

TUNGSTEN



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(Part- II : Metals & Alloys)

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TUNGSTEN

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**GOVERNMENT OF INDIA
MINISTRY OF MINES
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18 Tungsten

Tungsten is a vital metal of strategic importance. The chief sources of tungsten are minerals scheelite (CaWO_4) and wolframite [$(\text{Fe},\text{Mn})\text{WO}_4$] which are deposited by hydrothermal solutions. Tungsten has a melting point of $3,350^\circ\text{C}$, the highest of all metals and it is resistant to all acids at ordinary temperatures. It is elastic, ductile and has high tensile strength and can be drawn into very thin wires. The domestic requirements of tungsten and its products are met mainly through imports. A significant amount of tungsten is recovered through recycling of scrap tungsten products.

RESOURCES

The total resources of tungsten ore in the country, as per UNFC system, as on 1.4.2010 have been estimated at 87.4 million tonnes containing 142,094 tonnes WO_3 content. All these resources are placed under 'remaining resources' category.

Resources are mainly distributed in Karnataka (42%), Rajasthan (27%), Andhra Pradesh (17%) and Maharashtra (9%). Remaining 5% resources are in Haryana, Tamil Nadu, Uttarakhand and West Bengal (Table - 1).

At Degana, Rajasthan, WO_3 value in vein deposits varies from 0.25 to 0.54% while in gravel deposit, it is, on an average 0.04%. In Sirohi deposit, Rajasthan, WO_3 content ranges from 0.02 to 2.2%. In West Bengal, Bankura deposit contains, on an average, 0.1% WO_3 . In Kuhi-Khobana-Agargaon belt, GSI has identified seven mineralised zones in Sakoli basin in Bhandara and Nagpur districts, Maharashtra. The analysis showed 0.01 to 0.19% WO_3 in Kuhi block, 0.13 to 0.38% WO_3 in Khobana block and 0.48% WO_3 in Pardi-Dahegaon-Pipalgaon block. The deposit contains 0.17% WO_3 on an average. Gold ore at Mysore mine of BGML in Karnataka has been reckoned as a potential source of scheelite. The tailing dumps at Kolar Gold Fields contain about 0.035 to 0.18% WO_3 .

EXPLORATION & DEVELOPMENT

During 2011-12, DMG, Rajasthan conducted exploration for wolframite in 15 km radius around Sirohi by mapping- 1:50,000 -100 sq km, 1:10,000 -10 sq km with collection of 17 samples. In the north of village Balda, the occurrence of wolframite in the form of disseminated grains and fine stringers in quartz veins were seen. Twelve samples were analysed.

PRODUCTION & PRICES

There was no production of tungsten ore/concentrate during 2011-12. The production of tungsten was reported from Degana, Rajasthan and Chendapathar, West Bengal in the past. The domestic prices of tungsten ore and concentrate are furnished in the General Review on 'Prices'.

MINING & PROCESSING

Deposits of wolframite occurring in Degana and Chendapathar are found associated with quartz veins, the width of which varies from a few centimetres to three metres or sometimes even more. In Degana, Rajasthan, it is also associated with gravel beds overlain by 2.5 m thick sand.

Gravel mining was carried out in the past in selected areas where wolframite was found to be concentrated. The overburden sand was loosened and loaded manually and transported by tractor unit at dump sites. The payable gravel was then worked.

In case of vein deposits, ore body was cut with chisel and hammer, at convenient places, forming undercuts. At Degana, Rajasthan, tungsten orebody occurs as vein, stockwork and alluvial deposits. Inclined veins were developed by putting adits in the stockwork.

Degana in Rajasthan and Chendapathar in West Bengal were the only operative mines of tungsten in India producing meagre quantities of concentrate. However, owing to economic non-viability, they have been closed down.

USES

The main use of tungsten is in the form of ferro-tungsten in the making of special and alloy steels. Ferro-tungsten typically contains between 25% and 75% tungsten. The other principal use of tungsten is in the manufacture of tungsten carbide, one of the hardest synthetic materials used in industry. It is used widely in cutting and wear-resistant materials, particularly those that have to work at high temperatures. Tungsten wires form the filament in incandescent light bulbs and cathodes for electronic tubes. The metal is used in superalloys with copper or silver and in chemical industry. It is also used in armour plate and armour-piercing ordnance. Tungsten compounds are used in dyes and pigments, manufacture of paints and printing ink and also in ceramic industry for producing yellow tint. Other alloys bearing tungsten are used for ornaments, heat sinks, radiation shielding, weights and counter-weights, wear resistant parts and coatings.

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

Grade/State	Reserve Total (A)	Remaining resources								Total resources (A+B)
		Feasibility STD211	Pre-feasibility STD222	Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total B		
All India : Total	-	2230000	173063	19611152	23435954	25356049	16581246	87387464	87387464	87387464
Ore	-	3568	450	9914	20180.92	103415.15	4566.28	142094.35	142094.35	142094.35
Contained WO ₃	-	-	-	-	-	-	-	-	-	-
By States										
Andhra Pradesh										
Ore	-	-	-	3640000	4700800	5952500	509000	14802300	14802300	14802300
Contained WO ₃	-	-	-	5096	6574.64	8273.65	318.28	20262.57	20262.57	20262.57
Haryana										
Ore	-	2230000	-	-	-	-	-	2230000	2230000	2230000
Contained WO ₃	-	3568	-	-	-	-	-	3568	3568	3568
Karnataka										
Ore	-	-	-	15361152	11805499	172921	9338246	36677818	36677818	36677818
Contained WO ₃	-	-	-	2915	1775	142	1403	6235	6235	6235
Maharashtra										
Ore	-	-	-	610000	5637250	1830000	-	8077250	8077250	8077250
Contained WO ₃	-	-	-	1903	10304	3828	-	16035	16035	16035
Rajasthan										
Ore	-	-	-	-	963666	17000628	5964000	23928294	23928294	23928294
Contained WO ₃	-	-	-	-	1421.44	90171.5	2115	93707.94	93707.94	93707.94
Tamil Nadu										
Ore	-	-	-	-	-	-	250000	250000	250000	250000
Contained WO ₃	-	-	-	-	-	-	50	50	50	50
Uttarakhand										
Ore	-	-	-	138000	-	-	520000	658000	658000	658000
Contained WO ₃	-	-	-	-	25	-	680	705	705	705
West Bengal										
Ore	-	-	-	190739	400000	1000	-	763802	763802	763802
Contained WO ₃	-	-	-	80.84	1000	-	-	1530.84	1530.84	1530.84

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SUBSTITUTES

Titanium, tantalum and niobium carbides can be used in some wear-resistant applications. Molybdenum tool steels and tungsten tool steels are interchangeable. In some cutting tool applications, bulk ceramic is an alternative. Tungsten remained the essentially unsubstitutable material for filaments, electrodes, and contacts in lamp & lighting applications. However, an electrodeless, non-tungsten lamp is available for commercial and industrial uses. In some applications, substitution would result in increased cost or a loss in product performance.

TECHNICAL POSSIBILITIES

Further development of new metal shaping method; i.e., laser is possible. Development of new cutting tool materials could reduce the usage. Increased use in ceramics and in catalysts is possible because of increasing use of coating on cemented carbide cutting tools to prolong tool life. Use of tungsten scrap could be increased. Tungsten compounds could be used in light-sensitive applications.

POLICY

As per the Foreign Trade Policy, 2009-14, the imports and exports of tungsten ores and concentrates can be made freely.

CONSUMPTION

The entire domestic requirements of tungsten ore/ concentrates are met by imports. Sandvik Asia Pvt. Ltd, Pune; Widia (India) Ltd, Bengaluru and Rapticut Carbides Ltd, Ankaleshwar. Mishra Dhatu Nigam Ltd, Hyderabad and Sunflag Iron & Steel Co. Ltd, Bhandara, Maharashtra were the important consumers of ferro-tungsten for alloy steel.

Annual consumption of tungsten ore/concentrate and ferro-tungsten during the year 2011-12 is estimated at 530 tonnes and 18 tonnes respectively.

WORLD REVIEW

The world reserves of tungsten in terms of metal content are about 3.2 million tonnes, distributed broadly amongst China (59%), Russia (8%), USA (4%) and Canada (4%) (Table -2).

The world mine production of tungsten in terms of metal content in 2011 increased to 72,900 tonnes from 68,600 tonnes in 2010. China was the leading producer (82%), followed by Russia (6%) and Bolivia (2%) (Table-3).

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

(In '000 tonnes of Tungsten content)

Country	Reserves
World: Total	3237
Austria	10
Bolivia	53
Canada	120
China	1900
Portugal	4
Russia	250
USA	140
Other countries	760

Source: Mineral Commodity Summaries, 2013.

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

(In tonnes of metal content)

Country	2009(R)	2010(R)	2011(P)
World: Total	64700	68600	72900
Austria	887	975	861
Bolivia	1023	1203	1418
Canada	2501	364	2368
China ^(e)	51000	59100	60000
Korea, Dem. Peoples Rep. of ^(e)	100	100	100
Peru	634	716	546
Portugal*	823	799	818
Russia ^(e)	5500	3000	4200
Rwanda	690	630	950
Spain	284	303	425
Thailand*	274	481	229
Uzbekistan ^(e)	300	300	300
Other countries	684	629	685

Source: World Mineral Production, 2007-2011.

* Wolframite & Scheelite.

FOREIGN TRADE

Exports

Exports of tungsten alloys and scrap increased to 638 tonnes in 2011-12 from 431 tonnes in the previous year. Exports were mainly to Germany(44%), USA (28%), Italy (5%), Sweden (4.4%) and UK (4%). In 2011-12 exports of tungsten ores & concentrates increased to 321 tonnes as against 32 tonnes in the preceding year (Tables - 4 and 5).

Imports

Imports of tungsten ores and concentrates drastically increased to 327 tonnes in 2011-12 from 27 tonnes in the previous year. Imports were mainly from Israel. Imports of tungsten and alloys including scrap increased to 638 tonnes in 2011-12 from 405 tonnes in the previous year. Imports were mainly from China (34%), USA(15%), Rep. of Korea (11%) and Japan (8%) (Tables - 6 to 8).

WORLD REVIEW

China

The Chinese Government undertook measures to regulate the production of tungsten concentrates by forbidding foreign investment in exploration and mining in order to conserve its tungsten resources and to stabilise tungsten prices. In the processing sector, the Government encouraged the recovery of tungsten from low grade ores, mixed scheelite-wolframite concentrates and scrap. The Government also regulated tungsten exports by restricting the volumes and types of materials, products.

Rep. of Korea

Woulfe Mining Corp.commissioned a feasibility study on reopening of the Saydong tungsten-molybdenum mine. The company was considering an underground mine with a life of 11.5 years, a beneficiation plant to produce tungsten and molybdenum concentrates and an onsite processing plant with capacity to produce approximately 3100 tonnes per year of tungsten in APT.

Russia

Wolfram Company completed the first phase of a refractory metals plant in Unecha Bryansk Oblant, expected to produce tungsten metal powder as its main product.

UK

Wolf Minerals Ltd was studying the feasibility of redeveloping the Hemerdon tungsten-tin-mine near Plymouth. The open pit mine and beneficiation plant is expected to produce approximately 2700 tonnes per year of tungsten in wolframite concentrate and 462 tonnes per year of tin in concentrates for a minimum of 10 years from 2014.

Vietnam

Hazelwood Resources formed a joint venture with Asia Tungsten Products to produce ferro-tungsten containing 80% tungsten near the Haiphong Port. Nui Phao open pit Project of Masan Group Corp. would produce 4,700 tpy of contained tungsten besides copper, fluorite and bismuth. The project is slated to begin in 2013.

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

Country	2010-11		2011-12	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	430970	669662	638430	1423388
Germany	105351	90657	280028	456000
USA	120726	163472	175897	373748
Sweden	28667	35009	28106	66824
Italy	14698	16488	33259	52523
Poland	8810	17903	5949	46508
Brazil	2065	24605	12542	45647
Belgium	36282	38860	22976	44390
France	4419	29048	4141	43788
UK	53886	72487	25228	41283
Austria	4669	13316	2275	36871
Other countries	51397	167817	48029	215806

**Table – 5 : Exports of Tungsten Ores & Conc.
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	32	19244	321	63393
UK	32	19244	313	54216
Germany	-	-	8	9078
Nepal	-	-	++	99

**Table – 6: Imports of Tungsten Ores & Conc.
(By Countries)**

Country	2010-11		2011-12	
	Qty (t)	Value (₹'000)	Qty (t)	Value (₹'000)
All Countries	27	900	327	5179
Israel	-	-	277	3516
Nigeria	-	-	25	858
China	-	-	25	805
Other countries	27	900	-	-

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**Table – 7: Imports of Tungsten & Alloys Incl. Scrap
(By Countries)**

Country	2010-11		2011-12	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Countries	404654	848380	637994	1634925
China	176132	379690	216906	790956
USA	33473	66804	93878	209767
Rep.of Korea	46411	110168	70314	184329
Germany	60099	107476	37937	125993
Singapore	12384	33738	45131	66601
Netherlands	1694	2528	5289	41643
Japan	21993	50369	52037	30835
Austria	8137	24929	13410	28623
France	1507	2884	8865	25029
UK	5212	10150	32250	21122
Other countries	37612	59644	61977	110027

**Table – 8 : Imports of Tungsten
(By Items)**

Item	2010-11		2011-12	
	Qty (kg)	Value (₹'000)	Qty (kg)	Value (₹'000)
All Items	404654	848380	637994	1634925
Tungsten & alloys, unwrought	186336	352787	305291	670619
Tungsten filament	32670	69059	52147	102325
Tungsten wire	131470	349722	258773	616945
Tungsten, unwrought	30809	58870	21783	245036
Tungsten scrap	23369	17942	-	-

FUTURE OUTLOOK

World tungsten supply will continue to be dominated by Chinese production and

exports. In India, the entire demand can only be met by imports, as there is no indigenous production of tungsten concentrates.