

MOLYBDENUM



Indian Minerals Yearbook 2015

(Part- II : Metals & Alloys)

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MOLYBDENUM

(FINAL RELEASE)

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

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11 Molybdenum

Molybdenum (Mo) is a refractory metal used principally as an alloying agent in steel, cast iron & superalloys to enhance strength and wear and corrosion resistance. It does not occur in nature in free state. Usually, it is found in chemically combined form with other elements. Molybdenite (MoS_2) is the principal ore of molybdenum. About two-thirds of global molybdenum production is as by-product of copper mining and only about one-third is obtained from primary molybdenum mines. In India, by-product concentrates of molybdenum are produced intermittently from uranium ore of Jaduguda mine belonging to Uranium Corporation of India Ltd (UCIL) in Jharkhand. The internal demand for molybdenum and its products is met mostly through imports.

RESOURCES

India continues to lack in several critical minerals and one of them is molybdenum. In India, molybdenum is associated generally with copper, lead and zinc ores. Rakha copper deposit in Jharkhand contains 45 to 48 ppm molybdenum. Malanjkhand copper deposit in Madhya Pradesh contains 0.04% recoverable molybdenum. Dariba-Rajpura lead-zinc deposit in Rajasthan contains molybdenum besides bismuth, arsenic and cadmium. The multimetal deposit at Umpyrtha in Khasi and Jaintia Hills, Meghalaya, reportedly contains molybdenum in association with copper, lead and tungsten. Molybdenum deposit in Karadikuttam in Madurai District, Tamil Nadu, contains 0.02 to 0.14% recoverable molybdenum.

As per the UNFC System, the resources of molybdenum ore in the country as on 1.4.2013 are estimated at about 19.37 million tonnes containing about 12,668 tonnes MoS_2 . The above resources are located in Tamil Nadu (10 million tonnes), Madhya Pradesh (8 million tonnes) and Karnataka (1.32 million tonnes) (Table-1).

EXPLORATION & DEVELOPMENT

No exploration & development was carried out for molybdenum by GSI during the year.

USES

Molybdenum is a versatile alloying agent for alloy steel, cast iron, nickel, cobalt and titanium alloys. For desired metallurgical properties, it is used in the form of molybdic oxide or ferro-molybdenum. It is used in different proportions for imparting desired properties, such as increased strength, hardness and resistance to corrosion, temperature and chipping. It also finds application in permanent magnet alloys. As a refractory metal, it is used in many electrical and electronic components and as resistance element in electric furnaces and other equipment which are operated at extremely high temperatures. Its non-metallurgical uses are in lubricants, catalysts, pigments, as an additive in oil and greases, in aerosol sprays, in reducing surface friction and as an antiwear and antifriction agent in plastics. Molybdenum plays a vital role in the energy industry and it may become an increasingly essential factor in green technology.

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**Table – 1 : Reserves/Resources of Molybdenum as on 1.4.2013
(By Grades/Stages)**

(In tonnes)

Grade/State	Reserves		Remaining resources					Total resources (A+B)
	Total (A)	Pre-feasibility STD221	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
All India : Total								
Ore	-	1500000	36000	569304	17098594	167800	19371698	19371698
Contained MoS ₂	-	1050	83	287	11198.03	50.34	12668.37	12668.37
By States								
Karnataka								
Ore	-	-	-	-	1320900	-	1320900	1320900
Contained MoS ₂	-	-	-	-	1718.7	-	1718.7	1718.7
Madhya Pradesh								
Ore	-	-	-	-	8000000	-	8000000	8000000
Contained MoS ₂	-	-	-	-	5020	-	5020	5020
Tamil Nadu								
Ore	-	1500000	36000	569304	7777694	167800	10050798	10050798
Contained MoS ₂	-	1050	83	287	4459.33	50.34	5929.67	5929.67

Figures rounded off.

SUBSTITUTES

There is little substitution for molybdenum in its major application, viz, as an alloying element in steel and cast irons. Owing to the availability and versatility of molybdenum, industry has sought to develop new materials that benefit from the alloying properties of the metal. Potential substitutes for molybdenum include chromium, vanadium, niobium (columbium) and boron in alloy steels; tungsten in tool steels; graphite, tungsten and tantalum for refractory materials in high temperature electric furnaces and chrome-orange, cadmium-red and organic-orange pigments for molybdenum orange.

MINING

Molybdenum concentrate is produced intermittently incidental to uranium mining at Jaduguda mine of UCIL.

INDUSTRY AND CONSUMPTION

Usually, molybdenum is used in the form of roasted concentrates, oxide or ferro-molybdenum in the defence industries. HCL has installed a pilot plant for producing molybdenum concentrate from copper ore containing 0.3% Mo at Rakha mine, East Singhbhum district, Jharkhand. However, molybdenum recovery at Rakha is not found economical.

Molybdenum is used chiefly in the form of ferro-molybdenum. The production of ferro-molybdenum increased from 1,076 tonnes in 2012-13 to 1,231 tonnes in 2013-14. The consumption of ferro-molybdenum in 2014-15 was

672 tonnes and 688 tonnes in 2013-14. Alloy steel industry alone accounted for about 65% consumption followed by iron & steel (24%) and foundry (12%). The data on production and consumption of ferro-molybdenum are given in Tables- 2 and 3, respectively.

Non-ferrous Technology Development Centre at the Defence Metallurgical Research Laboratory, Hyderabad has a pilot plant for producing molybdenum powder. Institute of Minerals and Materials Technology (formerly RRL), Bhubaneswar, is carrying out basic research on recovery of molybdenum from spent catalysts.

Table – 2 : Production of Ferro-molybdenum
2010-11 to 2014-15

	(In tonnes)
year	Production
2010-11	3090
2011-12	4362
2012-13	1076
2013-14(P)	1231
2014-15(P)	-

Source: Monthly Statistics of Mineral Production March 2014.

TRADE POLICY

As per Foreign Trade Policy, 2009-2014, imports of molybdenum ores & concentrates under heading No. 2613 and molybdenum & articles thereof under heading No. 8102 are allowed freely, except molybdenum waste & scrap (under ITC-HS Code No. 8102 9700) which are restricted.

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Table – 3 : Reported Consumption of Ferro-molybdenum, 2012-13 to 2014-15 (By Industries)

Industry	(In tonnes)		
	2012-13	2013-14	2014-15(P)
All Industries	667	688	672
Alloy steel	435(8)	435(8)	435(8)
Electrode	22(2)	20(2)	2(2)
Foundry	50(8)	73(10)	75(10)
Iron & steel	160(8)	160(8)	160(8)

Figures in parentheses denote the number of units in organised sector reporting consumption.*

(Includes actual reported consumption and for estimates made wherever required).*

WORLD REVIEW

The world reserves of molybdenum are 11 million tonnes, located mainly in China (39%), USA (25%), Chile (16%), Peru (4%) together accounted for about 84%, besides Russia, Armenia, Canada and Mexico (Table-4).

The world production of molybdenum in terms of metal decreased to 2.67 lakh tonnes in 2015 from 2.81 lakh tonnes in the previous year. China (38%), USA (21%) and Chile (18%) together accounted for about 77% of world production (Table-5).

Table-4: World Reserves of Molybdenum (By Principal Countries)

(In '000 tonnes of molybdenum content)	
Country	Reserves
World: Total (rounded)	11000
Armenia	150
Australia	190
Canada	260
Chile	1800
China	4300
Iran	43
Kazakhstan	130
Kyrgyzstan	100
Mexico	130
Mongolia	160
Peru	450
Russia ^(e)	250
Turkey	100
USA	2700
Uzbekistan ^(e)	60

Source: Mineral Commodity Summaries, 2016.

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**Table – 5 : World Mine Production of Molybdenum
(By Principal Countries)**

(In tonnes of metal content)

Country	2013	2014	2015
World: Total (rounded)	256000	281000	267000
Armenia	5446	7100	7300
Canada	8954	9700	9300
Chile	35090	48800	49000
China	104000	103000 ^e	101000
Iran	3512	4000 ^e	4000
Mexico	11366	14400	13000
Mongolia	-	2000	2000
Peru	16790	17000	18100
Russia	4838	4800 ^e	4800
Turkey	-	1300	1400
Uzbekistan	-	530	520
USA	60400	68200 ^e	56300

Source: Mineral Commodity Summaries, 2016.

China

Jinduicheng Molybdenum Co. Ltd (JDC) announced that it planned to increase its molybdenum concentrate production in 2015 to approximately 45,000 tonnes. In 2014, JDC produced 39,200 tonnes of molybdenum concentrate, a slight increase from the 39,000 tonnes of molybdenum concentrate produced in 2013. JDC operated the Jinduicheng open pit molybdenum mine, two concentrators, one smelter, and two processing plants in Jinduicheng, Hua County, in northwest Shaanxi Province.

Canada

At Gibraltar mine in South-Central British Columbia, Taseko Mines Ltd produced 1,057 tonnes of molybdenum in 2014 compared to 658 tonnes produced in 2013. The new molybdenum separation facility commissioned in 2014 was responsible for increased production in 2014.

Chile

Corporacion Nacioal del Cobre de Chile

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(codelco) the state controlled molybdenum & copper producer announced that it produced 30,600 tonnes of molybdenum in 2014 compared to 23,000 tonnes in 2013.

Antofagasta plc (London, United Kingdom) announced that, in 2014, molybdenum production at its Los Pelambres Mine was 7,900 tonnes a 12% decrease compared to 9,000 tonnes of molybdenum produced in 2013.

Mexico

Southern Copper Corp. reported that its La Caridad Mine produced 10,800 tonnes of molybdenum in 2014 compared to 11,700 tonnes of molybdenum in 2013. The La Caridad complex is located in northeastern Sonora (Southern Copper Corp.).

Peru

The Cerro Verde Mine continued construction of its large scale expansion project which would expand its concentrator facilities from 1,20,000 to 3,60,000 tonnes per day of ore and would have the capacity to produce 6,800 tonnes per year molybdenum beginning in 2016. In 2014 molybdenum production at Cerro Verde was approximately 5,000 tonnes of molybdenum, a 15%

decrease compared to 5,900 tonnes of molybdenum produced in 2013.

FOREIGN TRADE

Exports

Exports of molybdenum ores & concentrates decreased drastically to 24 tonnes in 2014-15 from 351 tonnes in the previous year. In 2014-15, exports were mainly to Netherlands (83%). Exports of molybdenum and scrap also decreased to 55 tonnes in 2014-15 from 77 tonnes in 2013-14. Exports were mainly to Netherlands (36%), USA (25%) and UK (20%) (Tables-6 and 7).

Imports

Imports of molybdenum ores & concentrate increased considerably to 8,093 tonnes in 2014-15 from 5,572 tonnes in the previous year. Imports were mainly from Chile (37%), Thailand (23%), USA (11%) and Mexico (9%). Imports of molybdenum and scrap also increased marginally to 373 tonnes in 2014-15 from 339 tonnes in the previous year. China (67%), Austria (21%) and USA (6%) were the main suppliers (Tables- 8 & 9).

**Table – 6 : Exports of Molybdenum Ore & Conc.
(By Countries)**

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	351	324538	24	17801
Netherlands	28	18184	20	15112
Israel	-	-	1	2529
Oman	-	-	3	160
Other countries	323	306354	-	-

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

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	77	161373	55	188842
USA	1	10467	14	37861
Germany	1	17524	3	28761
Japan	++	20992	1	25703
Singapore	1	13429	1	23069
Austria	2	15812	1	16159
Belgium	1	24917	1	12406
Poland	1	11218	1	8808
Netherlands	10	3420	20	5884
Egypt	++	3214	1	5722
UK	52	19109	11	4854
Other countries	8	21271	1	19615

**Table – 8 : Imports of Molybdenum Ore and Conc.
(By Countries)**

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	5572	5558080	8093	8645534
Chile	1180	1125369	3026	3090846
Thailand	296	389058	1860	2321799
USA	1747	1751217	853	938463
Mexico	1098	1100214	666	827643
China	225	251582	521	707914
Korea, Rep. of	244	293838	220	230794
Belgium	121	104118	173	131550
South Africa	113	77411	111	96373
Netherlands	23	29031	72	63981
Vietnam	63	47427	51	59230
Other countries	462	388814	540	176941

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**Table -9 : Imports of Molybdenum & Scrap
(By Countries)**

Country	2013-14		2014-15(P)	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	339	1119658	373	1268948
China	208	562681	249	676695
Austria	73	347177	77	408887
USA	25	95542	23	93412
Germany	14	53095	8	36883
Singapore	1	4179	2	12319
UAE	7	12823	6	12315
Hungary	1	5500	++	6004
Hong Kong	2	11371	1	4666
UK	2	5977	2	4315
Russia	-	-	2	3896
Other countries	6	21313	3	9556

FUTURE OUTLOOK

The principal uses of molybdenum in chemical applications and as catalyst and as an additive in steel manufacturing, most importantly alloy and stainless steel, are expected to continue. Molybdenum plays a vital role in the energy industry and it may become increasingly important factor in environment protection technology, where it is used in high strength

steels for automobiles to reduce weight and improve fuel economy and safety. Molybdenum-based catalysts have a number of important applications in Petroleum and Plastic Industries.

In India, it is expected that demand for molybdenum will be increasing and this internal demand for molybdenum will continue to be met through imports.