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DRY MAGNETIC SEPARATION OF MAGNESITE FROM FINE FRACTION OF SANTIYE MAGNESITE REJECTS*

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Magnetic concentration study on a fine fraction of hand picked santiye magnesite rejects left in a sink-float operation has been carried out. The fines (minus 0.5 mm) were subjected to high intensity dry magnetic separation to recover magnesite from serpentine gangue. By fixing various parameters of magnetic separator and depending upon the extent of silica ranging from 3.0 to 18.0% in the samples, various grades of magnesite concentrate were obtained.

Based on experimental data some standard graphs have been presented which may be applicable for predicting the suitability of magnetic separation of SiO_2 gangue from calcined magnesite or the natural ore.

INTRODUCTION

High grade magnesite containing over 42% magnesia, after calcination is used for the production of basic refractory for steel making.

The quality of refractory so produced depends upon the extent of silica, lime and iron present in the ore. For the production of a good grade refractory, it is necessary to remove these constitutents by mineral processing techniques to a desirable limit [1].

Gravity based concentration processes and flotation methods are extensively used for upgrading magnesite ores [2,10]. But the ore fines if treated by the above mentioned techniques create a lot of problems. Special techniques, however, are employed to recover magnesite from fine fractions of the ore.

Magnetic separation method seems to have better scope for the treatment of fine fraction of magnesite and the ore containing silica or serpentine in disseminated form. Over ten million tonnes of magnesite ore reserves have been located at Santiye in Avdan District of Western Turkey. A Turkish firm named Continental Magnesite Company is exploiting santiye magnesite deposits and using hand picking process for good quality magnesite, for the production of high quality sintered magnesite and rejecting the low grade ore containing an appreciable amount of serpentine [11,12].

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Based on intensive investigation Dogan and his associates [2] established a sink and float concentration method for the recovery of magnesite from the Santiye rejects. A series of sink – float tests reported indicates that a good grade magnesite concentrate can be produced from the rejects in the size range of –30 mm to +0.5 .The sink-float method due to its limitations was not found applicable to treat the –0.5 mm fraction which contained considerable amount of magnesite and made about 10% of the total feed.

For achieving optimum recovery and making the sink-float method [13] more economical, the incorporation of a magnetic separation method for the recovery of magnesite from the fines (–0.5 mm. fraction) has been worked out.

MATERIALS AND METHOD

Sample preparation. Four trench samples of hand picked rejects of magnesite ore were obtained from the company. Samples were crushed to –15 mm in a jaw crusher and the following size fractions were obtained for almost all the samples.

Fractions 1 and 2 in Table 1 were treated by sink-float method, whereas fraction 3 in each sample was subjected to dry high intensity magnetic separation for the removal of serpentine.

The average screen analysis of –0.5 mm fraction is given in Table 2.

Table 1. Size analysis of crushed magnesite ore.

S. No.	Size fraction	Weight %
1.	–15 mm. + 3.35 mm.	73.9
2.	–3.35 mm. + 0.50 mm.	16.7
3.	–0.50 mm.	9.4

Liberation studies on the ore were carried out by using a binoccular microscope after crushing the sample. Complete liberation found at –0.5 mm (30 mesh).

The chemical analysis of samples for determining the silica content were carried out on a Unicam SP600 Series 2 Spectrophotometer.

Magnetic Concentration Tests. A cropco M-127 dry high intensity induced roll magnetic separator was used for magnetic separation. The parameters controlling magnetic separation were mainly, the field strength or current, setting or speed of roller, and the angle of splitter blade.

A series of tests were carried out to optimize the parameters, in order to obtain the clean separation of setting of three amperes current and rotor speed of 20 rpm keeping the cutter blade to the extreme left position.

The magnesite ore samples were run on the above fixed setting for the removal of serpentine. The concentration tests were extended to the calcined magnesite samples. Samples were calcined at 900^{o} for 6 hours in an electric furnance. They were cooled and subjected to magnetic separation at the previously fixed settings.

RESULTS AND DISCUSSIONS

The results of dry magnetic separation tests of magnesite ore containing different percentages of silica, before and after calcination are given in Figs. 1 and 2.

Fig. 1 describes magnetic concentration tests on the calcined material. It shows a plot of silica percentage in the feed versus silica percentage in the concentrate (non magnetic product) and designated as Graph 'A', whereas the silica percentage versus the weight percentage in the concentrate recovered is plotted in Graph 'B'.

Fig. 2 is based on the results of magnetic concentration tests on natural magnesite ore samples. It shows a plot of silica content in feed *versus* silica percentage in the concentrate (non-magnetic product) as Graph 'A', whereas the silica percentage in feed *versus* weight percentage in the concentrate recovered is plotted in Graph 'B'.

The specifications generally considered in the U.S.A. for silica limits in calcined magnesite or concentrate for recovery use are as follows:

SiO_2 %	Grade
Extra 1	2.0
Extra 2	4.0
Special	5.0

Figs. 1 and 2 may be used for predicting the grade of concentrate in respect of SiO_2 obtained and weight recovery of non magnetic fraction (mostly magnesite) either from calcined ore or natural magnesite.

In Fig. 1, considering Graph "A" a calcined magnesite containing 6.6, 11.3 and 13.6% silica may be concentrated by magnetic separation to Extra 1, Extra 2 and Speical grades, containing 1.90, 3.90 and 4.85 per cent silica respectively. Whereas the Graph "B" gives respective weight recoveries of non-magnetic fractions equal to 70.0, 60.0 and 54.0%. It may be realized from graph that the calcined magnesite containing above 13,6% silica, can not be concentrated even to obtain Special grade of magnesite acceptable for commercial purposes.

Table 2. Screen analysis of minus 0.5 mm. fraction.

S. No.	Mesh size (B.S.)	Weight %	Cum. weight %	Silica %
1.	– 30 + 36	2.50	2.50	13.56
2.	– 36 + 44	11.07	13.57	13.31
3.	– 44 + 72	20.56	34.13	15.60
4.	– 72 + 100	12.22	46.35	16.51
5.	–100 + 150	23.18	69.53	16.10
6.	–150 + 200	10.73	80.26	16.88
7.	–200	19.74	100.00	19.81
			Average SiO_2	16.49

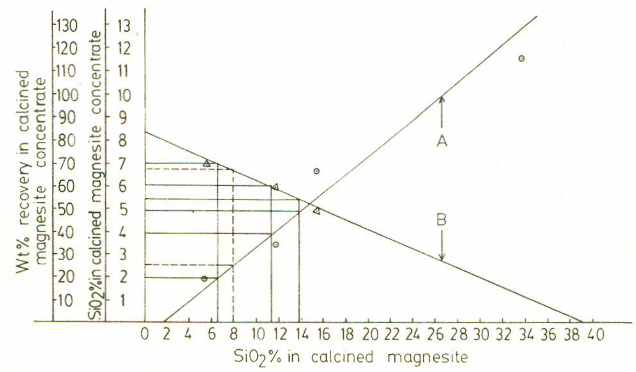

Fig. 1. Relation between: (A) SiO_2 content of calcined magnesite and calcined magnesite concentrate. (B) SiO_2 content of calcined magnesite and percentage weight recovered in calcined magnesite concentrate.

Experimental observations indicate that silica has a tendency to become nearly double on calcination. So in Fig. 2, it is found from Graph "A" that silica values of 3.8,5.8 and 6.9% will give Extra 1, Extra 2 and Special grades on magnetic concentration and the values of 76.0, 68.0 and 63.0% recoveries may be obtained respectively from Graph "B", for the corresponding silica contents.

We can further elaborate the use of above mentioned figures to predict the application of magnetic separation for producing commercial grades of concentrates from any magnesite ore deposit found in Pakistan containing low and high grade silica contents.

For example, we find a magnesite ore containing 4.0 per cent silica and on calcination the silica percentage becomes nearly double, say, 8.0%. From Fig. 1 (drawn from our experimental data) if we take on horizontal axis, 8% silica for the calcined ore and draw a vertical dotted line touching Graph "A", we may read on vertical axis the amount of silica to be present in the concentrate produced by magnetic separation. Which in this case comes out to be 2.5% (Extra 2 grade) and by extending the vertical dotted line till it touches to Graph "B", weight recovery can be read on vertical axis representing per cent recovery. It comes out to be 65%.

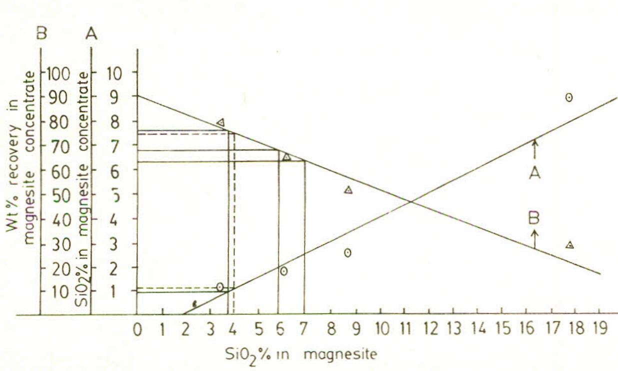

Fig. 2. Relation between: (A) SiO_2 content of magnesite ore and magnesite concentrate. (B) SiO_2 content of magnesite ore and percentage recovered in magnesite concentrate.

In the case of treating the original ore containing 4.0% Fig. 2 may be used for predicting the amount of silica content to be resulted in the concentrate by magnetic separation and its weight recovered may be found in the same way as described above for the calcined ore. So, if the ore contains 4.0% silica then the concentrate will have 1.1% silica and the weight recovery will be 75.0%.

Figs. 1 and 2, therefore, will not only help to predict the grade and weight recovery of the concentrate obtained by applying dry magnetic concentration either to calcined magnesite or original ore but also may help to finding out the limit of its application to an ore containing considerable amount of silica.

CONCLUSION

According to our experimental data we can safely say that dry magnetic separation, if applied in combination with sink-float method to Santiye magnesite rejects, improves the recovery of magnesite significantly (about 8.0%). Thus, economics of sink-float operation on the rejects may be improved considerably by this method.

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