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(Part- III : Mineral Reviews)

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MINOR MINERALS

30.12 GYPSUM (MINOR) and SELENITE (MAJOR)

(FINAL RELEASE)

GOVERNMENT OF INDIA
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30-12 Gypsum

Gypsum ($CaSO_4.2H_2O$) is a hydrated calcium sulphate used widely in various industries because of its special property of losing three-fourth of the combined water of crystallisation when moderately heated (calcined) to about 130ºC. Besides, calcined gypsum when cooled, finely ground and made plastic with water can be spread out, cast or moulded to any desired surface or form. On drying, it sets into a hard rock-like form. Selenite is a colourless, transparent, naturally occurring crystalline variety of gypsum and is used extensively in Ceramic Industry and for manufacturing surgical grade plaster of Paris, whereas alabaster is a fine-grained, massive variety, white or shaded in colour. Silky and fibrous variety of gypsum is called satin spar. Anhydrite ($CaSO_4$) is a calcium sulphate mineral found associated with gypsum commonly as a massive or fibrous mineral.

Gypsum that occurs in nature is called mineral gypsum. In addition to mineral gypsum, seawater and some chemical and fertilizer plants are sources of by-product marine gypsum and by-product chemical gypsum, respectively. The latter is obtained as by-product phospho-gypsum or fluoro-gypsum or boro-gypsum, depending upon the source. Phosphoric acid plants are important sources of by-product phospho-gypsum.

Marine gypsum is recovered from salt pans during production of common salt in coastal region, particularly in Gujarat and Tamil Nadu. The recovery of by-product gypsum and marine gypsum together is substantial and is comparable with the production of mineral gypsum.

FGD Gypsum is a unique synthetic product derived from flue gas desulphurisation (FGD) systems at electric power plants. Sulphur dioxide emission control systems used by coal-fired power plants remove sulphur from combustion gases using 'scrubbers'. In addition to FGD gypsum, synthetic gypsum includes materials such as phospho-gypsum, titano-gypsum, fluoro-gypsum and citro-gypsum.

Various grades of gypsum (as per $CaSO_4.2H_2O$ content) are produced and consumed by industries like cement, fertilizer plants, plaster of Paris etc. Gypsum also acts as a neutralising agent and helps in improving soil permeability.

In gypsum, calcium or magnesium carbonate, chlorides, other sulphate minerals, clay minerals or silica are considered as deleterious constituents. As a result, mostly mine production of gypsum possess purity ranging between 70 to 95%.

RESERVES/RESOURCES

As per NMI database, based on UNFC system, the total reserves/resources of mineral gypsum in India as on 1.4.2015 have been estimated at 1,330 million tonnes of which 37 million tonnes have been placed under 'Reserves' and 1,293 million tonnes under 'Remaining Resources' category.

Of the total reserves/resources, Fertilizer/ Pottery grade accounts for about 80% and Cement/Paint grade 13%. The Unclassified and Not-known grades together account for 5% resources. The remaining two percent of resources is shared by Surgical Plaster and Soil Reclamation grades. By States, Rajasthan alone accounts for 81% resources, Jammu & Kashmir 14% and Tamil Nadu 2% resources. The remaining 3% resources are in Gujarat, Himachal Pradesh, Karnataka, Uttarakhand, Andhra Pradesh and Madhya Pradesh (Table- 1).

EXPLORATION & DEVELOPMENT

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

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

(In '000 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	**35141**	**311**	**1169**	**36621**	**10826**	**93127**	**33419**	**9071**	**713834**	**428097**	**4518**	**1292892**	**1329513**
By Grades													
Surgical Plaster	621	-	-	621	-	1039	82	-	-	3773	-	4894	5515
Fertilizer/Pottery	18933	-	45	18978	2296	9266	270	7680	703244	320454	-	1043211	1062189
Cement/Paint	11547	311	691	12549	7980	82430	30372	1148	3184	39191	10	164315	176864
Soil reclamation	-	-	-	-	185	392	2573	100	206	7939	2180	13576	13576
Unclassified	367	-	46	413	3	-	116	78	5548	33548	2328	41621	42034
Not-known	3670	-	387	4057	356	-	-	66	1652	23191	-	25265	29322
Others	3	-	-	3	5	-	5	-	-	-	-	11	14
By States													
Andhra Pradesh	-	-	-	-	-	-	-	-	-	404	-	404	404
Gujarat	4	5	24	33	4	-	-	616	308	15446	-	16374	16407
Haryana	-	-	-	-	-	-	-	-	-	-	2180	2180	2180
Himachal Pradesh	-	-	-	-	-	-	1365	-	-	3081	-	4446	4446
Jammu & Kashmir	11383	153	442	11977	4602	9844	6570	7680	2673	146914	2328	180610	192588
Karnataka	-	-	-	-	-	-	-	-	-	3784	-	3784	3784
Madhya Pradesh	-	-	-	-	-	-	-	-	-	69	-	69	69
Rajasthan	23617	153	658	24428	6201	82814	18663	750	710604	236847	-	1055878	1080306
Tamil Nadu	137	-	46	183	19	469	6786	25	249	19540	10	27099	27282
Uttarakhand	-	-	-	-	-	-	35	-	-	2012	-	2047	2047

Figures rounded off

PRODUCTION

As per Govt. of India Notification S.O.423(E) dated 10.02.2015, 'Gypsum' has been declared as a 'Minor Mineral', hence, the production data is not available with IBM.The mineral 'Selenite' has not been included in the list of minor mineral by name, hence, it is covered in this review. The details of producer of selenite is furnished in Table-2.

Table – 2 : Principal Producer of Selenite, 2015-16

Name & Address of Producer	Location of Mines	
	State	District
Rajasthan State Mines & Minerals Ltd, C 89-90, Janpath, Lal Kothi Scheme, Jaipur –302 015, Rajasthan.	Rajasthan	Barmer Bikaner

Selenite

M/s RSMML, a public sector company, is a leading producer of natural gypsum and selenite variety, producing from Thar desert areas of Rajasthan. Gypsum with (+)70% $CaSO_4.2H_2O$ purity produced by RSMML fulfils the demands of the cement industries and powder gypsum is used by farmers as a direct fertilizer for re-conditioning of alkaline soils for reducing alkanity and improving crop production.

Production of Selenite was 4327 tonnes in 2016-17, all of which was from 3 public sector deposits in Rajasthan.

The production of selenite was 3,103 tonnes in the year 2015-16 as against 207 tonnes during the previous year. The entire production of selenite was reported by Rajasthan State Mines & Minerals Ltd (RSMML), a Public Sector Undertaking, that operates three mines, two in Barmer and one in Bikaner district of Rajasthan.

There were no mine-head closing stocks of selenite at the end year 2014-15 and 2015-16.

The average daily labour employed in selenite mines during 2015-16 was 21 as against 12 in the previous year (Tables-3 to 5).

Table – 3 : Production of Selenite, 2016-17
(By Sector/State)

(Qty in tonnes; Value in `'000)

State/District	No. of mines	Quantity	Value
India	**3**	**4327**	**9211**
Public sector	3	4327	9211
Rajasthan	**3**	**4327**	**9211**

Table – 4 : Production of Selenite, 2013-14 to 2015-16
(By State)

(Qty in tonnes; Value in `'000)

State	2013-14		2014-15		2015-16 (P)	
	Quantity	Value	Quantity	Value	Quantity	Value
India/ Rajasthan	**531**	**706**	**207**	**456**	**3103**	**6938**

Table – 5 : Production of Selenite, 2014-15 and 2015-16
(By Sector/State/Districts)

(Qty in tonnes; Value in `'000)

State/District	2014-15			2015-16 (P)		
	No. of mines	Quantity	Value	No. of mines	Quantity	Value
India	**2**	**207**	**456**	**3**	**3103**	**6938**
Public sector	2	207	456	3	3103	6938
Rajasthan	**2**	**207**	**456**	**3**	**3103**	**6938**
Barmer	1	207	456	2	3103	6938
Bikaner*	1	-	-	1	-	-

******Only labour reported.*

MINING AND MARKETING

Gypsum deposits are usually found at shallow depths and are scattered over large areas. The deposits are mined out by opencast method and usually by manual mining except a few semi-mechanised mines in Rajasthan. In semi mechanised mines, gypsum is excavated by back-hoe excavator and directly loaded into trucks/ dumpers. The trucks and dumpers loaded with gypsum are despatched directly to the user- industry or are taken to railway siding for further loading into railway wagons for dispatch to far living user industry. In some mines of Rajasthan, the excavated gypsum is ground before despatching to the user or party. Based on the use of gypsum, the production is classified into different grades like Fertilizer grade, Cement grade, plaster of Paris grade, Surgical grade, etc.

Gypsum is mostly mined in Barmer, Bikaner and Jaisalmer & Sriganganagar districts of Thar desert region of Rajasthan by M/s.FAGMIL (15 mines) and RSMML companies. Some gypsum mines in Bikaner district also produce crystalline variety, i.e., selenite. Gypsum from Rajasthan is despatched to cement plants in India spread over Rajasthan, Gujarat, Madhya Pradesh, West Bengal, Uttar Pradesh, Bihar, Jharkhand, Chhattisgarh, Himachal Pradesh, etc. Besides, a substantial quantity, containing about 60-70% $CaSO_4.2H_2O$ is supplied to Punjab, Uttar Pradesh, Haryana, Delhi, etc. for reclaiming alkaline soil. A sizeable quantity of gypsum from mines in Barmer, Bikaner, Jaisalmer, Hanumangarh, Sri Ganganagar and Nagaur districts of Rajasthan is also supplied to the plaster of Paris units in Rajasthan, Uttar Pradesh, Haryana, Maharashtra, West Bengal, Delhi, etc.

M/s Saint Gobain Gyproc India Ltd and Boral Gypsum India Pvt Ltd are among the market leaders in plaster of Paris industries and specialise in dry construction techniques.

USES AND SPECIFICATIONS

Cement, fertilizer (ammonium sulphate) and plaster of Paris are the three important industries in which gypsum is utilised. Gypsum of less purity in crushed form is utilised in portland cement manufacturing for controlling the setting time of portland cement (i.e. as a retarder to prevent quick set). It is added to the clinker just before final grinding to finished cement. Proportion of gypsum in Cement Industry is 4-5% of the cement produced. Both, mineral and by-product gypsum are used in cement manufacture.Calcined gypsum finds use in manufacturing plaster of Paris. It is also used in manufacturing partition blocks, sheets & tiles, insulation boards for stucco and lattice works. Gypsum board is primarily used as a finish for walls and ceilings. It is also used as a binder in fast dry tennis court clay. Low-grade gypsum is calcined and used as gypsum plaster after preparation of mortar. It is used for internal plastering and masonry work. Requirement of low-grade gypsum for use in Building Industry as per IS:12654-1989 (Reaffirmed 2010) is: $CaSO_4.2H_2O$ not less than 60%. In pottery, calcined gypsum is used for preparation of moulds in the production of sanitarywares. The used and discarded moulds are in turn again used as source of gypsum in cement and other industries. Low-grade gypsum is used in conditioning of alkaline soil and as manure in agriculture mainly for correcting black alkali soils. BIS has also prescribed IS:6046-1982 (First Revision; reaffirmed 2008) for gypsum for agricultural use.

Selenite, a crystalline variety is used to a limited extent for gypsum plate for petrological microscopes, known as Sensitive Tint. It is also used in the Ceramic Industry for making moulds to manufacture surgical grade plaster of Paris and also for producing white cement. Plaster of paris Industry requires high purity gypsum. Different grades of plaster of Paris are manufactured depending upon the period for setting. For surgical plaster, a minimum 96% $CaSO_4.2H_2O$ grade gypsum is required.

High-purity gypsum can be utilised for manufacturing of ammonium sulphate fertilizer. Ground pure white gypsum is also used as a filler in paper, paints and textile goods. Ground low-grade gypsum is used in mine dusting, manufacture of black board chalks and as a filler in insecticides. Besides, gypsum is also used in other industries like pharmaceutical, textile and asbestos products.

Alabaster, a dense, massive, granular and translucent variety, is employed as ornamental stone in statuary and interior decoration.

BIS specification for by-product gypsum (IS:10170-1982, reaffirmed 2008) lays down a minimum 70% content of $CaSO_4.2H_2O$ and maximum limit of 0.75% Na, 1.0% F and 15% free moisture on dry basis. The material should pass through 2 mm sieve, but 50% of material should also pass through 0.25 mm (60 mesh) sieve. The specifications of by-product gypsum for use in plaster, blocks and boards are as per IS:12679-1989 (reaffirmed 2010). Besides, BIS has prescribed IS:1290-1973 (Second Revision; reaffirmed 2011) for mineral gypsum.

CONSUMPTION

Substantial quantity of mineral gypsum as well as phospho-gypsum was used in agricultural sector for conditioning of alkaline soil and in Cement Industry. The remaining nominal consumption was in plaster of paris, asbestos products, ceramic, fertilizer, refractories, textile, pharmaceutical and paint industries. The entire quantity of marine gypsum and gypsum moulds was also consumed in cement and ceramic industries respectively.

WORLD SCENARIO

The world reserves of gypsum are large. China was the largest producer of gypsum followed by Iran, Thailand, USA, Iraq, Turkey, Spain, Mexico, Oman, Japan, Russia, Germany and Australia.

TRADE POLICY

As per 'Export-Import Policy, 2015-2020, gypsum, anhydrite, plasters (consisting of calcined gypsum or calcium sulphate) whether or not coloured, with or without small quantities of accelerators or retarders are free under import policy under heading 2520.

FUTURE OUTLOOK

India's domestic resources of gypsum are large enough to meet increased demand. The apparent domestic demand of gypsum was estimated at 8.71 million tonnes by 2016-17 at 9% growth rate as per the Report of the Working Group for 12th Plan, Planning Commission of India.

With renewed focus on improving the economy and upscaling industrial developments, India lays greater emphasis on creation of infrastructure. As per the Working Group report, augmentation of infrastructural activities will endanger further growth of the Cement Industry which concomitantly will raise the consumption of gypsum and therby its demand, with consequence, leading to increased dependence on imports and synthetic gypsum to meet cement demand. Further, as per the report, steps would be necessary to find out suitable mining technology to exploit, deep-seated gypsum resources in Bhadvasi deposit, Nagaur district Rajasthan. State-of-the-art-technology needs to be adopted for the exploitation of deep-seated gypsum.

Other segments that would attract attention would be production of gypsum wallboard which is currently negligible in India. It could find better prospects because of its light weight and other special characteristics. It being an excellent partition material could facilitate its utility in high rise building constructions. In view of the environmental problem arising from huge accumulation of phospho-gypsum at different fertilizer plants, possibilities of finding other possible means for its utilisation has become a necessity. Low-grade gypsum being cheaper could find better prospects in its application more as a soil conditioner for reclamation of alkaline soils.