Original Research Paper

Volume-9 | Issue-7 | July - 2019 | PRINT ISSN No. 2249 - 555X

Geology

A TECHNICAL REPORT ON CHEMICAL VARIATION IN LIMESTONE DEPOSIT OF RAJASTHAN & ITS UTILITY IN DIFFERENT INDUSTRIES

Aijaz Mohammed Adjunct Professor (Mines and Geology)

KEYWORDS :

INTRODUCTION:

Limestone is a versatile mineral having the largest and widest industrial applications; it is also important building material. The important industries where it uses are cement, chemical, metallurgical, sugar glass, ceramics, paper, and fertilizers. However cement is largest consumer of limestone where it is principal raw material. Almost 1.5 tonne of limestone is required for each tonne of cement produced.

Rajasthan has been fortunate enough in possessing large number of limestone deposits in 25 out of 32 districts of the state. However, the important districts are well known for the cement grade limestone deposits are chitttaurgarh, Udaipur, Sirohi, Sawai Madhopur, Bundi, Ajmer, Alwar, Banswara, Bhilwara, Jodhpur, jhunjhunu, Kota, nagaur, Pali, sikar, jaipur and jaisalmer.

Although limestone rocks are widely occurring in the state, the same are not alike. It is associated with varying quantities of impurities like silica, magnesia, alumina, iron oxide, iron sulphide etc. The absence and presence of such impurities determines the use of limestone in an industry.

LIMESTONE FORMATIONS IN RAJASTHAN:

Limestone deposits of Rajasthan can be grouped in to the following geological formations:-

A) Aravali super group: Lunavada group, Udaipur group
B) Delhi Super group: Raialo Group, Ajabgarh Group
C) Vindhyan Super group: Lower Vindhyan,Upper Vindhiyan
D) Mesozoic: Jurassic
E) Tertiary: Eocene

A) Limestone deposits of Aravali Super group representing the oldest sedimentary rocks are occurring in the districts of banswara, dungarpur and sirohi. In banswara district, these have been located near bhamria-kalinjara, umral-talwara kushalpura. Bari – lalpura, Khamera- bhungra, narwali, patan, bhimkund, surwani-kelamela and loharia in dungarpur district it is seen near sabia. In sirohi district. Araavali, limestone occurrences are found near bhatana, badechi, basari, selwara, perwa-serwa and sibagaon. All these deposits have a general characteristic of being small and scattered having reserves of 15 to 40 million tonnes. These are located in the tribal belt of Rajasthan and are not connected by rail. Their chemical compositions quite suitable for cement manufacturing as they contain more than 45 % CaO,less than 3% MgO and 2 to 15% Sio2, since they belong to the oldest sedimentary rocks, they are crystalline in nature due to metamorphic which has resulted in these being utilised as marble. One medium scale cement plant was established in banswara district at Bari-lalpura is closed for last few years because the limestone deposit lies in the forest land. From banswara, limestone is also, supplied to various cement plant located at dahod in the neighbouring state of Gujarat. In sirohi district also limestone supplied to various mini tiny cement plants located in the same district and also to the major cement plant as sweetener.

B) Limestone of raialo group are crystalline in nature and geologically come under the category of marble, this group represents the famous marble belts of makrana and rajnagar however, some deposits of this group which are not suitable for marble mining have been found to be good cement grade limestone. Such deposits mainly occur in Udaipur and Pali districts. In Udaipur, the state government had investigated limestone deposits near daroli- manderia block and proved nearly90 millions tonnes of reserves. Based on which a cement plant is working since 1970. Other small deposits are located in Udaipur and to other industries, has recently marble mining has also been started in this belt.

In Pali district, limestone of raiaola group occurs near ras and deoli-jhillian-guria villages. A small part of limestone deposits near ras was investigated by the department in 1962-64 which establish reserves of 45.37 % million tonnes up to 18 mts. Depth containing 45% CaO and less than 2% MgO. This deposit is located about 20 km. west of beawar runs almost 30 kms. Strike length and is most suitable for cement manufacture. Two cement plants are already coming up in this belt. (DLF. Shree cement). Besides, five more blocks have been recently notified for grant of prospecting license.

In southern extension of ras- Limestone deposit, outcrops are seen near Gurla Rly station for about 8.8 kms. Strike length up to deoli and jhilan villages. Nearly 12.30 million tonnes reserves were estimated over a small part of this area which is expected to be enhanced by further prospecting.

C) The limestone belonging to ajabgarh group of Delhi super group is exposed at many places, along the central axis of aravali range starting from south western corner in sirohi district, and passing through Udaipur, Pali, Ajmer, jaipur, and sikar districts to jhunjhunu district in the northern corner of state. Most of the deposit is in the vicinity of Delhi Ahmadabad line of western railway deposits in sikar and jhunjhunu district, are lying along available in these districts which support to major cement plants in sirohi district at pindwara and one near beawar in ajmer district and few mini tiny plants at Abu road and pindwara in sirohi, kotputli in jaipur and in sikar and jhunjhunu districts. The limestone belt in sirohi district runs for about 65 km. Strike length from amil in north to siyawa-abu road in south. The limestone in general in grey in colour, hard, compact, crystalline, and fine to medium grained. On the basis of preliminary investigation carried by the state.deptt. About 400 million tonnes of cement grade limestone may be available in this belt. Besides catering to the existing cement plant and lime kilns. There is further scope of establishing major cement plants near pindwara based on the deposit and near kotal-kundal which has been recently notified for leasing.

In Udaipur district limestone deposits was investigated near bikarni-khajuria village in kotra tehsil. The area is about 40kms east of sarupganj railway station on Delhi Ahmadabad line. The limestone forms discontinuous and parallel to sub-parallel bands separated by schist's and granites. Detailed exploration has established about 37.47 million tonnes reserves containing 48.33% CaO. A small deposit was also investigated near hathun-jaswantpura in bhim tehsil, which is about 12 kms southwest of beawar railway station. A reserve of 30 million tonnes has been estimated in this area containing 40 to 50 %CaO. This deposit further continues towards sheopura- lulwa and may sustain a major cement plant.

D) Vindhiyan Limestone Deposits:

Vindhiyan limestone deposits are most extensively found in the state in the district of Chittorgarh, bundi, Kota, jhalawar, bhilwara, and sawai madhopur. These deposits at present sustain six major cement plant located at Chittorgarh, shambhpura, nimbhaera, lakheri (bundi) sawai madhopur, Kota and morak (Kota). One more cement plant is in the stage of establishing very soon near shambhupura. Some marginal cement grade limestone deposits are occurring near gadola and borkheri which may also sustain a cement plant with the help of sweetner.

Satur-hapura deposits in bundi district were prospected in detail by Cement Corporation of India which as established 70 million tonnes reserves containing 43% CaO. This deposit now falls along the newly constructed broad-gauge railway line but suffers from the problem of forest.

In bhilwara district, a number of small deposits of marginal grade have been located near laadpura, biharipura, hamedpura in mandalgarh tehsil based on which efforts have been made by M/s Zuari agro industries to establish cement plant at mandalgarh but suffers setback due to forest. The other deposit near mandiyardi-patiyal with 30.78 million tonnes reserves is also promising for a mini plant but it may also need forest clearance.

In milo-julmi area of Kota district, Reserve of 48. 70 million tons has been established by the department which can further be enhanced by exploration to sustain a cement plant.

E) Sojat – Bilara:

Gotan limestone belt is equivalent to Vindhyan super group but has been given separate status under Marwar super group. This belt passing through Pali - Jodhpur and Nagaur district is the most important as it contains high grade limestone bands which are also used in chemical, sugar, metallurgy and Other industries besides white cement plants located at Gotan and khairya khangar.A Large number of minor mineral leases have been granted in this build for limestone which caters to the need of various industries. Nagaur district has been reserved for SMS grade limestone but recently 4 blocks near village Tantwas was have been dereserved, where there is no potential of SMS grade limestone. These blocks required detail prospecting one major cement plant is likely to establish near Mundhwa for which prospective has been completed recently in the area.

F) In Jaisalmer district, limestone deposits of Jurassic and using ages have been located which are highly potential source of cement grade limestone. Near Jaisalmer reserve 15 Million tonne has been estimated in Sanu- khuiala area, Reserve of 854 million tonnes of Chalky limestone has estimated which lies Beneath SMS grade limestone. This Chalky limestone has been found suitable for cement manufacture by NCCB. it will open new avenues for Industrial development of this desert area. One area near minyor ki dhani is already in the process of sanctioning the mining lease for cement plant have been proposed and two more areas near Tulsiram ki Dhani and Khinya Khimsar have been proposed to Leasing out.

Total reserves of limestone of all grades in Rajasthan have been placed at 9000 million tonnes, which is almost 13% of the all India figure of 69353 million tonnes. Thus, Rajasthan is an important state from the point of limestone deposits.

Specification of limestone for different industries:

Limestone is calcareous sedimentary rock composed of Mineral calcite (CacO3) which upon calcinations yield lime (CaO) for commercial use. Cement and iron & steel industries is the major consumer of limestone. It is also considered chemical Industries like calcium carbide, bleaching powder; soda ash precipitated calcium carbonate etc. Besides, it is used as of fluxing material in Ferro-alloy, polletisation plants,foundires and in the production of sponge iron as refining material in the production of sugar, as additive in Fertilizer industry, as a coating material in glass industry and in the cooking of rags and grass in the paper industry.

Present status of specification of limestone for different end use Industries and the likely future Trends. The detailed specifications of limestone required by various industries are given below:

Cement industry:

Limestone containing about 45% CaO and above is usually preferred for the manufacture of cement. Magnesia contained in the stone should it be less than 3% although as high as 5% MgO is used by the industry. The proportion of Al2O3 + Fe2O3. Sio2 should be 1:2:5 magnesia, Sulphur and phosphorus are regarded as most undesirable impurities. The presence of phosphorus and P2 o5 more than 1% slows down the setting time of Portland cement. The cement industry in India in general prescribed the following specification of limestone CaO of 42% Al2O3 2 to 4% Fe2O3 1-2 % SiO2 12 to 16% and MgO 4 %(Max).

Iron and steel industry:

Limestone is used in this industry both in the blast furnace and steel melting shop. It has two basic functions, first to lower the temperature of the melting and second to form calcium silicate by combining with silica of the iron ore comes out as slag.

Blast furnace: specification of limestone in various steel plants in India for use in blast furnace are given as follows :

Plant size	Cao	Mgo	Sio2	Al2O3	T.I(total insolubles)
BSP +50mm 10%(max) -25%mm 5	42% +-1%	8%			6.5%+-1%b
BSL -25mm 5%(Max) +80% 5%(Max)	45%	6%	5%		
RSP +50mm 10% (Max)	44%			2%	
DSP -25mm 10%(Max) +75%mm 10%(Max)	45%		7.5%		12%max
IISCO +75mm 10%(max) -25%mm 10%(max)	46%				
TISCO -75mm +25mm O/s 10% up to 100mm u/s up to 10 %	6%max		10%	10%	11%(max) 12%(max)

Steel melting shop

For this purpose good fluxing limestone low an acid constituent such as silica, alumina, sulphur and phosphorus is required the limestone should be dense, massive preferably fine grained, compact and non-fritting on burning. The specification of limestone required by the Steel plant in India for SMS for purposes are given below

	Plant size	Cao	Mgo	Sio2	Al2O3	T.I (total insolubles)
BSP a)O.H b)L.D	+50mm 5%(max) 40-80mm +5%	49% 53%	4% (Max) 2%(Max)	1.8%	1.7%	5%(Max)
BSL(LD)	-30mm 5%(Max) +60mm 5%(Max)	50%	3.5% (Max)			
RSP	+80mm 10% (Max) -40mm 10%(Max)	51%				5% +-1.5%
DSP	75-125mm +125mm 10%(Max) -75mm 10%(Max)	48%		3.5% (Max)		5%max
IISCO	+125mm 5%) -75mm 10%(max)	50%		4% (max)		
TISCO a)OH b)L.D.	-75mm +35mm -70mm to35mm 5 %(Max)	53%	2% (Max) 2% (Max)			4%(max) 1%(max)

from the above it is seen that limestone LD surface LD furnace must be of high purity with low silica content as far as possible some plants are insisting on as low as 0.5 SiO2 .The ISI(IS:10345-1982) has prescribed the under mentioned guidelines for flux grade limestone for use in steel plants.

Characteristics	Grade I (For use in lime manufacturing)	Grade II (For use in steel making)	Grade III (for use in iron making)
CaO	52% Min	50% Min	42% Min
MgO	2% Max	3% Max	9% Max
Acid insolubles	2% Max	4% Max	10%Max
Preferred Size	-	25-60 mm	25-60 mm

The size ranges other than specified above shall be subjected to agreement between the supplier and the procedure.

Chemical industries:
Generally quick lime is used in the manufacture of calcium carbide. The calcium carbide manufacturers generally prefer lime containing 95% CaO (min) not more than 3% Sio2 not more than 0.95% Phosphorus and other impurities should not exceed 2%. Though chemical composition is the guiding factor, the physical characteristics of the limestone are also very important. For the manufacture of bleaching powder also, fat lime containing CaO 95% above is required. Total Fe2O3+ Al2O3+MnO2 Should be less than 2%, MgO should be below 2% and Sio2 less than 1.5 %. Bleaching powder is prepared by absorption of chlorine by dry hydrated lime. The hydrated lime should not contain more than 2% excess water. Iron and Manganese oxide leads to an unsuitability of the product and iron oxide tends to discolour the bleach material. Magnesia renders the bleaching powder hygroscopic. Silica and clay Impede solution and setting of the bleaching powder. Limestone suitable for bleaching powder manufacturer can be advantageously utilised by alkali industry for the manufacture of Soda Ash and Caustic Soda.

Sugar industry:
In sugar industry lime is used for the clarification of the juice from cane and beets. Milk of lime 1% in volume of Cane juice is added two preheated juice. Limestone to be used in sugar industry must be high in active lime (CaO 80% minimum), must be low in iron aluminium and silica etc. Magnesia should be less than 1% excess of silica is undesirable because it separates acid gelatinous precipitate which covers the sugar crystals and their growth and filtration. Magnesia is objectionable because magnesium carbonate is soluble in sugar juice presence of iron tends to colour the finished product. The following Specification of limestone for use in the preparation of bleaching powder caustic soda and calcium carbide and sugar.

Characteristics	**Requirements in percent by mass for**			
	Bleaching Powder	Caustic Soda	Calcium Carbide	Sugar
1.LOI	46.0	46.0	46.0	44.0
2.Sio2(Max)	0.75	-	1.0	2.0
3.Fe2O3(Max)	0.15	-	0.25	-
4.CaO(Max)	54.0	53.0	54.0	50.0
5.MgO(Max)	2.0	1.0	0.8	1.0
6.Mn2O3(Min)	0.06	-	-	-
7.CO2(Min)	42.0	42.0	42.0	41.0
8.S(Max)	-	-	0.1	-
9.P(Max)	-	-	0.01	-
10.Al203+Fe203(max)	-	-	0.50	1.5
11.Sio2+Al203(Max) Fe203	-	3.0	-	-

Glass Industry:
Glass industry requires high calcium limestone CaCo3 94% combined CaC03 and MgCO3 should be 97.5%. Iron and other colouring material like carbon are regarded as objectionable.Fe2O3 should be up to 0.20% maximum. For colourless Glass limestone should contain 08.5% CaCo3. Iron content as Fe2O3 should not be more than 0.04% and for bottle glass Fe2O3 up to 0.05% The ISI specification(IS:977-1973) for limestone for used in glass industries are as follows:-

1.Silica (Sio2)	2.5%
2.Total iron(Fe2O3) a) Calcite or Marble b) Limestone c) Dolomite	0.05% 0.10% 0.15%
3. Lime	53.0%
4. Total Lime and Magnesia	54.5%

Fertilizer Industry:
The latest use of limestone introduced in the country in the manufacture of calcium Ammonium Nitrate fertilizer. Limestone is used as career. For this purpose limestone should contain MgCO3 + CaCo3 85% (Min) ,SiO2 5%(Max) and acid insoluble 14%(Max).

The chemical requirements of limestone for use in foundries as per ISI specification (IS: 4140-1978) are given below:-

Characteristics	**Grade 1**	**Grade 2**	**Grade 3**
Calcium oxide (CaO) Min	52	50	45
Silica (SiO2) Max	1.5	3	5
Mixes Oxides R2O3(Fe2O3+Al2O3) Max	1	1	2
Magnesium Oxide (MgO)	2	3	5
Insoluble Matter Max	0.5	1	2

With **sulphur and phosphorus** in traces.

Future Trends:
It is noticed that a rigid specification are prescribed by the steel Industry for L.D grade limestone. The CaO content in limestone should be 52% (Min) and 1% Sio2 (Max) besides the physical characteristic is important. It should not be non decrepitating and should have low content of alkalis.

The present status of classification of reserves of according to the industrial application:
In the mineral inventory by IBM the Reserve of limestone are classified in the cement, BF, SMS and chemical grade taking into consideration,

(A) reported content CaO Mgo and SiO2
(B) Judgements of the exploration Agencies without any separate chemical analysis data and
(C) actual reported use where

Where chemical analysis data has been taken as criteria the parameters are under below:

Cement	CaO MgO	42 to 45% 5%(Max)
BF	CaO CaO+MgO SiO2	42%(Min) 48%(Min) 9%(Max)
SMS	CaO MgO SiO2	48%(Min) 3%(Max) 4%(Max)
Chemical	CaO MgO SiO2	50%(Min) 2%(Max) 2%(Max)

REFERENCES

1. D.M.G.Udaipur
2. G.S.I. Jaipur Office
3. C.R.I. New Delhi
4. N.C.C.B.M. New Delhi
5. R.T.C. Nimbhaera