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Analysis on Some Chemical Properties of Dolomite Deposit Pandikunta, Warangal District, Telangana, India

KEYWORDS: Refractories; refractoriness,Dolomite

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ABSTRACT *A study to investigate the properties of the locally available dolomite for refractory applications has been carried out. Dolomite 13 samples from Pandikunta dolomite mining location at ,Mulugu Mandal,Warangal District,Telangana, India were used for this investigation. The internationally accepted methods for testing refractories were adopted and their properties compare favourably with most of those of standard dolomite currently in use in Europe, Asia and United Kingdom. These results make the dolomite suitable for use as a basic refractory material especially in the machine tools and steel making industry.*

1.0 INTRODUCTION

Refractories are necessary in the metallurgical, cement, glass, and machine tools industries where kilns and furnaces are used for value addition process to materials. Dolomite refractories are currently in use in some foreign countries such as China, France, England India etc. Dolomite refractories have wide applications in the steel industry where it is used in open hearth, basic oxygen converters and other steel refining systems.

The shifts in metallurgical process and the aggravation of operating conditions by the use of oxygen have also caused changes in the qualities to be satisfied by refractories. The development of refractory products and of the lining technology has had to be adapted to these changed requirements [l].

Dolomite with an estimated reserve deposit of 24 million tonnes is found in Kogi, FCT, Niger, Oyo, Kaduna, Kwara and Edo states. At the moment, mining is pronounced in four states; Edo, Kogi, Nassarawa, and Niger states [2].

According to Chatillon, et. al. [3], the interest in dolomite as a refractory is hinged on the fact that the composition of dolomite makes it desirable for its use as a basic refractory. Dolomite is environmentally friendly and can be used for the production of pure and extra low carbon steels. Dolomite that is ceramically bonded exhibit high hot erosion resistance. Good quality dolomite, with low silica content is thermodynamically stable and has a significantly high heat sink characteristics. These qualities make dolomite refractory preferable to silica, alumina and even magnesite chrome refractories.

Dolomite mineral is a double carbonate of calcium and magnesium having the formula CaMg (C03M 4]. It is slightly hard, transparent, and forms rhombohedron as its typical crystal habit. Dolomite used for refractory purpose should be hard and compact with uniform texture containing very low percentages of iron, silica, alumina etc. This is because these impurities adversely affect the refractoriness of dolomite refractories [5].

Under actual conditions of operation, refractories are subjected to mechanical loads. For this reason, refractory materials are assessed by their ability to withstand loads at high temperatures [6]. Each refractory composition has optimal conditions of heating and roasting which should be adhered to in order to prevent cracking, glass phase formations etc [7].

The chemical composition of refractories depends on the composition of the starting materials. The composition of refractories determines their activity in steel making slags. Refractories composed mainly of silica (an acid oxide) should not be in contact with basic slags' while those prepared from basic oxides (MgO, CaO) should be protected from contact with acid slags; otherwise, their particles in the lining will be slagged vigorously, resulting in quick failure of the lining [6].

The stability of refractories determines not only their consumption, but also the productivity of steel making. The refractory material for steel making should have low porosity i.e high density so as to avoid the erosion by the moving metal and slag [7].

The increasing demand for cleaner steel cannot be fulfilled in ladles lined with conventional silica containing refractories such as sand, fire clay, zircon or high alumina. It is therefore necessary to use basic linings. It is generally considered that the total impurity level of high performance dolomite products should not exceed 3%. Above this level the low melting point phases such as browmillerite and dicalcium ferrite have a detrimental effect on the refractoriness and corrosion resistance of fired dolomite products [3].

The physical properties of refractory bricks is a function of the physical properties of the original raw material and to a greater extent, those of the clinker. For steel refractory these physical properties include volume change, abrasion, compression, spalling properties which are indicated in their bulk densities, specific gravities, porosities, swelling index, linear shrinkage and crystallite sizes [8]. There is little or no study on the Chemical properties of refractory dolomite found in Pandikunta. This paper is a research effort made at studying these properties and assessing their suitability for refractory applications.

Location of the Study Area

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Study Area:
Warangal district is one of the important tourism spot in India.Warangal is located at 18.0°N 79.58°E. Pandikunta Village, Mulugu Mandal, Warangal District state is Telangana of India. Survey of India Toposheet number is covering 56N/16, Where 13 samples collected and East side is Khammam Distirict, south by Kurnool of Andhrapradesh,west is Medak District and the other sides Chhattisgarh state. It is being attracted by travelers from in and around the world

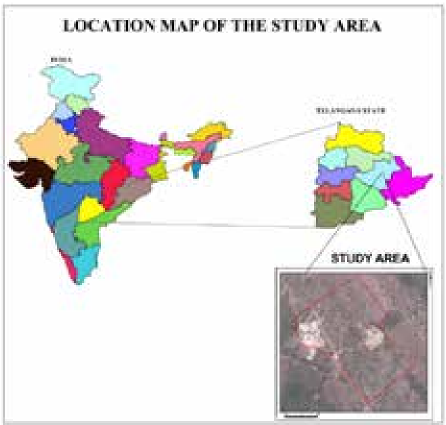

Fig:1 Location Map of The Study area

2.0 MATERIALS AND METHODS

2.1 Materials

Quartering and cone method was used in sampling specimens for the experiments. The raw dolomite was quarried, crushed, partially washed and then introduced as lumps into a kiln for burning. During the burning process otherwise known as calcinations, the carbonates decompose between 780 and 1600C and are transformed into lime (calcium oxide) and periclase (magnesium oxide) while carbon dioxide (C02) is given off [3] as indicated in equation (2.1).

$CaC0_3MgCo_3$ --> Ca0 + MgO + $2C0_2$

The calcined or burned dolomite lumps are crushed, milled and finally graded into fractions. After milling, the dolomite was thoroughly mixed to obtain a homogeneous mix. A binder (honey) 5% wt and 4% water is added during the mixing. The binder is added in order to impart green strength and also act as a plastifier and hydration protection After mixing, the batch is taken to a hydraulic press of about $100MN/m^2$ where the mixed dolomite is introduced into the mould and shaped at high pressure. Thereafter, the shaped dolomite is oven dried at 110°C for 12 hours. After oven drying, the bricks were taken to a furnace of heat capacity of 1500 - I 800°C where the bricks were sintered. It is preferable to sinter at a high temperature. At the end of firing, the bricks are allowed to cool down within the furnaces and later, they are brought out to cool down before checking and measuring the characteristics under study. Most of the tests carried out involved cutting a section of the sintered dolomite refractory brick with a cut off wheel as specified by the refractory testing standards.

2.2 Methods

2.2.1 Chemical Analysis of Dolomite

Flame spectroscopy was utilized in the determination of the chemical composition. It involves obtaining a sample in an appropriate solution, evaporating same into atomic vapour and passing it through the equipment and detecting the wavelengths in the screen of the detector.

2.2.2 Loss on Ignition (L.O.I)

About 100g of dolomite was subjected to heating in a muffle furnace and later cooled in a desiccators and weighed. Thereafter, the L.O. I was calculated using the formula

Loss on ignition (LOT)
M2-M3 X 100% 2.2
M2-Ml
Where
M1 = Mass of dried porcelain crucible
M2 = Mass of sample of dolomite and porcelain crucible

M3 = Mass of heated dolomite and porcelain crucible

3.0 RESULTS AND DISCUSSION

The experiments and all the approaches at arriving at the objectives of this research yielded results, which are presented in tables and discussed in this section.

3.1 Chemical Composition of Dolomite

The chemical composition of the locally found dolomite under investigation is shown in Table 3.1. Calcium oxide (CaO) and Magnesium oxide (MgO) are the two major components of the dolomite refractory. For dolomite to be useful as a refractory it must have a reasonable percentage of Magnesium Oxide (MgO). This distinguishes dolomite from Limestone. Limestone is richly made of calcium oxide (CaO) and very small percentage of MgO.[9]. From the table, all deposits study have MgO content of 20.76%,20.66 % ,20.16%and 20.46% while the dolomite at sample number 2 measures an MgO content of 20.76%. Hence most of the dolomite found in pandikunta village can be used for refractory purpose judging by their chemical composition. During the chemical analysis, it was found out that the samples have some percentages of $Si0_2$, $Al0_3$, $Fe20_3$, Na_20, K_20 and $Mn0_2$ as expressed on Table3.1 According to [3], high preponderance of Si02 have some deleterious effects on the refractoriness of refractories. Si02 in small quantity is also known to be a good source of tricalcium silicate which is regarded as the most stabilized form of dolomite refractory. The low content of $Si0_2$ and $Fe20_3$. Low fluxing oxides possess a high crushing strength, high slag resistance and a much higher melting point (9). This makes these grades of dolomite desirable for refractory use and comparable with dolomite refractory in use in China, England, India and France.

4.0 CONCLUSION

After a close study of the results of the experiments, the following conclusions are hereby made:

The results of the investigation were very useful and serve as a database for prospective investors and mangers of metallurgical industries.

The tests on chemical composition were carried out on all the Thirteen (13) samples in accordance with National Accreditation Board for Testing and calibration laboratories, Department of science & Technology, India.

Chemical analysis revealed that majority of the Pandikunta Village dolomite have chemical composition comparable to dolomite currently in use in India. They possess good contents of CaO and MgO and can therefore be used for

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refractory applications.

Concentration Maps:

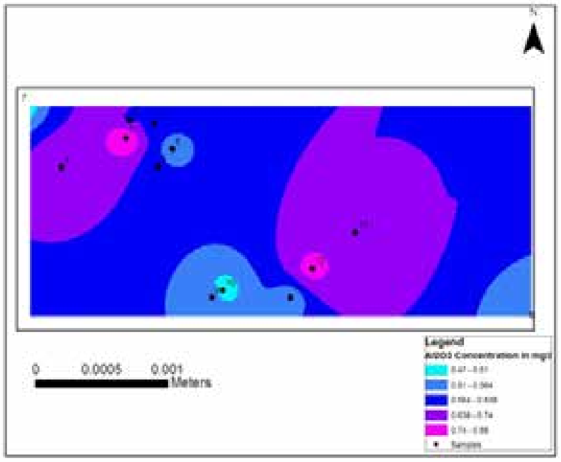

Fig:2 Al_2O_3 Concentration

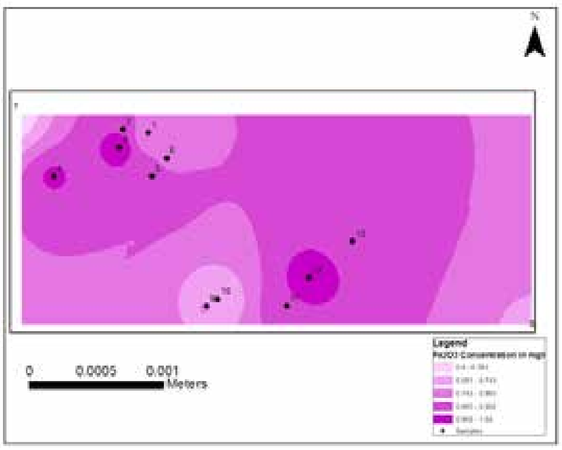

Fig:3 Fe_2O_3 Concentration

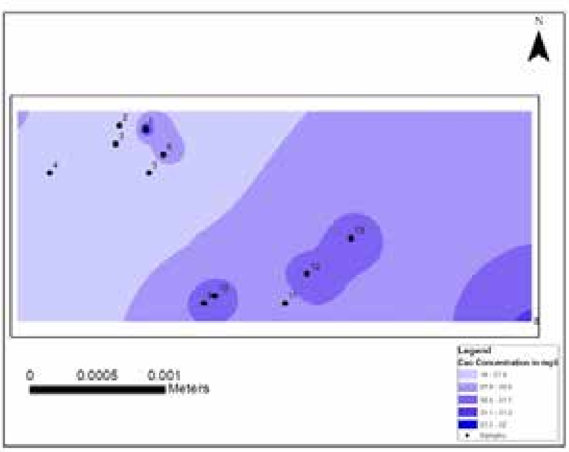

Fig:4 Cao Concentration

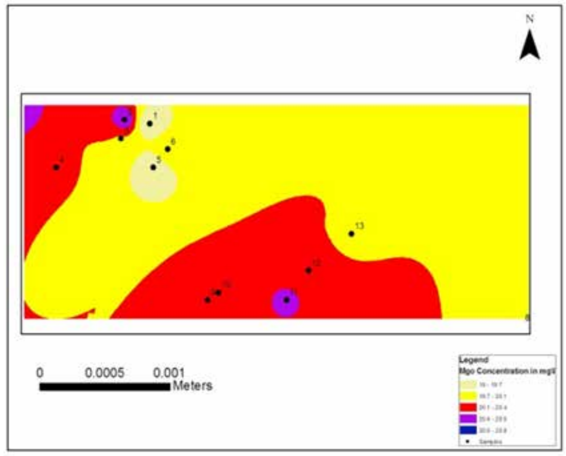

Fig:5 Mgo Concentration

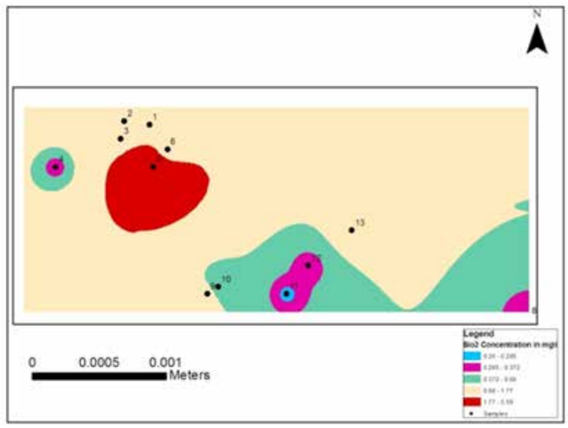

Fig:6 SiO_2 Concentration

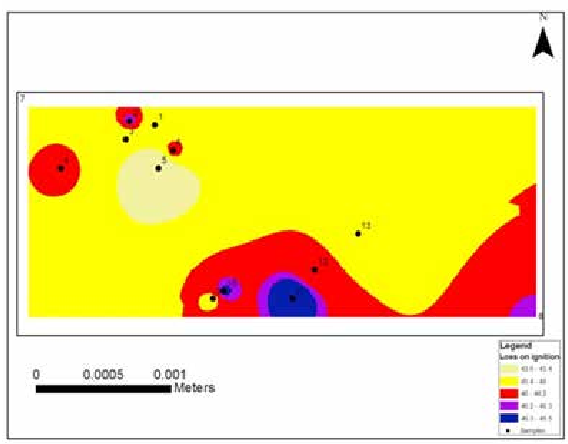

Fig:7 Loss of ignition

Table:3.1 Chemical Composition of raw Dolomite (%)

Sam-ples	Lati-tude	Longi-tude		Loss on ignition	Sio2	Fe2O3	Al2O3	Cao	Mgo
1	18 8 39.4	79 54 36.6	273	45.92	0.63	0.68	0.57	32	19.03
2	18 8 38.7	79 54 36.7	274	46.34	0.35	0.96	0.62	20.76	20.76
3	18 8 38.6	79 54 36.2	276	45.39	1.66	1.04	0.88	20.05	20.05

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4	18 8 36.8	79 54 35.4	280	46.2	0.27	0.98	0.73	20.16	20.16
5	18 8 39.5	79 54 35.4	276	43.64	5.59	1.02	0.57	19.03	19.03
6	18 8 39.9	79 54 35.9	274	46.25	0.5	0.8	0.52	30.58	20.26
7	18 8 35.6	79 54 37.1	282	45.86	1.79	0.4	0.47	29.73	20.66
8	18 8 49.9	79 54 31.1	276	46.24	0.32	0.72	0.52	31.15	20.05
9	18 8 41.0	79 54 31.8	278	45.92	1.03	0.76	0.57	30.58	20.16
10	18 8 41.3	79 54 32.0	277	46.34	0.28	0.59	0.47	30.72	20.46
11	18 8 43.2	79 54 31.8	279	46.48	0.26	0.96	0.52	30.3	20.46
12	18 8 43.8	79 54 32.6	277	46.1	0.29	1.02	0.78	30.72	20.15
13	18 8 45.0	79 54 33.6	273	45.69	0.92	0.94	0.73	30.58	20.05

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