Enviromental Impact Assessment of Marble Mines, A case study of Babermal Mining area of Udaipur (Rajasthan)

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***Abstract** - In old times, the term marble was applied to any stone equipped for taking shine, with practically no respect to its compound arrangement. With the advances in the studies of the planet, a more refined and precise grouping of rocks based on their introduction to the world, history and compound synthesis has appeared. In like manner speech, the term marble has a lot more extensive application. Business marble is any translucent stone made overwhelmingly out of calcite, dolomite or serpentine that is equipped for taking shine.*

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INTRODUCTION

The term marble has been derived from the Latin word Marmor which itself comes from the Greek root marmaros', meaning a shining stone. In ancient times, the term marble was applied to any stone capable of taking polish, without any regard to its chemical composition. With the advances in the earth sciences, a more sophisticated and accurate classification of rocks on the basis of their birth, history and chemical composition has come into existence.

Attempting a genetic definition, we can say that marble is a metamorphosed rock formed by the very crystallization of limestone. It has the same chemical composition as limestone or dolomite, but the chief characteristics of marble are its granularity and formation by recrystallization due to metamorphic processes. In common parlance, the term marble has much wider application.Commercial marble is any crystalline rock composed predominantly of calcite, dolomite or serpentine that is capable of taking polish. The commercial classification adopted by the industry is mainly based on general properties and use of stone.

- **Calcite Marble:** A crystalline variety of limestone containing not more than 5% magnesium carbonate
- **Dolomite marble:** A crystalline variety of marble containing 40% magnesium carbonate as the dolomite molecule
- **Magnesium marble:** A crystalline variety of limestone containing not less than 5% magnesium carbonate as the dolomite molecule
- **Serpentine marble:** A marble characterized by the prominent amount of mineral serpentine.

Marble occurrences are widely distributed throughout India but the Occurrence of marble of economic importance are limited to a very few states. Important deposits of marble are located in Rajasthan, Gujarat, Haryana and Andhra Pradesh. Marble deposits of inferior grade occur in Madhya Pradesh, Uttar Pradesh and W Bengal but Rajasthan is the leading producer of marble in India and has the largest reserves of good quality.

Rajasthan is the richest state in India with regard to marble deposits both in quality and quantity.The important and well known marble deposits are situated at Makrana in Nagaurdistrict,TripuraSundari in Banswara, Amet, Sardargarh, Rajnagar and Kelwa in Rajasamand, Kishangarh in Ajmer,Bar in Pali, Jhini and RajgarhAlwar, Unmar in Bundi, Meonda in Sikar, Babarmal and Jaspura in Udaipur district.

Marble deposits in Udaipur district have been known for long, when palaces and monuments in and around Udaipur were built with local marble but in recent years, this district has received greater attention and mining activity has developed rapidly. In Udaipur district Jaspura, Japora, Bichhiwira etc. have emerged as white marble belts. Babarmal-Devimata-Kaeora area is the only main producer of pink marble in the state. This area is situated 25 km S of Udaipur city on Jaisamand road. This belt is about 7 km in length and 30-200 m in width. The Rikhabdeo and Modi deposits are known for green marble (serpentine).

Properties of Marble

Marble has a broad range of physical and chemical properties. The suitability of marble for any purpose is decided by its properties, meeting the specifications established for the purpose Martie is mostly used because of its pleasing appearance and physical strength. Its chemical properties are of less importance than the physical properties. Particularly its suitability (reference) to weathering.The marble is more susceptible to acidic conditions in the form of tests, smoke fumes and groundwater. Thus a variety of tests are carried out to study the physical and chemical properties of marble Chemically, the impurities may be in the form of silica (SiO2) as free quartz of silicates, on caide as hematite (feO3) limestone, manganese oxide (MnO_2), alumina (Al2O3) in the form of aluminium silicates and sulphur usually as pyrites

(FeS.). Small quantities of organic material in theform of graphite are also present in some marbles. The presence of impurities produces decorative pattern and colour in the marble.

The bands of silica may be present in marble as its original constituent or they may be introduced through fractures by the action of percolating water. The silica, so introduced through fractures causes unsoundness in the marble blocks. But the presence of silica often gives decorative marking to the stone. However, because of its higher hardness, silica usually creates problem and channeling, drilling and processing. The silicate impurities in the form of mica and chlorite are generally scattered as dark patches and these, may impart a pleasing pattern or they may weaken the rock and reduce its value. Bands of dolomite and calcite are often present as alternating bands in marble and lenses of dolomite are also common. The presence of dolomite gives an uneven surface to marble and may cause some difficulties in its processing.

The desirable physical properties of marble may vary with its intended use. Generally strength durability and appearance are the most important physical properties, though a number of other properties may also influence its utility and value.

Hardness is a measure of the resistance, the surface of a substance offers to abrasion in this respect, the hardness of marble is more than that of most other limestone. The presence of fint or silicate mineral increases the hardness of marble Abrasive resistance is determined by the composition and texture of marble. A high texture resists the abrasion best. The specific gravity of marble depends on its chemical composition. Dolomite marble is heavier than pure calcite marble.

The solubility of marble intended for exterior use is a very crucial factor. Marble exposed to atmospheric agencies dissolves and disintegrates, though very slowly, with the passage of time. The porosity and absorption have a direct influence on the strength and weathering of marble. The porosity is the volume of pore space in a stone and absorption is the amount of liquid a stone willabsorb on immersion. The porosity of high grade marble ranges from 0.02 to 0.5% the marble for external use should have low porosity.

Colour of the marble is perhaps the most important physical property which is governed by its chemical constituents. Generally calctic and dolomitic marble are of pure white colour. Variation from the whiteness of pure marble is due to admixture of foreign substances. Such impurities are present in the form of bands or streaks that makes it colored or imparts nonuniform colour Black and greyish shades are due to graphite and pink ,red or reddish brown are mainly due to the presence of manganese oxides or hematite grains by himonite.

Uses of Marble:

Marbles used in different forms is slabs, tiles, blocks chips, powder etc. and also for different uses like flooring walls, facade, working surfaces, furniture tope etc. its maximum use, however, is found in building constructions in the form of slabs.

Marbles of ornamental varieties are used as novelties in the form of lamp bases; clock cases paper weight and various other gift items. Pure white, fine grained, equigranular marble, with some translucence and utmost adaptability for carving is selected for statutory purposes.

The marble for these purposes should withstand artist's chisel without chipping or splitting.

Extraction of Marble

The Udaipur Mineral Basin produces three types of marble. The pink marble is found at Babarmal and Devimata areas, white marble is mined at JaspurawhereasModi area is known for green marble mining. The Babarmal and Devimata areas are the major areas and produce 100% pink marble of the state of Rajasthan.

In this region, marble mines are semi-mechanised and mining is being done with the help of drilling machines, compressors, wire saw etc and the excavated blocks are being shifted by the cranes. The heavy earth moving machineries like dozers, showel, J.C B. pockilain, dumpers, etc. are often used. Blasting takes place frequently in marble mining areas. The amount and quality of explosives affect the intensity of the blast. The number of blasts per day reported is about 250 at Babarmal, 50 at Devimata, 50-75 at Jaspura and 25 at Modi.

The mining operation is done in undulating hilly terrain and in the courses of rivulets atBabarmal, Devimata and Modi. TheJaspura mining area is stretching in the levelled landsurrounded by agricultural fields. The groundwater aquifers are punctured by mining at Babarmal and Jaspura areas leading to the ponding of water into the pits.

The Babarmal area comprises of 85 mines, of which 70 are active and 15 are abandoned .A narrow but long mining area, extends NNW to SSE and the length of the activity area is about 3.5 km its width varies from 100 to 500 m. The average depth of the mining pits is 10-15 m.

The Jaspura mining area has 20 mines; 16 active and 4 abandoned. The activity area extends NW to SE over a length of 1 km and width varies from 200-250 m, the average depth of the pits being 10 m.

The Devimata area has 10 pink marble mines Mining activity here takes place at two different sites..TheNn pit is extending north to S having size of 300 x 200 m and depth of 5-10 m. The average size of the Sn pits is around 500 X 200 X 10 m. The Modi area consists of green marble mines. Of these, 6 are active and 2 stand abandoned. The mines are in scattered patches and total length of the activity area is about 1 m with an average width of 200 m. The depth of the pits varies from 5 to 10 m.

The overburden of marble mines contains big marble slabs, boulders, 'khanda, cobbles, pebbles and fine powder. The top layer being the weathered rock, marble is found below the surface and thus produces a lot of waste material.The method of mining being drilling, followed by heavy blasting, increases the amount of overburden. The powerful explosives, inspite of full care, break down the marble blocks converting them into waste only.

The Babarmal mines produces overburden in huge quantity. In the absence of any waste dump yard, overburden is scattered all over the area. The En side of the activity area faces adverse impact of dumping because this area lies downward, causing rolling down of the boulders, damaging agricultural fields and vegetation. Overburden dumps are also observed at the Sn end of theactivity area on the Wn hill slopes. The overburden of Devimata mines is dumped in the low lying areas and hill slopes.

Topography of Mining area

The mining complex having undulating topography has plain relief, leading to small-sized scattered agricultural fields. The height of the relief decreases from NWW to SSE from Babarmal to Kevra. The maximum altitude of the area is approximately 860 m (Samar hill) above msl.Anotherdominat feature is the Babarmal hill (718 m). Both these are located in the W of Babarmal village as well as the mining complex. The master contour of the area is approx. 540 m.The lowest altitude is around 440 m along the rivulet in the SE, hardly 500 m away from the active phase.

According to G.T. Sheet (1968-69) mining complex has undulating hilly terrain with small hillocks but now the scene has changed. The hillocks have been converted into ditches and rivulets have taken the shape of the overburden hillocks. Vegetation has disappeared and wild life is extinct. The mines have been dug to the groundwater table and 10 mines are now filled with water. It is all due to puncturing of the aquifer. The steep slope of hillock causes severe erosion. The slope gradient of Samar and Babarnmal hills is very steep in comparison to that of the Sn hillocks. The En part of the activity area is very low with altitudinal difference of hardly 100 m.

Drainage of Mining area:

Here the drainage direction is W and E all tributaries are seasonal. The major rivulet passes through the NE and SE of the activity area. The twelve seasonal channels pass through the mining area, the maximum being in the middle. The mining activity has changed the natural courses of these rivulets.

From N to S, rivulet no. 1 in the Nn end of the activity area is filled with overburden. This rivulet meets the major rivulet near village KevraKalan. Rivulet no. 2 is just parallel to the former and originates from the activity area. Rivulet no. 3 is a major rivulet, has larger Catchment area and is a third order stream. Along this rivulet, there is rich vegetation around the mining area but next to it, it disappears under the overburden, deposited in the course of the rivulet no. 4 and 5(small tributaries) are completely spoiled by the mining activity. Huge quantity of waste material has been dumped along their courses. Rivulet no. 6 starts from Babarmal hill having rich vegetation showing good potential of groundwater. The mines are located in the stream course and are filled with groundwater. This rivulet has been obstructed by the mining activity of three mines; located in the lower middle course. The overburden of these mines has been directly dumped in this rivulet.Rivulet no. 7 and 8 are small seasonal rivulets, showing higher water level in comparison to the wells around the mining area.

These channels disappear near the mining area as large quantities of the waste material have been dumped in the courses. All these tributaries meet with the major stream which originates from JogiKaTalav' in the N and finally drains into Tidi river in the S. Rivulet no.9and 10 originate from the Sn part of the complex and flow towards the E. Mining activity is taking place in the course of the rivulets affecting adversely. The dumped waste material in the En parts has filled up the stream bed. Rivulet no 11 and 12 start from the Sn end of the activity area, flowing N to S. Five mines situated on the En side of the hillock directly throw their waste material into the rivulet which stand filled with overburden. In the rainy season, loose material mixes with rain water contaminating it.

Landuse pattern:

Babarmal mining is one of the major operations of marble in the basin. It has threatened 1,536 hect of land which is 40.20% of the total land, threatened by the marble mining activity. In the base year 1971-72, the above threatened area was comprised 1034 hect (67.32%) of forest land, 245 hect (15.95%) of open land, 242 hect (1 5.76%) of agricultural land and 15 hect (0.98 %) of land under settlement.

Water Analysis of Mining Area:

pH: The water shows alkaline nature nearby the marble mining areas, the pH from 7.36 to 8.50. The pH value is under standard limit.

EC: The EC value of nearby marble deposits varies from 0.244 to 0.716 m/mhos. The EC value of groundwater is near about 0.5 m/mhos where as the EC value of mining pit is near about 0.250 m/mhos. It is so because of the samples collected in the rainy season and rain water having accumulated in the pit.

TDS: The TDS value of water samples ranges from 0.161 to 0.469 ppt or g/l. The TDS value of ground water has been recorded more than that of the surface water. It is so because the surface water is being the collection of rainy water which is later on almost distilled.

Total hardness: The total hardness of water is the result of calcium and magnesium ions present in it. Marble is the metamorphosed form of limestone having CaC0, leading to the total hardness value varying from 112 to 320 mg/l. The total hardness of well water is more than the water of mining pits because of mixing with the rainy water, which is almost distilled.

Magnesium: The concentration of magnesium was found between 1.71 to 46.48 mg/l .The average magnesium concentration in the marble mining area is 24.66 mg/l, It is under the standard limit; the concentration of magnesium in ground water is higher than the surface water ponded in the mining pit. It is so, as the samples were collected in rainy season and rainy water is almost distilled has been stored in the pit,lowers down the concentration. Alkalinity: The total alkalinity value of marble mining areas varies from 72 to 340 mg/l, the average being 223.2 mg/l.

Chloride: The average chloride concentration was found 167.38 mg// which varies from 88.75 to 259.15 mg// the highest concentration of chloride was recorded in a rivulet flowing through the mining and waste dumping areas of Babarmal mining area.

Soil analysis of Mining area:

pH: pH of all the samples was found more than 7. It shows the alkaline nature of the soil. However, in general, near the activity area the pH is, strictly speaking, less than that of the other distant places.

EC: The electrical conductivity ranges from 0.235 to 0.237 m/mhos. The average EC value of all the samples was found 0.175 m/mhos.

Chloride: The chloride content in the collected soil samples varies from 0.318 to 0.687 mg/g The maximum value was found in the sample of Modi mining area which was collected from an agricultural field located at 200 m in the S of the activity area.

Alkalinity: The alkalinity value ranges from 0.182 to 0.704 mg/g. The maximum value was recorded in the sample of Jaspura mining area, collected from a fertile agriculture land located at. 50 m W of the activity area.

Organic matter: Organic matter ranges from 18.5 to 49.86 mg/g. The least organic matter was found in Babarmal mining area. The maximum was found N of the mining area.

REFERENCES

1. Agrawal, M.C., 1980. Environmental Pollution due to Surface Mining. Indian Mining and Engineering Jl.,19, (102): 13-18.
2. Agrawal, R.K. (1990): Water management in Denuded and Degraded Hillocks of Aravallis - An Environmental need, proceedings of the National seminar on water management Techniques, Udaipur, PP 33-39.
3. Agrawal, S.C.1982: Mineral Economics. Director of mines and Geology, Rajasthan, Udaipur.
4. Allaway, W.H.1969: Control of Environment levels of Selenium. In Trace substances in Environmental health II ed. D.D. Hamphill PP. 191-206 Columbia missouri. University of Missouri Press
5. Allet, E.J. 1983, Environmental Aspects of New Mine Planning. Colliery Guardian, Vol.23 (8): 434-441.
6. Ashley, G.D. and Wilkinson B. 1959: Some observation on soil development on restored open cast coal sites N.A.A.S.C. Rev. on 44.. 147-53
7. Babel, K. (1992): Water Resources of Udaipur City: A Geographical Evaluation, Ph.D. Thesis, M.L. Sukhadia University Udaipur.
8. Bales, J. 1979: TVA Strip Mine Assessment Model Hydrological Component. Proc. Symp. On Surface Mining, Hydrology, Sedimentology and Reclamation. Univ. of Kentucky, Lexington 47th Dec. 1979: 119-125.
9. Barr, W. 1979: TVA Strip Mine Aquatic Assessment Model-Benthic Invertebrate Models. Proc. Symp. On Surface Mining, Hydrology, Sedimentology and Reclamation. Univ. of Kentucky, Lexington, 4-7th Dec243-250.
10. Barton, W.K. 1960: Dimention stone W.S. Bureu of mines Information circular No. 8391 Basu, D. 1943: Darjeeling Coals: Utilization possiblities. Calcutta Geographical Review. Batman, A.G. and N.L. Jenson 1981:

Economic Mineral Deposttes. Jhon Willey and Sons, New york.

11. Bergstrom, R.E.1968: Disposal of Wastes: Scientific and Admistrative Consideration. Environmental Geology Notes No. 20. Illinois state Geological Survey.
12. Bhandari, S. 1990: Assessment of Environment Impact due to Sandstone mining of Jodhpur Report University of Jodhpur, Jodhpur page 1-50
13. Bhargawa, D.N. 1983 & 1989: Indian Minerals Year Book, India, Bureau of Mines.

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