are in use as materials that could substitute nickel metal or nickel-based alloys in applications to resist corrosion in highly corrosive chemical environments. Lithium ion batteries are replacing nickel-metal hydride batteries in many applications.

## TRADE POLICY

As per Foreign Trade Policy, 2015-2020, imports of nickel ores & concentrates (Heading no. 2604) and Nickel waste & scrap (Heading no. 75030010) are allowed free. 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 94 million tonnes of metal content. Indonesia (22%), Australia (21%), Brazil (17%), Russia (7%), Cuba (6%) and Philippines (5%) are the major countries having reserves of Nickel. The identified land-based resources averaging approximately 0.5% nickel or more contain at least 300 million tonnes of nickel. About 60% of nickel reserves is in laterites and 40% in sulphide deposits. Extensive nickel resources are also found in manganese crusts and as nodules in the ocean floor (Table-2).

In 2019, world mine production of nickel increased considerably to 2.70 million tonnes as compared to 2.38 million tonnes of metal content in the previous year (Table-3). The chief producers of nickel in the world in 2019 were Indonesia (38%), Philippines (12%), Russia & New Caledonia (8% each), Canada (7%), Australia (6%), China (4%), etc. (Table-3).

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

(In Metric tonnes of nickel content)	
Country	Reserves
<b>World: Total (rounded off)</b>	<b>94000000</b>
Australia	20000000 <sup>(a)</sup>
Brazil	16000000
Canada	2800000
China	2800000
Cuba	5500000
Dominican Republic	NA
Indonesia	21000000
New Caledonia <sup>(b)</sup>	NA
Philippines	4800000
Russia	6900000
USA	100000
Other countries	14000000

*Source: USGS, Mineral Commodity Summaries, 2021*  
 (a) for Australia, Joint Ore Reserve Committee - compliant reserves were 6.2 million tonnes.  
 (b) Overseas territory of France. NA- Not Available

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

(In tonnes of metal content)			
Country	2017	2018	2019
<b>World: Total</b>	<b>2137000</b>	<b>2384000</b>	<b>2702000</b>
Indonesia*	355000	651600	1036200
Philippines	339377	344966	323325
Russia	221000	218000	226000
New Caledonia	215382	216225	209549
Canada	214302	185962	180904
Australia	185466	160022	158751
China	102300	108200	104674
Brazil	83200	65300	55700
Guatemala	54517	65710	55000 <sup>(c)</sup>
Other countries	366278	367854	352325

*Source: BGS, World Mineral Production, 2015-19.*

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**FOREIGN TRADE**

**Exports**

Exports of nickel ores and concentrates were negligible in the current year. However, there were 50 tonnes exports of nickel ores & concentrates in the preceding year. Exports were only to the United Kingdom. On the other hand, exports of nickel and alloys including scrap increased drastically by more than four fold to 16,909 tonnes in 2019-20 from 3,764 tonnes in the previous year. Out of the total alloys and scrap exported in 2019-20, nickel & alloys were 15,654 tonnes, while nickel waste & scrap were 1,255 tonnes. Exports of nickel and alloys including scrap were mainly to China (82%), UK (3%), USA (2%), and Thailand, Netherlands, Republic of Korea & Mexico (1% each) (Tables-4 to 7).

**Imports**

Imports of nickel ores & concentrates were negligible in the current year 2019-20. Imports of nickel & alloys including scrap were at 48,428 tonnes in 2019-20 which increased marginally by 3% from that of 47,229 tonnes in the previous year. Out of the total alloys and scrap imported in 2019-20, nickel & alloys were at 45,299 tonnes as compared to 45,133 tonnes in the previous year, while nickel waste & scrap were 3,129 tonnes as compared to 2,095 tonnes in the previous year. Imports of nickel and alloys including scrap in 2019-20 were mainly from Norway (12%), Japan (11%), China (9%), South Africa & Netherlands (8% each), USA (6%), Malaysia (5%), UK (4%) and France & Germany (3% each). (Tables-8 to 11).

**Table – 4: Exports of Nickel Ores and Conc.  
(By Countries)**

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value ( ` '000)	Qty (t)	Value ( ` '000)
<b>All Countries</b>	<b>50</b>	<b>1618</b>	++	++
UK	++	4	++	++
Singapore	39	948	-	-
Germany	11	667	-	-

*Figures rounded off*

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

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value ( ` '000)	Qty (t)	Value ( ` '000)
<b>All Countries</b>	<b>3764</b>	<b>4648661</b>	<b>16909</b>	<b>6532316</b>
China	280	298048	13866	2731459
UK	595	455337	568	414230
USA	492	636069	276	389531
Saudi Arabia	153	488780	110	339970
Mexico	228	290214	174	264840
Italy	48	99647	114	236452
Thailand	165	196144	236	219857
Korea, Rep. of	281	500226	169	213243
Netherlands	318	229487	186	194937
Germany	136	81653	165	147363
Other countries	1069	1373057	1045	1380434

*Figures rounded off*

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

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
<b>All Countries</b>	<b>2480</b>	<b>3935406</b>	<b>15654</b>	<b>5830632</b>
China	280	298048	13866	2731458
Saudi Arabia	152	488732	110	339970
USA	306	513334	181	321090
Mexico	228	290214	172	258687
Italy	48	99647	114	236452
Korea, Rep. of	281	500226	169	213243
Netherlands	121	157310	109	172914
Thailand	156	193024	95	130144
UAE	93	136778	72	127493
Turkey	78	89413	82	113712
Other countries	736	1168681	684	1185469

*Figures rounded off*

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

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
<b>All Countries</b>	<b>1284</b>	<b>713255</b>	<b>1255</b>	<b>701684</b>
UK	530	341088	510	318515
Thailand	8	3120	141	89713
Japan	133	74426	144	84267
USA	186	122735	95	68440
Sweden	80	39848	134	64106
Germany	114	39379	130	44474
Netherlands	197	72177	77	22023
Mexico	-	-	2	6153
Nepal	4	946	6	1878
Brazil	-	-	6	1458
Other countries	32	19536	11	657

*Figures rounded off*

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

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
<b>All Countries</b>	<b>++</b>	<b>169</b>	<b>++</b>	<b>204</b>
Cote D' Ivoire	-	-	++	126
Austria	++	99	++	78
Netherlands	++	70	-	-

*Figures rounded off*

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

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
<b>All Countries</b>	<b>47229</b>	<b>51678358</b>	<b>48428</b>	<b>55491372</b>
Japan	2634	3346610	5116	6660013
Norway	5768	5531216	5901	6031943
China	2305	2903182	4568	5597300
USA	1765	3441760	2796	4964096
South Africa	5081	4711066	4040	3972545
Netherlands	4419	4343380	3749	3481246
UK	2952	3934218	1994	3169555
Malaysia	2377	2128375	2440	2249644
Germany	561	1193406	1249	2065252
France	392	657055	1659	1976368
Other countries	18976	19488090	14916	15323409

*Figures rounded off*

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

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value (` '000)	Qty (t)	Value (` '000)
<b>All Countries</b>	<b>45133</b>	<b>50672255</b>	<b>45299</b>	<b>53854195</b>
Japan	2611	3329447	5116	6660013
Norway	5768	5531216	5901	6031943
China	2305	2903182	4568	5597300
USA	1518	3325543	2429	4758930
South Africa	5081	4711066	4034	3966489
Netherlands	4334	4304008	3677	3453209
UK	2844	3874065	1910	3120782
Malaysia	2277	2079511	2252	2159294
Germany	561	1193406	1099	2006989
France	392	657055	1650	1971544
Other countries	17443	18763755	12663	14127702

*Figures rounded off*

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

Country	2018-19 (R)		2019-20 (P)	
	Qty (t)	Value ('000)	Qty (t)	Value ('000)
<b>All Countries</b>	<b>2095</b>	<b>1006103</b>	<b>3129</b>	<b>1637176</b>
UAE	619	261591	492	251979
Canada	-	-	219	245936
USA	248	116217	367	205166
Bangladesh	236	134037	296	153825
Saudi Arabia	132	63137	326	139357
Qatar	270	117513	258	105813
Malaysia	100	48864	188	90350
Bahrain	77	34300	153	63583
Germany	-	-	149	58262
Georgia	2	1648	134	50629
Other countries	411	228795	547	272277

*Figures rounded off*

## FUTURE OUTLOOK

Primarily World nickel demand is for the production of stainless steel where about 65% nickel is consumed. 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. Batteries and the ongoing Electric Vehicle revolution could prove to be a transformational event as NCA and NCM, one still predominantly used. However, Li-ion technology is gaining in popularity and increasingly by getting established as the battery of choice.

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.

The process developed by HCL for the production of primary nickel from waste generated during copper refining will be a breakthrough in the area of nickel production in the country.

India imports as well as exports nickel scrap covered by ISRI code, Aroma, Barly, Dandy, Daunt, Delta, Decov, Depth, Hitch, House, Ideal, Indian, Junto, Lemon, Lemur are covered under HS code 75030010. But there is hardly any data available or reported for recycling and recovery of nickel from scrap. The recycling of nickel-bearing scrap in Organised Sector will be another source for meeting the demand.