

Gypsum: Resources of Bikaner and New Prospective Areas

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Abstract- Gypsum is a naturally occurring mineral produced in many parts of the India and the world. Chemically it is hydrated calcium sulfate. The chemical formula for pure gypsum is $\text{Ca}(\text{SO}_4) \cdot 2(\text{H}_2\text{O})$. In the chemically pure form, gypsum contains 23.28% calcium (Ca) and 18.62% sulfur (S) in the readily available sulfate form (SO_4). However, the typical gypsum sources that are commercially available for agricultural often contain impurities which result in a Ca level between 16%-23% Ca and 15%-19%. Rajasthan produces 99% of the total mineral Gypsum production in India. And most promising deposit occurs in Bikaner Distt. As demand is increasing so there is need for prospecting new promising areas of Gypsum/Gypsite. This research paper would help in meeting the increasing demand of natural Gypsum with the search of new deposits in Bikaner Distt. It would also help in generating revenues to the Govt.

Index Terms- Mineral Gypsum, new deposits, prospecting works.

I. INTRODUCTION

Gypsum is a hydrated sulphate of calcium which occurs as white opaque or transparent mineral in beds in Thar desert of Rajasthan in India. Such deposits are seen in Bikaner area. Except this it also occurs in bands in sedimentary formations such as limestones, sandstones and shales. In some cases it occurs as transparent crystals associated with clays (Gothmanglod deposits of Nagaur).

Distribution:-

Gypsum deposits are known to exist in several parts of India. The more well-known gypsum-bearing regions are in Rajasthan and in South India, but smaller deposits occur also in Tehri-Garhwal, Himachal Pradesh and parts of western India. The latter have not been fully explored yet. Northern India-Small deposits of gypsum as pockets and thin beds are also known to occur in the Dehra Dun, Nainital and Tehri-Garhwal regions of Uttar Pradesh. The reserves are estimated at about 200,000 tons. Among the other deposits are those in the Sirmur district of Himachal Pradesh, which are estimated to contain about 1 million tons, and small deposits in Bhutan, Kashmir and Rewa (Vindhya Pradesh) for which no estimates of the reserves are available. Gypsum in veins and thin beds and as crystals distributed in sedimentary strata is also found in Saurashtra and Kutch. The reserves are estimated at 6.4 million tons. The in situ reserves of gypsum are estimated at 383 million tonnes. Out of this two million tonnes are of surgical/plaster grade, 92 million tonnes of fertilizer/pottery grade, 76 million tonnes of cement/paint grade,

13 million tonnes of soil reclamation grade and the rest is unclassified. The total recoverable reserves of all grades of gypsum in Rajasthan are of the order of 105.5 million tonnes. With few exceptions, gypsum in India occurs mostly in thin beds, veins, lenses and as isolated clusters of crystals in various formations. Anhydrite, a common associate of gypsum has not been noticed in the known gypsum deposits in India.

However, 99% of Total Indian Production of natural Gypsum is from Rajasthan only. In which major production dist. are Bikaner, Sri-Ganganagar and Nagaur. They vary in thickness from a few inches to 10 ft. and over. Reserves have been roughly estimated to exceed 40 million tons.

Uses:

It is an essential constituent of cement, though its proportion is only 4-5 per cent. It is also used in making plaster of Paris, moulds in ceramic industry, nitrogen chalk, partition blocks, sheets, tiles, plastics, etc. It is conveniently applied as surface plaster in agriculture for conserving moisture in the soil and for aiding nitrogen absorption. Gypsum had many uses in addition to agriculture. A partial list of products and processes that use gypsum includes blackboard chalk, cement, wall board, Plaster of Paris, dental moulds, paint filler, toothpaste, molds for casting metals, Tofu coagulation, improving mineral content of brewing water, dietary calcium additives in breads and cereals, and pharmaceuticals.

II. GEOLOGY OF BIKANER

Topographically sediments of Bikaner basin are elongated in shape and occurs in two distinctly separated areas separated by an arcuate high of Marwar Super gp. Origin. The Tertiary sequence contains sediments of continental and marine origin deposited over the Neoproterozoic Nagaur Group (Marwar Sup. Gp.) of rocks. It is represented by the Palana, Marh and Jogira Formations in ascending order having conformable contacts. It is bound on the north and south by East-West trending faults and marked by basement highs at Dulmera and adjoining areas. The Bikaner basin or the Palana – Ganganagar shelf, is an East-West trending elongated basin extending for about 200 kms, with a maximum width of about 50 kms in north-south direction. The basin preserves Palana and Sri Ganganagar embayments, enclosed eastwards, connecting with the Indus basin. The entire area is under thick wind-blown sand cover of Thar desert.

III. GENERAL STRATIIONGRAPHY OF BIKANER BASIN

AGE	FORMATION
Pleistocene to Recent	Kolayat Formation
~~~~~ Unconformity ~~~~~	
Early to Middy Eocene	Jogira Formation ( Calcareous Facies)
~~~~~ Angular Unconformity ~~~~~	
*Late Paleocene (?)	Marh Formation (Arenaceous Facies)
**Early Paleocene (?)	Palana Formation (

Carbonaceous Facies)
~~~~~ Base not encountered ~~~~~

Tertiary formation of Bikaner Nagaour basin ( After Ghose, 1983 a).

*The formation had been described to be of Early Eocene ( Bhandari, 1999).

** The Formation has been described to be of Eocene ( La Touche, T.D. 1897; Rao and Vimal, 1952).

IV. TECTONO-SRATIOGRAPHY OF BIKANER BASIN

	Geological Age	Formation Thickness in (m)	Depositional Enviornment	Tectono Depositional System
Quaternary	Pleistocene Recent	Alluvium (80-85)	Shallow Water	Upliftment Clastic Dominant System
Tertiary	Paleocene-Eocnene	Palana & Marh Formation (20-110)	Shallow Marin	
Mesozoic	Cretaceous	Parh Epy. Fm (30-35)	Terrestrial	
	Jurrassic	Lathi Epy. Fm ( 290-380)		
Paleozoic	Permo-Triassic	Bap & Badhura Fm ( 55-65)	Fluvio - Glacial	
	Cambrian	Up. Carbonate Fm.(250-600)	Transgressive Marine	Post rift Clastic Carbonate System
			Nagaur Fm (150-190)	
Proterozoic	Infra Cambrian	Hanseran Evaportite Fm ( 160-150)	Intertidal Evaporite Transgressive Marine	Syn rift Clastic Carbonate System
		Bilara Fm.(50-55)		
		Jodhpur Fm(25-35)	Fluvia	
	Pre-Cambrian	Malani Ign. Suite		Volcanism

V. GYPSUM DEMAND AND SUPPLY

The Principal consumer of mineral Gypsum is construction sector. Construction Industry in India is increasing with the avege growth of 11% per annum .Cement is the primary requirement of this Sector. With the increase in GDP the investment in Infrastructure in India increased and as the demand of Cement Increased the demand of natural Gypsum also increased.

The cement industry in India is continuously growing. According to various research reports and in view of the upcoming massive infrastructure developments, the Indian cement consumption is expected to increase at a rate of 9-11 % per year. The rising costs of raw materials like gypsum and coal have been playing a heavy strain on the cement and construction

industry. As result, there is enormous need to explore new deposits of natural gypsum.

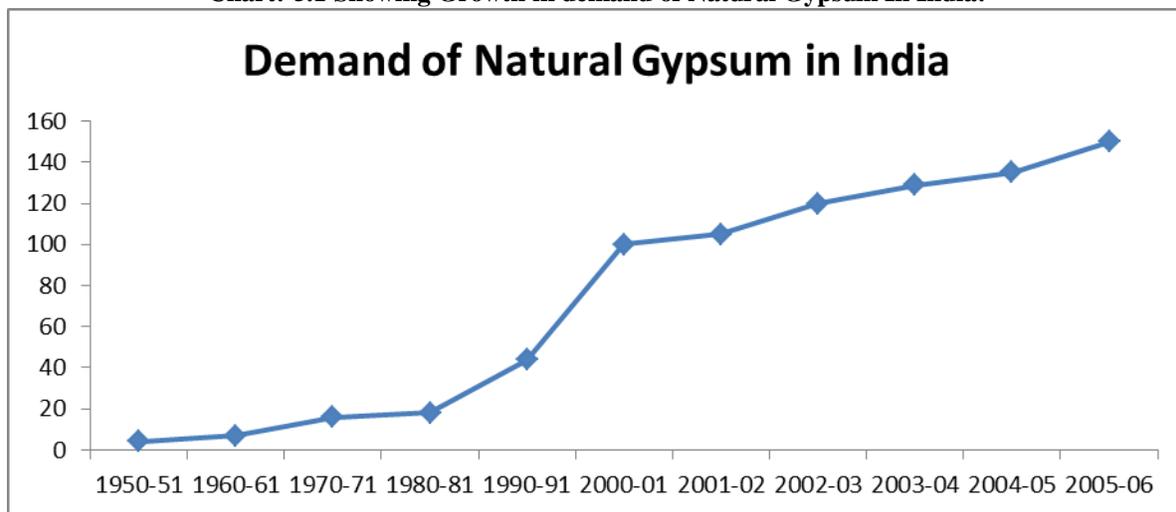
On the basis of these projected cement production growth figures, as per the base line, India’s cement industry will be requiring over 428 million tonnes of gypsum during the next 15 years against the local gypsum resources (natural and as by-product) of around 115 million tonnes, which means India depends on over 313 million tonnes of gypsum through imports. Natural gypsum will remain the primary source of cement commodity for decades to come. There is presently no substitute for gypsum in the production of cement. In Rajasthan there were 33 reporting mines during the year as against 38 in the preceding year. Two principal producers i.e RSMML and FAGMIL together accounted for about 99% of the total production of gypsum.Five mines producing above 2 lakh tonnes annually contributed 70% of total production, 2 mines producing between one to two lakh tonnes contributed 9% of the total production, 3

mines producing between 50 thousand tonnes to 1 lakh tonnes contributed 7% of total production, 15 mines producing between 10 thousand to 50 thousand tonnes accounted for 13% of total Production of natural Gypsum is on decreasing Trend by 11 % per year against it the demand of Gypsum is increasing. The major deficit in the production of natural gypsum is due to inconsistent quality of natural gypsum. Due to this inconsistency

cement sector had started moving towards the alternate sources as well as starting importing their requirement. This imports are creating negative impacts on the Indigenous mines and inducing economic losses to Indian natural Gypsum producers. So there is need to find out new promising areas as well as to find the buyer's of low grade natural Gypsum.

Year	1951	1961	1971	1981	1990-91	2000-01	2002-11	2012-15
Production in'000 (MT)	207	866	1,089	957	15,89	12,586	33 million ( MT)	14 million (MT)

**Chart:-5.1 Showing Growth in demand of Natural Gypsum In India:**



**MINERAL GYPSUM OCCURRENCE IN BIKANER:**

Bikaner is known for its Gypsum deposits all over India. Out of 8 Tehsils of Bikaner ,4 tehsils are having the deposits of natural Gypsum. These deposits occurs as horizontal beds at several places on the surface.They exits in depressions surrounded by sand dunes. They are devoid of any vegetation in the outcrops.These deposits are sometimes found in small parts of depressions while other times occupy entire depression by gypsum bed. These are also termed as gypsites and amorphous in formation.Thickness of bed varies from 0.20 m to about 2 m.The overburden , mostly sand and clay is a few centimeter only , though at placed it is 3-4 m.The gypsum beds in Bikaner are under lain by loose sand.

The importance of gypsum deposits of Bikaner increased from the year 2000 when the rise in Infrastructure projects in India was seen. Large infra-structure projects started in India and the demand of cement rised. Gypsum is used in cement industry as a retarder upto 5-7% of total production.

Bikaner is having nearly 28,466 sq, kms of Area out of which about 60% area is having Gypsum / Gypsite deposits. Out of 8 Tehsils 6 are having thick to thin sheet deposits of Gypsites. The major tehsils are Bikaner, Pugal ,Miranwala, Lunkaransar, Chattargarh NW parts of Kolayat.

Total 34 mining leases of Mineral Gypsum are existing in the Distt. out of which 11 ML's are of Rajasthan Govt. or Central Govt. ownership rest of the 23 Mining Leases are of Private parties. Major mining leases are in Miranwali (Khajuwala) tehsil , Kolayat , Pugal and Bikaner.The Govt. Mining leases are big in extension whereas private ML's are of less than 5 hectares.

Prospecting was planned for discovering new potential areas based on the surface indicator's. The samples were drawn from the prospected areas and were tested in Lab by Gravimetric method.

**VI. SAMPLING AND ANALYSIS MEHODOLOGY**

74 samples were taken from various gypsum mining Leases areas including farm lands , road cuttings , tube well mud in such a way that the entire thickness of the deposits might be exposed. And were tested in the laboratory in Bikaner.

**VII. METHORD OF ANALYSIS OF GYPSUM PURITY%**

The samples were collected in 5 kgs, packets and were tagged as per date of collection & location. The packed samples were brought in the lab, where it was crushed and Quarter

Conning was done. By Quarter conning the representative sample was reduced to 100 gms standard sample. Then it was demoisturized in Hot Air Oven at 40°C temperature. Moisture was detected by re-weighing this 100 gms of representative sample. For analysis of SO₃ or Gypsum Purity% one gm is taken out from this 100 grams. To this one gram of the sample, add 25 ml of cold water, and while the mixture is stirred vigorously add 5 ml of hydrochloric acid. If necessary, heat the solution and grind the material with flattened end of a glass rod until it is evident that the decomposition of the cement is complete. Dilute the solution to 50 ml and digest for 15 minutes at a temperature just below boiling. Filter and wash the residue thoroughly with hot water. Set aside the filter paper with the residue. Dilute the filtrate to 250 ml and heat to boiling. Add slowly drop by drop, 10 ml of hot barium chloride (100 g/l) solution and continue the boiling until the precipitate is well formed. Digest the solution on a steam-bath for 4 hours or preferably overnight. Filter the precipitate through a Whatman No. 42 filter paper or equivalent and wash the precipitate thoroughly. Place the filter paper and the contents in a weighed platinum or porcelain crucible and slowly incinerate the paper without inflaming. Then ignite at 800 to 900°C, cool in a desiccator and weigh the barium sulphate obtained, calculate the sulphuric anhydride content of the material taken for the test.

*Calculation* — Calculate the percentage of SO₃ as follows:

SO₃ percent =  $W \times 34.3$  ; PURITY % =  $2.5 \times \text{SO}_3$ .

W = Weight of the sample in g.

W = weight of residue (BaSO₄) in g; and

34.3 = molecular ratio of SO₃ to BaSO₄

#### **New Potential Areas of Gypsum in Bikaner:-**

The most potential gypsum bearing areas in the districts Bikaner are discovered in the north west direction of the City. The details of the area as under. Area having more potentials for new mining leases and investigated as follows :-

#### **Sattasar Command Area:-**

1. 17 SMD and In 12 DKD area , the thickness of Gypsum bed as explored by the trial pit is around 1 meter and the thickness of overburden is 0.5 to 1.5 meter. The total Gypsum bearing area is approx.. 400 X 70 M.

Estimated Reserves = 8 lac MT.

Average Purity tested = 60 to 70%

2. In 17 LKD area, gypsum is encountered in water tank about 2 meter below sand cover. The gypsum is also found as float ore in cultivated field.
3. In the area between 17 LKD and C minor block, sufficient deposit of gypsum occurs in an area of about 1.5 kms X 1.7 kms area. In this area no overburden is seen and the gypsum bed occurs on the surface.
4. In 16 LKD ara, the total gypsum bearing area is about 500X700 sq. mtr.s The thickness of gypsum bed , exposed in the pit is about 1 m to 1.5 m and thickness of overburden is 0.50 meter.
5. In 13 DKD ara, gypsum also occur on surface. The gypsum bearing area is about 500 X 500 sq. meter.
6. In 6PB area, gypsum occurs in small area of about 150X200 sq. mtere .Gypsum occurs on surface and

thickness of gypsum bed is about 0.50 mtere to 0.75 meter.

7. Bhagu Block :- Bhagu village is located near Khajuwala on Dantaur road.
  - a. About 6 kms away from Khajuwala , gypsum occurs below 1 meter from surface. Thickness of gypsum bed is about 0.60 meter. Area of gypsum bearing area is approx.. 600 m X 400 meter.
  - b. In the agriculture field of 16 bsd , along the Anupgarh brach of I.G.canal , gypsum occurs on the surface on 0.50 meter below surface. Thickness of gypsum bed is 1 to 1.5 meter. Gypsum bearing area is approx.. 600 X 400 sq. meter.
8. Siyasar Abadi :-A potential gypsum deposit is located near Siyasar Abadi village. The thickness of this deposit was explored by the trial pit .The depth of the deposit is around 0.50 to 1.50 mter .The total gypsum bearing area is approx.. 500X250 sq. km.
9. Rawal Ali Talai :-An area of gypsum about 300 mter X 200 mtere on R.H.S of road leading Pugal to Khajuwala situated 3 kms from Pugal was observed. The area is surrounded by sand dune. Thickness of Gypsum bed vary from 1 meter to 1.50 meter. Gypsum of the area is dirty white and earthy. Gypsum is found below 0.25 meter thick soil cover.
10. Raola Khera :- This area is located on Pugal – Dkodha road about 2 kms east of Pugal .Gypsum occurrence is noted in the depression (Talai) under 0.50 meter thick soil cover. Thickness of gypsum bed as seen in the pit is 1 meter .Gypsum is exposed in 400X200 sq. meter area.
11. Chogolai Talai :- This area is found potential for mineral Gypsum in 1 kms X 1.5 kms area. It had become whitish on surface due to salt encrustations. Gypsum debris were found around Tanka but thickness of gypsum bed was not more than 0.50 meter.
12. Chak 1 ADM :- Gypsum occurrences were observed in Muraba number 186/40 in an area of about 0.50 X 1.50 meter cultivable soil. Thus gypsum bearing area is 250 meter X 100 meter.
13. 10 P.B. Area :- This area is situated about 4 kms west of Sattasar bifurcation ( 17 kms from Pugal on Khajuwala rad). Gypsum occurrence was observed in 4 Murabases i.e. 100 bigha around Jallal jaat Ki Dhani in Murabba no 22,23,24,14 and 1. Thickness of gypsum bed is 0.50 meter to 2 meter in the extension of 300 meter X 200 meter area.
14. 7 P.B. :- This area is located adjacent to Chak 10 P.B. Gypsum occurrence was observed near Lichhmaran jaat ki Dhani about 4 murabases. In this area , thickness of gypsum bed is 1 X 1.5 meter thick below soil cover of 0.50 to 1.50 meter.
15. Near 8 P.B. :-This area is about 3 kms west of Sattasar bifurcation. Gypsum was observed in an area of about 3 kms X 550 meter in the west of kumharaon ki Dhani. Explored thickness of gypsum bed in the trial pit was 1.60 meter. Quality of gypsum seems to be good. Overburden in the area is 10 to 50 cms.
16. Chak 2 HWM :-It is located at 12 kms from Khajuwala on Khajuwala to Ballar road. Gypsum occurrence is

found in 4 Murabbas. In this area, 2 pits in the area of dimension of 100 x 50 m, 80 x 70 m. Gypsum bed of 1 m x 1.5m thick was observed below an overburden of 50 cms soil cover.

17. Ranewala :- This area is situated about 6 kms south from Ballar. Gypsum occurrence was observed in some parts of 5 Murabbas. Thickness of gypsum bed was not known because there was no pit in the area. Gypsum was brought to surface due to Ploughing only.
18. Chak 16 KHM :- An area of gypsum about 300 meter x 100 meter on the R.H.S of Bajju – Dantore road. The area is surrounded by sand dunes. The thickness of gypsum bed vary from 0.50 x 1.50 m. Gypsum of the area is dirty white and earthy. Gypsum is found below 0.25 m thick soil cover. There are 2 pits in the area of dimensions 25x15 meter and 15x20 meter.
19. Near 4 & 6 PRM abadi : This area is located near to 4 and 6 PRM abadi area on Pugal to Dantore road. Gypsum was observed in an area of about 700x500 meter in north of Abadi area. Gypsum was explored below an overburden of 50 cms.
20. 17 Chak 23 BLD :- An area of gypsum about 2 kms x 2 kms . On Dantore to Ballar road ( Bhawani Ram Khumar, Murraba no. 217/1) 8 kms from Ballar. The thickness of gypsum bed varies from 0.50 to 1.50 meter. Gypsum is found below 0.30 meter thick soil cover.
21. 13 bld- Bhagu (village) A small pit of Gypsum is seen on Dantore to Pugal Road & Left side to road & 15 km far from Dantore Scl office in NE direction. Estimated Reserves = 30 lac MT and Avg. Purity% = 45-65%.
22. Kawani (village) : The next sampled area village Kawani is adjacent to RSM mines & 2 km far in NNW direction. This area 33 km far from Bikaner Dist. Headquarter in NW direction. The almost area is govt land & whole area Excavated by Unauthorized mining. The thickness of gypsum bed is 2.0-3.50 feet & O.B. is 4.0-6.0 feet.

Estimated Reserves = 15 lac MT.

Average Purity tested = 50-55%

23. Ranasar (village)

The next visited area village Ranasar, Tehsil Kolayat. This area 75-80 km 33 km far from Bikaner Dist. Headquarter in West direction. The almost area is govt land & whole area Excavated by Unauthorized mining. The thickness of gypsum bed is 2.0-3.00 feet & O.B. is 2.0-6.0 feet.

Estimated Reserves = 10 lac MT.

Average Purity tested = 50-65%

## VIII. DISCUSSION AND CONCLUSION

The new areas prospected and discussed above would help in developing new potential deposits and enhancement of unexplored natural gypsum deposits. Except this the reserves estimated would add in serving the various industries using natural gypsum of Bikaner. The new deposits found would add life to the natural gypsum mines of Bikaner, Rajasthan. Except this would also help plaster factories of Bikaner which are striving for the good quality gypsum. But simultaneously we have to keep watch on the illegal miners so that these identified areas could be developed.

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