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(Part- III : MINERAL REVIEWS)

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ASBESTOS

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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

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2 Asbestos

Asbestos is a group of six naturally occurring fibrous silicate minerals. The physical properties, besides fibrous character, such as, fineness, flexibility, tensile strength & length of fibres, infusibility, low heat conductivity and high resistance to electricity & sound as also to corrosion by acids, make asbestos commercially important. Commercial asbestos is classified into two main mineralogical groups: serpentine asbestos or chrysotile asbestos and amphibole asbestos. The latter includes asbestos minerals, such as, tremolite, actinolite, anthophyllite, amosite and crocidolite. Commercially, chrysotile asbestos is far superior in physical properties and hence more valuable than amphibole asbestos.

India's asbestos requirement is met through imports from Russia, Kazakhstan, Brazil and China.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total reserves/resources of asbestos in the country as on 1.4.2015 have been placed at 22.95 million tonnes. Out of these, 0.025 million tonnes are placed under reserves and 22.92 million tonnes are remaining resources. Out of the total resources, Rajasthan accounts for 13.61 million tonnes (59%) and Karnataka 8.28 million tonnes (36%). The remaining five per cent resources are estimated in States of Jharkhand, Andhra Pradesh, Odisha and Uttarakhand (Table-1).

Table-2 summarises the mineralogical varieties of asbestos occurring in various parts of the country.

PRODUCTION & STOCKS

No production of asbestos was reported in 2017-18 as well as in the previous year and there were no reporting mines in 2017-18 as well as in preceding year.

The mine-head closing stocks of asbestos remained 'Nil' for the year 2017-18 as well as in the preceding year 2016-17.

Table – 2 : Occurrences of Asbestos in India

State	District	Mineralogical variety
Andhra Pradesh	Cuddapah	Chrysotile
Jharkhand	Singhbhum (East) Singhbhum (West)	Chrysotile, tremolite, chrysotile mixed with other minerals
Karnataka	Chikkamagaluru Hassan Mandya Mysuru Shivamogga	Amosite Anthophyllite Mixed amphibole minerals Chrysotile Amosite
Odisha	Kendujhar	-
Rajasthan	Ajmer Bhilwara Dungarpur Pali Rajsamand Udaipur	Mixed amphibole minerals -do- -do- Tremolite, chrysotile mixed with other amphibole minerals Tremolite, actinolite and mixed amphibole minerals Chrysotile, tremolite and mixed amphibole minerals
Uttarakhand	Chamoli	Others

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

(In tonnes)

Grade/State	Reserves				Remaining Resources								Total Resources (A+B)
	Proved STD111	Probable		Total (A)	Feasibility STD211	Pre-feasibility		Measured STD331	Indicated STD332	Inferred STD333	Reconnaissance STD334	Total (B)	
		STD121	STD122			STD221	STD222						
All India : Total	**20016**	**-**	**4617**	**24633**	**2488167**	**3114728**	**4064178**	**100687**	**2527959**	**10569233**	**57800**	**22922751**	**22947384**
By Grades													
Chrysotile	-	-	-	-	684838	40408	18200	2885	17660	67915	-	831905	831905
Amosite	-	-	-	-	-	-	-	-	3987	4459680	-	4463667	4463667
Tremolite	-	-	-	-	-	94768	116516	-	2426700	1562125	-	4200109	4200109
Chrysotile mixed with others	-	-	-	-	-	3871	18309	-	-	336	-	22516	22516
Mixed Amphibole	-	-	-	-	1743560	2642595	3745856	87802	42101	4121718	-	12383632	12383632
Actinolite	-	-	-	-	-	-	-	-	311	34000	-	34311	34311
Anthophyllite	-	-	-	-	-	-	-	-	-	20000	-	20000	20000
Others	-	-	-	-	-	332459	99675	-	-	-	-	432134	432134
Not-known	-	-	-	-	59623	627	65467	-	-	279574	57800	463091	463091
Unclassified	20016	-	4617	24633	146	-	155	10000	37200	23884	-	71385	96018
By States													
Andhra Pradesh	20016	-	4617	24633	684984	40408	18355	-	1541	67392	-	812679	837312
Jharkhand	-	-	-	-	-	3871	18309	2885	5769	124059	-	154893	154893
Karnataka	-	-	-	-	-	-	-	-	2441037	5841420	-	8282457	8282457
Odisha	-	-	-	-	-	-	-	10000	37200	9500	-	56700	56700
Rajasthan	-	-	-	-	1803183	3070449	4027514	87802	42101	4526861	57800	13615710	13615710
Uttarakhand	-	-	-	-	-	-	-	-	311	-	-	311	311

Figures rounded off

MINING & MILLING

Presently there is no working mine in India. The usual method of mining chrysotile in Pulivendla Tehsil, Cuddapah district, Andhra Pradesh, was by opening an incline along the dip varying from 20^0 to 25^0, keeping the trap as floor and limestone as roof. Two or three such inclines were converted into a regular underground mine by developing levels and winzes, connecting them and adopting board-and-pillar system of development. In almost all the mines, operations like blasting, hole drilling, hoisting, pumping and ventilation were mechanised.

The run-of-mine was subjected to manual sorting of asbestos-bearing rock (ABR). ABR was then hand-combed for chipping off the asbestos-bearing portion in small pieces of about 2.5 cm for producing asbestos concentrates. From ABR, the serpentine was removed as a waste. The asbestos concentrate was fed manually into hopper of a hammer mill. In hammer mill, asbestos and other minerals were separated and then fed to double-deck screen having 10 to 40 mesh sieves. The screening gives three fractions: (a) oversize, (b) middling, and (c) tailing.

Tailing was taken as a waste which generally did not contain appreciable quantity of asbestos. The oversize was recycled in the hammer mill, and the middling fibre was sucked up by a cyclone and collected.

GRADING & MARKETING

Small fibres recovered through milling process account for nearly a two-third production. The general grading system adopted is as follows:

Grade	Fibre Size	Method
Grade - As	45 mm and above	Hand-sorted
Grade - A	Between 25 and 45 mm	
Grade - B	Between 12 and 25 mm	
Grade - C	Above 16 mesh	Mill-processed
Grade - D3	24 mesh	
Grade - D4	40 mesh	
Grade - D6	60 mesh	

***Note**: Producers of amphibole asbestos sell their output as crude or fluff and powder.*

CLASSIFICATIONS

Various classifications of chrysotile asbestos followed in India are based, by and large, on fibre length:

(1) Grade A or

A Special - 25.4 mm fibres or larger

As1 - 25.4 mm and larger fibres but brittle compared to As or A Special

A - 19.05 to 25.4 mm fibres

A1 - 19.05 to 25.4 mm fibres but brittle compared to A

A2 - 19.05 to 25.4 mm fibres but brittle compared to A1

Grade B - 6.35 to 19.05 mm fibres

B1 - 6.35 to 19.05 mm fibres but brittle compared to B

B2 - 6.35 to 19.05 mm fibres but brittle compared to B1

C - Below 6.35 mm fibres

(2) Grade A Special - Above 31.5 mm

A - Between 19 and 31.5 mm

B - Between 6.3 and 19 mm

C - Below 6.3 mm including powder

D - Dust

3) Quebec standard asbestos testing machine classification of chrysotile asbestos according to groups is given below:

Crude Asbestos

Group No. 1 Crude No. 1:	Consists basically of crude, 3/4 inch and longer staple
Group No. 2 Crude No. 2:	Consists basically of crude, 3/8 to 3/4 inch staple.

Milled Asbestos

Standard designation of grade	Guaranteed minimum spinning test
Group No. 3 (spinning fibres)	
3 D	10.5-3.9-1.3-0.3
3 Z	0-8-6-2
Group No. 4 (shingle fibres)	
4 D	0-7-6-3
4 Z	0-1.5-9.5-5
Group No. 5 (paper fibres)	
5 D	0-0.5-10.5-5
5 R	0-0-10-6
Group No. 6 (waste)	
6 D	0-0-7-9
Group No. 7 (shorts or refuse)	
7 D	0-0-8-11
7W	0-0-0-16
Group No. 7 (floats)*	
7 RF	No test
7 TF	No test
Group No. 8 (sand & gravel)	
8 S	Less than 50 lb per cu ft loose measure
8 T	Less than 75 lb per cu ft loose measure.
Group No. 9 (gravel & stone)	
9 T	More than 75 lb cu ft loose measure

** The suffix 'F' designates 'floats' in the case of 7R and 7T grades.*

USES

Industrial use of asbestos is linked with the type of asbestos. Chrysotile asbestos, being more fibrous and possessing better tensile strength than amphibole variety is used in the manufacture of asbestos fabrics, cement sheets, pipes and allied products. It is also used in brake linings, insulation and fireproof clothing. Short fibres are used with cement as binders for manufacturing asbestos-cement products. Amphibole asbestos generally finds use in heat insulation and treatment of acids. Anthophyllite and tremolite fibres, although of good length, are too weak and brittle to be spun. They are, therefore, used for boiler lagging, hard-setting magnesia composition and as a filler in asbestos paints and various asbestos-moulded articles.

SUBSTITUTION

Materials substituted for asbestos include calcium silicate, carbon fibres, fibres of cellulose, ceramic, glass & steel, wollastonite and several organic fibres like aramid, polyethylene, polypropylene and polytetrafluoroethylene. Where reinforcement properties of fibres are not required, several non-fibrous minerals are also considered for possible substitution. However, no single substitution is found to be as versatile or as cost-effective as asbestos.

ENVIRONMENTAL IMPACT OF ASBESTOS

Asbestos used as a part of construction material due to flame retardant quality poses major risk to human health and environment. Asbestos has been linked with number of serious medical conditions. These include the lungs and respiratory problems because asbestos is made of tiny fibres that when released into the air and prolonged breathing of air laden with asbestos dust can settle inside the lungs and irritate the tissues in the chest cavities. Mesothelioma is a rare form of cancer of the lungs and digestive tract which is most commonly caused by exposure to asbestos mixed air. Besides the personal health, asbestos has negative impact on the environment. A study presented in 2006 at the International Conference on Health, the Environment and Justice found that asbestos dust can easily travel

through the air into the water supply. It can also settle on the surface of the soil instead of getting absorbed into the ground, which means that it can still get picked up by the wind and inhaled into human respiratory system.

However, as per the report of the 'Asbestos Cement Products Manufactures' Association', in India, only chrysotile (white) asbestos fibre is used for manufacturing of asbestos-cement sheets and asbestos-cement pipes which contain a very small quantity of chrysotile fibre (only 8-10%). The other raw materials used are cement 45%, fly ash 30-35% and wood pulp. The asbestos fibres are firmly locked-in or encapsulated within the cement matrix during manufacture so that fibres cannot be emitted into the atmosphere under normal use and thus, pose no health risk to the general public or environment. Several studies abroad have concluded that use of chrysotile in the manufacture of Asbestos Cement Products under controlled conditions is safe for the workers, environment and the general public.

India has again opposed the listing of chrysotile asbestos as a hazardous substance under the Rotterdam Convention at the eighth meeting of the Conference of Parties (COP) held in Geneva from 24th April to 5th May 2017.

TRADE POLICY & LEGISLATION

No restrictions have been imposed on exports of asbestos in the Foreign Trade Policy, 2015-20. As per the prevailing Foreign Trade Policy, asbestos under heading 2524 can be imported freely with the exception of amosite which is restricted. However, the imports of crocidolite, actinolite, anthophyllite, amosite and tremolite are restricted in terms of Interim Prior Informed Consent (PIC) Procedure of Rotterdam Convention for Hazardous Chemicals and Pesticides.

Ministry of Environment and Forest, vide Notification dated 13.10.1998, under Sections 3 (1) and 6 (2) (d) of Environment (Protection) Act, 1986 and Rule 13 of Environment (Protection) Rules, 1986, has prohibited the imports of waste asbestos (dust and fibre), being a hazardous waste detrimental to human health and environment.

WORLD REVIEW

Large reserves are located mainly in China and Kazakhstan. The world production of asbestos remained unchanged to 1.3 million tonnes in 2017 as compared to 2016. Russia was the leading producer and accounted for 55% production followed by China, Brazil and Kazakhstan (15% each) (Tables-3 and 4).

Table – 3 : World Reserves of Asbestos (By Principal Countries)

(In million tonnes)

Country	Reserves
World: Total	**Large**
Brazil	12
China	96
Kazakhstan	Large
Russia	110
USA	Small

Source: *Mineral Commodity Summaries, 2019.*

Table – 4 : World Production of Asbestos (By Principal Countries)

(In '000 tonnes)

Country	2015	2016	2017
World: Total (rounded off)	**1300**	**1300**	**1300**
Brazil	232	200	200
China[e]	210	200	200
Kazakhstan	180	192	193
Russia	650	692	710

Source: *World Mineral Production, 2013-2017, BGS.*

FOREIGN TRADE

Exports

Exports of asbestos increased substantially by 29% to 132 tonnes in 2017-18 as compared to 102 tonnes in the previous year. Exports were mainly to Bangladesh (more than 90%) and Nepal 6%. Exports of asbestos (fibre products) were at 35,812 tonnes in 2017-18 as compared to 33,973 tonnes in the previous year. Exports were mainly to USA (26%), Egypt (8%), UAE (7%), Poland and Canada (3% each), Sri Lanka and South Africa (2% each). Export of asbestos (chrysotile) was only one tonne during the year 2017-18 as compared to 26 tonnes in the preceding year. Exports of asbestos (others) increased to 131 tonnes during the year 2017-18 as compared to 76 tonnes in the preceding year. Exports were almost to Bangladesh. Exports of asbestos-cement products were 62,291 tonnes in 2017-18 as compared to 69,125 tonnes in the preceding year. Exports of asbestos-cement products were mainly to UAE (34%), Qatar (18%), Nepal (15%), Saudi Arabia (7%) and Oman (4%) (Tables - 5 to 9).

Imports

Imports of asbestos were 3,57,182 tonnes in 2017-18 against 3,10,592 tonnes in the previous year. Entire import was that of chrysotile asbestos. Imports of asbestos were mainly from Russia (63%), Brazil (21%) and Kazakhstan (16%). A total of 29,031 tonnes asbestos-cement products were also imported in 2017-18 as against 28,416 tonnes in the previous year. Imports were mainly from Thailand (89%) and China (3%). Besides above, asbestos-fibre of 3,57,182 tonnes was also imported during the year 2017-18 as compared to 3,10,592 tonnes in the previous year. Imports of asbestos-fibre were mainly from Russia (63%), Brazil (21%) and Kazakhstan (16%). Imports of asbestos fibre products were 4,479 tonnes during the year 2017-18 as compared to 5,227 tonnes in previous year. Imports of asbestos fibre products were mainly from Japan (34%), China and USA (15% each) and Thailand (8%). In addition to asbestos minerals, an unknown quantity of asbestos is traded within manufactured products, possibly including brake linings and pads, building materials, gaskets, millboard, yarn and thread (Tables-10 to 15).

Table – 5 : Exports of Asbestos (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**102**	**963**	**132**	**943**
Bangladesh	16	495	131	847
Nepal	76	250	1	55
Kenya	-	-	++	40
Thailand	-	-	++	1
UAE	10	218	-	-

Table – 6 : Exports of Asbestos (Fibres Products) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**33973**	**4523801**	**35812**	**4636850**
USA	7971	1217412	9149	1281826
UAE	2204	309045	2465	337495
Egypt	2622	191770	2946	200677
Canada	998	139677	1168	169813
Poland	1099	153458	1009	142218
Sri Lanka	990	158846	844	138226
Nepal	578	94039	791	134253
Thailand	688	139046	653	123289
South Africa	897	107359	852	109493
Spain	402	63161	546	104060
Other countries	15524	1949988	15389	1895500

Table – 7 : Exports of Asbestos (Chrysotile) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (``'000)	Qty (t)	Value (``'000)
All Countries	**26**	**395**	**1**	**95**
Nepal	16	117	1	55
Kenya	-	-	++	40
UAE	10	218	-	-

Table – 8 : Exports of Asbestos (Others) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (``'000)	Qty (t)	Value (``'000)
All Countries	**76**	**568**	**131**	**848**
Bangladesh	16	495	131	847
Thailand	-	-	++	1
Nepal	60	73	-	-

Table – 9 : Exports of Asbestos Cement Products (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (``'000)	Qty (t)	Value (``'000)
All Countries	**69125**	**1166022**	**62291**	**974759**
UAE	28070	393279	21417	284613
Nepal	6088	200362	9604	185445
Qatar	5574	86612	11395	165299
Saudi Arabia	15898	219741	4472	56298
Oman	1708	25571	2570	38607
Maldives	1057	18610	1477	30585
Angola	1490	21697	1709	22959
Sri Lanka	1240	25198	1152	19894
UK	333	5944	1298	18219
South Africa	579	13474	765	16563
Other countries	7088	155534	6432	136277

Table – 10 : Imports of Asbestos (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (``'000)	Qty (t)	Value (``'000)
All Countries	**310592**	**11279369**	**357182**	**11603678**
Russia	208696	7791467	225255	7286072
Brazil	37280	1341595	74560	2580637
Kazakhstan	63497	2110813	55851	1680885
Switzerland	-	-	675	27622
China	1005	32011	705	24750
Poland	68	1851	136	3577
Colombia	-	-	++	135
Marshall Island	46	1632	-	-

Table – 11 : Imports of Asbestos (Chrysotile) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (``'000)	Qty (t)	Value (``'000)
All Countries	**310592**	**11279369**	**357182**	**11603543**
Russia	208696	7791467	225255	7286072
Brazil	37280	1341595	74560	2580637
Kazakhstan	63497	2110813	55851	1680885
Switzerland	-	-	675	27622
China	1005	32011	705	24750
Poland	68	1851	136	3577
Marshall Island	46	1632	-	-

Table – 12 : Imports of Asbestos (Others) (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (``'000)	Qty (t)	Value (``'000)
All Countries	-	-	++	**135**
Colombia	-	-	++	135

Table – 13 : Imports of Asbestos Cement Products (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**28416**	**526153**	**29031**	**535896**
Thailand	25295	429339	25715	419480
China	2135	51673	993	20751
Mexico	-	-	727	19842
USA	127	16497	45	19129
Bangladesh	-	-	222	18916
Turkey	-	-	18	7695
Indonesia	376	5841	467	7242
Germany	30	3765	206	6822
Philippines	167	4069	249	6332
Malaysia	256	5120	341	5223
Other countries	30	9849	48	4464

Table – 14 : Imports of Asbestos Fibre (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**310592**	**11279369**	**357182**	**11603543**
Russia	208696	7791467	225255	7286072
Brazil	37280	1341595	74560	2580637
Kazakhstan	63497	2110813	55851	1680885
Switzerland	-	-	675	27622
China	1005	32011	705	24750
Poland	68	1851	136	3577
Marshall Island	46	1632	-	-

Table – 15 : Imports of Asbestos Fibre Products (By Countries)

Country	2016-17		2017-18	
	Qty (t)	Value (`'000)	Qty (t)	Value (`'000)
All Countries	**5227**	**2711359**	**4479**	**2994152**
Japan	1812	1176347	1544	1370690
Germany	235	280996	205	272636
Thailand	409	241875	377	272036
China	1422	203075	674	190233
USA	180	109268	656	188825
Korea, Rep. of	108	137857	130	153384
Denmark	124	63872	173	124292
Spain	69	63503	65	59862
Philippines	506	184740	233	58895
Austria	6	5540	64	46332
Other countries	356	244286	358	256967

FUTURE OUTLOOK

Consumption of asbestos minerals in India & other countries of the world will decline steadily in near future. This decline will be due to health and liability issues associated with asbestos use, leading to the displacement of asbestos from traditional domestic markets by substitutes, alternative materials and new technology globally.

While the economic impact of asbestos mining in India is minimal, mining operations nevertheless pose significant adverse consequences for human and environmental health. Globally, asbestos-cement products are expected to continue to be the leading market for asbestos. All the while India's import of chrysotile asbestos continues to grow significantly. Owing to continued demand for asbestos products in many regions of the world, global production is likely to remain steady at approximately 2.0 million tonnes per year for the near future as per USGS report on asbestos.