Indian Minerals Yearbook 2018

(Part- II Metals and Alloys)

57th Edition

COBALT

(FINAL RELEASE)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES

Indira Bhavan, Civil Lines,
NAGPUR – 440 001

PHONE/FAX NO. (0712) 2565471
PBX : (0712) 2562649, 2560544, 2560648
E-MAIL : cme@ibm.gov.in
Website: www.ibm.gov.in

June, 2019

4 Cobalt

Cobalt is an important ferromagnetic strategic alloying metal having irreplaceable industrial applications. Cobalt is associated mostly with copper, nickel and arsenic ores. Cobalt is extracted as a by-product of copper, nickel, zinc or precious metals. Lateritic/limonitic nickel ore usually is found to contain 0.08-0.15% Co along with 1.5-4% Ni in many parts of the world.

RESERVES/RESOURCES

Occurrences of cobalt are reported from Singhbhum district, Jharkhand; Kendujhar and Jajpur districts, Odisha; Jhunjhunu district, Rajasthan; Tuensang district, Nagaland; and Jhabua & Hoshangabad districts, Madhya Pradesh. Cobalt occurring with nickeliferous limonite/laterite in Sukinda area, Jajpur district, Odisha and copper slags produced by HCL are two possible sources of cobalt. The sea-bed multimetal nodules which contain 0.3% Co (Av) along with other minerals are the other sources of cobalt.

As per NMI data based on UNFC system, reserves/resources of cobalt in terms of ore as on 1.4.2015 have been estimated at 44.91 million tonnes of which about 69%, i.e. 30.91 million tonnes are estimated in Odisha. The remaining 31% resources are in Jharkhand (9 million tonnes) and Nagaland (5 million tonnes). The Reserves/Resources of cobalt as per UNFC system are furnished below in Table-1.

EXPLORATION & DEVELOPMENT

The exploration and development details, if any, are given in the review on "Exploration & Development" in "General Reviews".

USES

Major use of cobalt is in metallurgical applications, in special alloy/super alloy industry, in magnets and cutting tools industries. Cobalt is used as precursors (cobalt compounds) for cathodes in rechargeable batteries. Largest demand for cobalt has been from the Rechargeable Battery Industry. It was initially used in Ni Cd and NiMH cells since the invention of the Lithium ion battery, this technology accounted for all the growth in cobalt consumption from the Battery Sector (CRU). Cobalt-based super alloys normally contain 45% or more cobalt, while nickel and iron-based super alloys contain 8 to 20% cobalt. Cobalt oxide is used in chemical applications, such as, catalyst, dyes & pigments, paint driers/adhesives and glass & ceramics. Cobalt catalyst, mostly cobalt acetate is used in the manufacturing of terephthalic acid (TPA) and di-methyl-terephthalate (DMT).

Super alloys made of cobalt have improved strength and wear & corrosion-resistance characteristics at elevated temperatures. Another use of cobalt-based super alloys is in turbines for pipeline compressors and jet aircraft engines. Hard-facing or cutting tools with cobalt alloys provide greater resistance to wear, heat, impact and corrosion. Cobalt powder finds an important application as a binder in the production of cemented tungsten carbides for heavy-duty and high-speed cutting tools. It is also used on bonded tools for Diamond Industry. Cobalt application improves the coating/adhesive property of enamel in steel appliances and is used in manufacturing of steel-belted tyres. Cobalt-molybdenum-alumina compound is used as catalyst in hydrogenation and for petroleum desulphurisation. Elemental Cobalt-60 (radioactive isotope, a production of atomic pile) is used in industrial radiography and therapeutics. Cobalt can retain ferromagnetic property up to a temperature of 1,100 ^{o}C, highest for any metal. It is used in the manufacturing of Alnico magnets, magnetic recording media, soft magnetic material, alloys for spacecraft, etc. Cobalt is alloyed with aluminium and nickel to manufacture powerful magnets. Permanent magnets are used in wind turbines and electric motors for automobiles & aircraft. Other significant uses of cobalt are in battery electrodes, airbags in automobiles, etc. Further, as per Avicenne (CRU), 2015, different types of lithium ion batteries with composition of cobalt are available in the market i.e. LCO-Lithium-Cobalt Oxide which contains 60% of cobalt oxide is used in high capacity storage cell phone, iPad cameras and wearables; NMC-Lithium-Nickel-Manganese-Cobalt oxide that contains 10-20% of cobalt sulphate is used in the manufacturing of low capacity but high specific power batteries which have longer cycle life have found applications in laptops and electronic vehicle (EVs); and NCA Lithium-Nickel-Cobalt Aluminium-oxide that contains 9% cobalt sulphate is used in EVs, electric grid storage (Tesla's EVs and Smart Grid/ home storage and laptops).

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

(In million tonnes)

State	Reserves Total (A)	Remaining Resources					Total Resources (A+B)
		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
All India	-	**30.63**	**2**	**0.28**	**12**	**44.91**	**44.91**
Jharkhand	-	-	2	-	7	9	9
Nagaland	-	-	-	-	5	5	5
Odisha	-	30.63	-	0.28	-	30.91	30.91

INDUSTRY & PRODUCTION

Presently, there is no production of cobalt in the country from primary cobalt resources. The demand for cobalt is usually met through imports.

Refining capacity of cobalt in India is estimated at about 2,060 tonnes per year. Of these, Nicomet Industries Ltd, Cuncolim, Goa and Rubamin Ltd, Vadodara, Gujarat were India's leading producers of cobalt cathodes and compounds. Installed capacity for cobalt metal and different cobalt salts at Nicomet is 1,000 tpy.

Nicomet Industries Ltd manufactures cobalt cathodes of LME - approved specifications under NICO Brand along with nickel cathodes & sodium sulphate in Mumbai, Maharashtra. Vedanta Group is also exploring ways to produce cobalt for batteries as the Group has become the latest entrant among companies that seeks to capitalise on the anticipated electric vehicle boom. Cobalt metal powder is reportedly recovered from cemented carbide scrap by Sandvik Asia Ltd at its pilot plant in Pune, Maharashtra. In addition, spent cobalt catalyst from plants producing DMT, TPA and oxo alcohols are also understood to be reprocessed by several small cobalt chemical processors. However, information on reprocessing of cobalt from scrap is not available. It is expected that recycled cobalt would continue to be used for domestic supply.

SUBSTITUTES

Cobalt is used in specialised applications and is difficult to be substituted. Potential substitutes include barium or strontium ferrites, neodymium-iron-boron or nickel-iron alloys in magnets; nickel, cermets or ceramics in cutting and wear-resistant materials; nickel-based alloys or ceramics in jet engines; nickel in petroleum catalysts; rhodium in hydroformylation catalysts; and cerium, lead, manganese, iron, or vanadium in paints. Presently, about one-third of cobalt is replaced by cobalt-manganese-nickel in lithium-ion batteries. In some applications, substitution for cobalt would result in a loss in product performance. Potential substitutes include barium or strontium ferrites, neodymium-iron-boron, or nickel-iron alloys in magnets; cerium, iron, lead, manganese, or vanadium in paints; cobalt-iron-copper or iron-copper in diamond tools; copper-iron-manganese for curing unsaturated polyester resins; iron, iron-cobalt-nickel, nickel, cermets, or ceramics in cutting and wear-resistant materials; iron-phosphorous, manganese, nickel-cobalt-aluminum, or nickel-cobalt-manganese in lithium-ion batteries; nickel-based alloys or ceramics in jet engines; nickel in petroleum catalysts; and rhodium in hydroformylation catalysts.

RECYCLING

Recycling technologies for recovery of cobalt especially from waste Li-ion batteries have been an evolving process. The need for technologies which can recover valuable metals and the commercialisation of that technology by the industry is highly desirable. The technology related to “Recovery of cobalt from Li-ion batteries of mobile phones” developed by National Metallurgical Laboratory (NML), Jamshedpur reportedly claims up to 95% recovery of pure

cobalt from Li-ion batteries. The present technology uses Hydrometallurgy process for the recovery of cobalt from waste Li-ion batteries. In this process metal is extracted using sulphuric acid as it is less hazardous to the environment as compared to other materials. Hydrometallurgical processes are considered better than other known processes because of high proportion and purity of recovered metals, low energy requirement and minimal emission. Recovery of cobalt by this process has following benefits.

(i) Cobalt is recovered as precious metal in more pure form.

(ii) The recovery process is less hazardous.

(iii) It enables removal of Li-ion batteries from open environment and this is considered as an effective disposal mechanism by the industry.

Recovery of cobalt can be obtained by adopting following technologies which has been tranferred & commercialised.

Recovery of Co from Co sludge/scrap (100 tpa) M/s Rubamin Ltd. Baroda.

Recovery of Co from Cobalt -bearing slag of South Africa (135 tpa Co carbonate, M/s Shalina Trading Co Pvt. Ltd, Mumbai.

Recovery of cobalt from Beta-cake leach liquor (18 tpa), M/s HZL, Udaipur.

TRADE POLICY

As per the Foreign Trade Policy 2015-2020, imports of cobalt ores & concentrates under Heading No. 2605 and cobalt alloys and its products under Heading No. 8105 are allowed freely, except cobalt waste & scrap (ITC-HS Code No. 8105 3000) which are restricted.

WORLD REVIEW

The world cobalt reserves are estimated at 6.9 million tonnes of cobalt metal content. Cobalt reserves are mainly in the Congo(Kinshasa) which contributes 49% to the total reserves followed by Australia (17%). Besides, major reserves are also located in Cuba (7%), Philippines, Canada, & Russia (4% each). The world reserves of cobalt are provided in Table-2.

The world mine production of cobalt in terms of metal content remained the same to 139 thousand tonnes in 2016 & 2017. The Democratic Republic of Congo (DRC) was the principal producer contributing about 59%, followed by New Caledonia (7%), China (6%), Canada (5%) and Australia (4 %) (Table-3).

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

(In '000 tonnes of metal content)

Country	Reserves
World: Total (rounded off)	**6900**
Australia	1200
Canada	250
China	80
Congo (Kinshasa)	3400
Cuba	500
Madagascar	140
Morocco	17
Papua New Guinea	56
Philippines	280
Russia	250
South Africa	24
Other countries	640

Source: *Mineral Commodity Summaries, 2019.*

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

(In tonnes of metal Content)

Country	2015	2016	2017
World:Total	**150000**	**139000**	**139000**
Australia[c]	6777	6012	5198
Brazil	2771	853	800
Canada	7489	7148	6503
China	10093	9293	9000[e]
Congo, Dem. P.R.	83529	68822	82461
Cuba	3734	3694	3601
Finland	2119	2260	2300[e]
Madagascar	3920	3370	2840
Morocco[a]	1722	2081	1924
New Caledonia	11444	17844	9397
Papua New Guinea	2505	2191	3308
Philippines	4140	2554	2681
Poland[b]	1730	1670	1580
Russia[a]	2040	3092	2077
South Africa[a]	1362	1101	1062
Zambia[a]	2979	5276	3240
Other countries	1646	1739	1028

Source: *World Mineral Production, 2013-2017, BGS.*
a: Metal and/or refined
b:By-product of copper mining but not currently recovered.
c : Years ended 30 June of that stated.

In India cobalt consumption is showing rising trend. It is very important to recover cobalt from various secondary sources. At Hindustan Zinc Ltd. , Process for recovery of cobalt from purification cake has been explored at lab scale and cobalt sulphate crystal of about 60% purity with 50% recovery has been generated.

Australia

Western Australian cobalt mine produces cobalt as a by-product of the State's Nickel Industry. Australian production of refined cobalt, which included production from imported lateritic ore, decreased.

The Palmer Nickel and Cobalt Refinery in Townsville, Queensland, produces refined cobalt as cobalt oxide hydroxide. In recent years, the refinery has processed lateritic ore from the Brolga Mine and the Dingo Dam mining lease of Metallica Minerals Ltd's Lucky Break project, both in Queensland; lateritic ore imported from New Caledonia and the Philippines; and an intermediate cobalt compound from Vale S.A.'s New Caledonia operation.

BHP Billiton Plc's Nickel West operations in Western Australia comprised nickel sulphide mines; concentrators, which processed ores mined by BHP Billiton and other companies; the Kalgoorlie smelter, where nickel matte was produced; and the Kwinana nickel refinery, which produced cobalt in intermediate nickel-cobalt sulphide.

First Quantum Minerals Ltd (Vancouver, British Columbia, Canada) produced intermediate nickel-cobalt hydroxide from its Ravensthorpe nickel-cobalt laterite mine and hydrometallurgical processing plant in Western Australia.

Panoramic Resources Ltd produced concentrates from its Savannah underground nickel-copper sulphide mine operation in Western Australia.

Mincor Resources NL mined nickel-copper sulphide ores from its South Kambalda operations in Western Australia. All of the ore was processed by BHP Billiton at its Nickel West Kambalda concentrator and the resulting concentrate was sold to BHP Billiton under long-term agreements.

Brazil

Votorantim Metais S.A. produced cobalt cathode at its Sao Miguel Paulista, Sao Paulo State, refinery mainly from lateritic nickel-cobalt ore mined from Niquelandia, Goias State. In January 2016, Votorantim announced that because of market conditions it would temporarily suspend its nickel operations.

Mirabela Nickel Ltd produced 149 tonnes of cobalt in nickel sulphide concentrate from its Santa Rita open-pit mine and concentrator in Bahia State.

Canada

Vale's global produced refined cobalt metal at its Port Colborne, Ontario, refinery and cobalt intermediate product at its nickel operations in Canada and New Caledonia, cobalt contained in other intermediate products such as nickel concentrates. Vale's cobalt originated from company-owned nickel sulphide mines at Sudbury, Ontario, Thompson, Manitoba, and Voisey's Bay in northeastern Labrador; from a company owned nickel laterite mine in New Caledonia; and from purchased feedstock materials.

Glencore produced cobalt at its Nikkelverk refinery in Norway from concentrates produced from its mines at Sudbury, Ontario, and Raglan, Quebec.

The Fort Saskatchewan refinery, a joint venture of Sherritt and General Nickel Co. S.A., produced cobalt as metal power and briquettes.

China

China's total production, including an estimate for Umicore's Ganzhou Yi Hao plant, was estimated to constitute more than one-half of world refined cobalt production. Nearly 80% of China's cobalt consumption was used to make cathode materials for rechargeable batteries, primarily lithium-ion batteries with cobalt or nickel-cobalt-manganese cathodes.

Numerous companies refined and (or) processed cobalt in China. As a result of consolidation in recent years, more than 90% of China's refined cobalt was produced by 10 companies. In 2015, Huayou began production at its newly constructed cobalt refinery in Quzhou, Zhejiang Province, reportedly bringing the Company's total refining capacity to 15,000 t/yr of contained cobalt. As a result, Huayou increased its direct involvement in acquiring raw materials from Congo (Kinshasa) and planned to triple its capacity to produce battery precursor materials.

Only a small portion of China's cobalt production originated from domestic mines. Most of the production was from imported cobalt concentrate and intermediate chemical compounds, the majority of which was sourced from Congo (Kinshasa). A comparison of China's cobalt supply (mine production, imports of raw materials and refined metal, and cobalt recovered from scrap) with its domestic cobalt consumption and exports indicated a stock buildup.

China's State Reserve Bureau (SRB) continued to add cobalt to its national stockpile. The cobalt reportedly was sourced mainly from domestic producers Jinchuan and Jiangsu Cobalt Nickel Metal.

Congo (Kinshasa)

Congo (Kinshasa) was the world's leading producer of mined cobalt and was estimated to represent one-half of global production. Some of the country's cobalt mine production was from copper-cobalt ores mined by industrial or mechanised methods, and some was gathered by tens of thousands of artisanal miners by handpicking cobalt-rich ores. Spencer identified a correlation between cobalt prices and the amount of cobalt mine production by artisanal methods and estimated that artisanal mines in Congo (Kinshasa) produced large quantities of cobalt. Some of Congo (Kinshasa)'s ores and concentrates were exported, some were processed in Congo (Kinshasa) to intermediate materials (crude cobalt carbonate, crude cobalt hydroxide, or cobalt bearing alloys, such as alliage blanc), and some were refined in Congo (Kinshasa) to cobalt metal. China was the leading destination for Congo (Kinshasa)'s cobalt exports. In December, the Government of Congo (Kinshasa) extended a moratorium on its 2013 ban on exports of copper and cobalt concentrates until December 31, 2016. The justification for the moratorium was the inadequate power supply to process the concentrates in the country.

In 2015, the Government of Congo (Kinshasa) began the process of dividing its existing 11 Provinces into 26. Following the division, the copper-cobalt deposits of the African Copper belt in the former Katanga Province were located in two Provinces. One was Lualaba Province, with Kolwezi as its capital, in the southwestern part of the former Katanga Province and the other was Haut-Katanga Province, with Lubumbashi as its capital, in the southeastern part of the former Katanga Province.

State-owned La Generale des Carrieres et des Mines SARL (Gecamines) held a minority interest in most of the copper-cobalt operations in Congo (Kinshasa).

Kamoto Copper Company SARL (KCC) (Katanga Mining Ltd, Gecamines, and La Societe Immobiliere du Congo) produced cobalt cathode.

New Caledonia

Vale continued to ramp up production at its Vale New Caledonia project in the southern tip of New Caledonia's main island. The project comprised a nickel cobalt laterite mine, a high-pressure acid-leaching processing plant, and a refinery. Following ramp up, Vale New Caledonia was expected to have a nominal production capacity of 57,000 t/yr of nickel contained in nickel oxide and 4,500 t/yr of cobalt contained in an intermediate cobalt carbonate.

Lateritic nickel-cobalt ore was exported to the Palmer Nickel and Cobalt Refinery in Queensland, Australia, for processing. Nickel matte from Société Le Nickel's Doniambo smelter was sent to Eramet's refinery in Sandouville, France, where nickel products and cobalt chloride were produced. Eramet planned to cease production of matte at Doniambo and increase its output of ferro-nickel instead.

FOREIGN TRADE

Exports

The exports of cobalt ores & concentrates were negligible during both the years 2016-17 & 2017-18.

Exports of cobalt and alloys including waste and scrap increased to 218 tonnes in 2017-18 from 37 tonnes in the previous year. Exports were mainly to UK (44%), Canada (35%), USA (9%) and Italy (4% each). Out of the total exports in 2017-18, exports of cobalt and alloys were at 113 tonnes and those of cobalt waste & scrap were at 105 tonnes (Tables- 4 to 10).

Imports

During both the years 2016-17 & 2017-18, there was no import of cobalt ores and concentrates.

Imports of cobalt and alloys including waste and scrap decreased to 875 tonnes in 2017-18 from 902 tonnes in the previous year. Imports in 2017-18 were mainly from USA & Canada (13% each), Belgium (12%), Norway & UK (9% each) and China (86%) & Morocco (7%). Besides, imports of cobalt in the form of cobalt powder, other articles and unwrought cobalt also took place at 272 tonnes, 270 tonnes and 333 tonnes, respectively (Tables - 11 to 14).

Table –4 : Exports of Cobalt Ores & Conc. (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**++**	**20**	**++**	**4**
Netherlands	++	16	++	3
UK	++	2	++	1
Zambia	++	2	-	-

Table – 5: Exports of Cobalt & Alloys (Including Waste and Scrap) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**37**	**56720**	**218**	**222962**
UK	2	921	89	36573
USA	4	13858	20	33901
Italy	-	-	9	33295
UAE	++	27	5	24578
Netherlands	++	411	5	23758
Canada	8	2047	76	21651
Singapore	++	22	8	8995
France	-	-	++	7424
Germany	2	3569	5	6477
Hungary	++	1342	++	5823
Other countries	21	34523	1	20487

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

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**25**	**52460**	**113**	**165545**
UK	2	921	87	33458
Italy	-	-	9	33295
UAE	++	27	5	24578
Netherlands	++	411	5	23758
USA	4	13858	6	16458
France	-	-	++	7424
Hungary	++	1342	++	5823
Switzerland	-	-	++	5580
Finland	9	16473	1	5466
Iran	2	13264	++	2525
Other countries	8	6164	++	7180

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

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**12**	**4260**	**105**	**57417**
Canada	8	2008	76	21651
USA	-	-	14	17443
Singapore	-	-	8	8963
Germany	1	1008	5	6188
UK	-	-	2	3115
Sri Lanka	-	-	++	57
Kuwait	++	198	-	-
Slovenia	3	1046	-	-

Table – 8: Exports of Cobalt Powder (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**3**	**15338**	**30**	**64921**
Italy	-	-	9	33295
Netherlands	-	-	3	14794
UK	-	-	18	10356
Iran	2	12555	++	2525
Korea, Rep of	-	-	++	1829
Turkey	++	418	++	1632
Brazil	-	-	++	490
Singapore	++	5	-	-
Germany	++	15	-	-
Sri Lanka	1	2345	-	-

Table – 9: Exports of Cobalt (Other Articles) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**22**	**37120**	**78**	**77421**
UK	2	921	69	23102
USA	4	13858	6	15859
Netherlands	++	411	2	8964
France	-	-	++	7424
Hungary	++	1342	++	5823
Switzerland	-	-	++	5580
Finland	9	16473	1	5466
UAE	++	27	++	2013
Ghana	-	-	++	744
Uganda	-	-	++	649
Other countries	7	4088	++	1797

Table – 10: Exports of Cobalt Unwrought (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**++**	**2**	**5**	**23203**
UAE	-	-	5	22565
USA	-	-	++	599
Turkey	-	-	++	30
Lebanon	-	-	++	9
Morocco	++	2	-	-

Table – 11: Imports of Cobalt & Alloys (Including Waste & Scrap) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**902**	**1972147**	**875**	**3423422**
Canada	116	206584	111	445625
USA	126	365785	111	425202
Belgium	104	243135	107	394249
Norway	78	135949	76	341767
Morocco	72	133884	65	275956
UK	50	136660	82	267702
China	58	134875	66	248585
Finland	32	57165	47	191290
Congo, Dem. Rep.	132	201847	57	190025
France	32	112616	33	162706
Other countries	102	243647	120	480315

Table – 12: Imports of Cobalt Powder (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**248**	**593648**	**272**	**1009881**
Belgium	81	183604	91	327109
Finland	13	19093	40	168627
USA	46	129501	37	125320
China	41	95154	33	124375
France	15	39012	23	97355
South Africa	17	39080	18	69406
Japan	17	44459	19	54394
Turkey	-	-	3	10691
UK	12	23677	3	10457
Germany	1	7630	2	9609
Other countries	5	12438	3	12538

Table – 13: Imports of Cobalt (Other Articles) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**241**	**681192**	**270**	**1088022**
USA	65	195370	66	269878
UK	37	111926	79	255905
Congo, Dem. Rep.	18	28789	21	85664
Belgium	23	59531	16	67140
Germany	5	57452	4	63790
Netherlands	++	51	15	58138
France	14	66175	9	57652
Morocco	28	50304	15	54442
Japan	3	6730	13	50570
China	16	35507	11	33889
Other countries	32	69357	21	90954

Table – 14 : Imports of Cobalt (Unwrought)
(By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**413**	**697307**	**333**	**1325519**
Canada	103	179583	107	425544
Norway	78	135949	75	337061
Morocco	44	83580	50	221514
Congo, Dem. Rep.	114	173058	36	104361
China	1	4214	22	90321
Congo, Peo. Rep	30	35296	29	85456
USA	15	40914	8	30004
Zambia	1	2919	3	11963
France	3	7429	1	7699
Ausralia	-	-	1	5230
Other countries	24	34365	1	6366

FUTURE OUTLOOK

India does not have any primary cobalt resources. Two possible secondary sources are nickel-bearing laterite deposits in Odisha and copper slag produced by HCL, which have been under R & D studies for commercial applications over the years. The cobalt refiners in India have catered to the market for chemical applications or where the cobalt metal or salt is dissolved and converted to cobalt oxide for cutting tools application.

Due to specialised nature of applications and difficulty in substitution, the future demand for cobalt is likely to follow an increasing trend.

The bulk demand for cobalt in the world would be in cemented carbides used in cutting tools, catalysts in Petrochemical Industry, drying agent in Paint Industry and in super alloys used mainly in jet engine parts. The demand for cobalt is estimated to go up manifolds with use of super-alloys in civil aviation, catalysts for gas-to-liquid production of synthetic liquid fuels, rechargeable batteries for hybrid electric vehicles, cellular telephones, aerospace and energy generation industries. The global demand for lithium-ion batteries has grown rapidly as a result of the increase in demand for mobile phones, portable PCs & electronic devices. The demand projection for refined cobalt as per CRU was expected to exceed 1,00,000 tonnes in 2016, while cobalt consumption was forecast to grow by a staggering 68% in the period between 2015 and 2025.

In India, cobalt will find major applications in metallurgy due to greater demand in special alloys/ super-alloys and in cutting tools and as an alloy in permanent magnets. Cobalt powder demand will continue to grow as it is extensively used in the manufacturing of bonded tools that are used in the Diamond Industry.

As far as cobalt is concerned the Indian Industry is very small, but it is growing at a steady pace in various sectors, especially for aerospace. There is a big sector for cobalt in the aerospace industry mainly dependent on import of cobalt. Other industries are growing at a consistence level but cannot be compared to China. The total consumption could be 70 tonnes to 80 tonnes minimum and it could be 100 tonnes in maximum per month in terms of cobalt content. Cobalt Sulphate is mostly used in Chemical Industries.

Battery manufacturing is considered as a huge potential in India which shall give a boost to new technology and product upgrading. There has been no rechargeable battery manufacturer in India but we hope to see new plants to be set up in the coming years.