

NOTE ON THE SORTING, CLASSIFICATION AND BRIQUETTING OF CHROME AND MANGANESE ORES.

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During mining operations it is inevitable that considerable quantities of low grade ore are obtained which cannot be disposed of profitably, while in the course of time there is a tendency for the quality of the ore to deteriorate owing to the removal of the higher grades. These facts have led to the extensive introduction of concentrating plant which has proved of the utmost value in many cases, particularly where sulphide ores are concerned. It is obvious, however, that when the ore-body is homogeneous or very nearly so, concentration is of little value.

In Mysore there are extensive deposits of chrome and manganese ores varying greatly in quality and it is a matter of some difficulty to distinguish the rich from the poor ore without recourse to analysis, consequently it was considered advisable to make a systematic examination of a number of samples in order to decide, if possible, the best means of recognizing the various qualities in the field. Some experiments were also made in concentrating some of the lower grade ores, and, in view of the fact that a great deal of the ore is in the form of powder which renders transportation somewhat difficult, attempts were made at briquetting this powder with various binding materials.

SORTING.

Samples of chromite from deposits at Arsikere, Sunkadahalli and Navale were examined. In most cases the ores could be sorted into well defined groups according to their appearance when broken. At Arsikere, five such types could be recognized but at Sunkadahalli only two. At Navale there is a reef of uniform appearance which cannot be classified, but boulders are also found in this locality and these can be separated into four types.

Lots weighing about 10 cwts. of each type were selected at the mine on different occasions by different people, crushed, sampled and analyzed. The results of the analyses of the different lots agreed within 1.5 per cent. for each type showing the reliability of the method. Table I shows the mean percentage of Cr_2O_3 in the various samples.

TABLE I.

Cr₂O₃ content of different types of chromite.

Type.	Navale.	Sunkadahalli.	Arsikere.	
	Cr ₂ O ₃	Cr ₂ O ₃ .	Cr ₂ O ₃ .	Density
Pink coarse grained ...	46.1	...	48.3	4.04
Pink fine grained ...	43.1	...	...	...
Dark steely ...	...	42.5	46.5	4.23
Pale steely ...	...	31.9	40.2	4.03
Yellowish brown ...	42.0	...	34.3	3.86
Do. do. speckled ...	38.4	...	...	...
Laminated ...	...	...	33.7	4.05

From these results it appears that although the appearance of the freshly broken surface affords a means of distinguishing high and low grade ores in different districts, it must not be assumed that samples of similar appearance from different localities will have the same chromium content. Nevertheless, the method is of considerable practical value when dealing with the output of a particular mine.

In the case of manganese no such correlation between fracture and composition has been found.

The densities of the Arsikere samples were measured, the values being shown in the last column of Table I, but these afforded no clue to the chromium content. This might be expected from the fact that the iron in chromite FeO. Cr₂O₃ may be replaced by magnesium and other substituents. Such a replacement would lower the density and increase the chromium content, while an admixture with foreign bodies or replacement of the Cr₂O₃ would lower both the density and the chromium content.

The density of a few samples of manganese ore was also determined. Specimens containing 52, 47, and 40 per cent. of Mn had specific gravities 4.29, 4.32, and 4.30 respectively so that in this case also there is no correlation.

CONCENTRATION.

100 lbs. lots of ore were crushed until the whole would pass through a 10 mesh sieve. By successive quartering and crushing a

sample of this was drawn and analyzed. About 60 lbs. of the powder were washed on a small laboratory Wilfley table and the concentrate and tailings collected in separate trays. The products were dried, weighed and analyzed. Table II shows the results obtained.

TABLE II
Results of concentrating chrome and manganese ores.

Mine.	Constituent.	Percentage in			Weight in lbs. of concentrate per 100 lbs. ore	Percentage of total Cr_2O_3 or Mn lost in tailings.
		Original ore.	Concentrate.	Tailings.		
Arsikere (a) ...	Cr_2O_3	36.3	44.3	4.4	80	2.4
	FeO	22.3	18.4	...	...	...
	SiO_2	8.7	6.3	...	...	...
Arsikere (a) 20 mesh ...	Cr_2O_3	36.3	46.2	...	74	5.8
	SiO_2	8.7	4.5	...	...	...
Arsikere (b) ...	Cr_2O_3	22.0	42.9	...	47	8.4
Sunkadahalli ...	Cr_2O_3	37.1	45.0	...	80	3.0
	FeO	22.7	18.3	...	...	...
Bairapur ...	Cr_2O_3	44.2	53.5	...	72	12.8
	FeO	28.0	24.8	...	...	...
Karekuchi ...	Mn	33.5	42.8	19.0	62	20.8
	Fe	24.1	21.5	...	...	...
	SiO_2	10.2	6.4	...	...	...
Mahadevpur ...	Mn	37.2	44.6	...	64	22.8

It is evident from these figures that considerable improvement in the quality of some chrome ores can be effected by this method with very little loss of chromium, but the results are not so satisfactory for the manganese ores.

BRIQUETTING.

If concentration of ores in the manner outlined were to be undertaken, a difficulty would arise with regard to the transportation of the product, since it has not so far been found practicable in this country to transport and ship powdered ores in bulk. The usual practice in the case of pyrolusite powder is to pack the mineral in bags, a somewhat costly method which does not entirely prevent loss of the contents.

The following experiments were made upon the feasibility of forming the powder into briquettes which could be transported in bulk.

1. *Tar*.—Wood tar was thickened by heating for some time at 100° and to the hot liquid the calculated quantity of concentrate was added gradually, mixing thoroughly after each addition. The mass was transferred to a brick-mould and well pressed in a firebrick press and then taken out of the mould. Some briquettes were allowed to dry in bright sunshine, some were heated for 3 days at about 100° and some others for the same time at about 400°. Although the proportion of tar was raised to 5 per cent. in no case was a satisfactory briquette obtained. Higher proportions of tar gave stronger briquettes but are prohibitive on account of the price.

2. (a) *Clay*, (b) *Lime* and (c) *Magnesia*.—Quantities of these up to 3 per cent. of the weight of the concentrate were added, mixed with enough water, and pressed into briquettes. The briquette obtained with bond (a) was heated at about 400° for 3 days and the others at 100° for the same time. The briquettes obtained were very weak.

3. *Magnesium Oxychloride*.—Various proportions of a mixture of magnesium oxide and chloride were thoroughly mixed with the concentrates, pressed and allowed to dry in the air. Even after 10 days the briquettes obtained were not strong enough for transit.

4. *Sodium Silicate*.—On mixing the concentrates with 1.5 per cent. of their weight of a warm 35 per cent. solution of sodium silicate and pressing the product a fairly satisfactory briquette was obtained even after air drying for about a week. If the briquette is kept at 200° for 2 days, it gets quite strong and remains intact even when dropped freely through about 3 feet on to a stone floor, but if heated to about 600° it becomes decidedly weaker. The cost of briquetting the concentrate by this method amounts to about Rs. 3 per ton, whereas bags for the same quantity cost at least Rs. 10.

SUMMARY.

1. The grade of a chrome ore can be ascertained with some exactness from its appearance when broken but this is not so in the case of manganese ores.
2. Specific gravity is not a reliable indication of the grade of chrome and manganese ores.
3. Several types of low grade chrome and manganese ores can be concentrated on the Wilfley table. In the case of chrome ores, the loss of chromium during concentration is small.

4. Sodium silicate is one of the best bonds for the briquetting of concentrates. Briquettes made with 1.5 per cent. of a 35 per cent. sodium silicate solution and heated to 200° are strong enough to withstand rough handling.

In conclusion it is my pleasant duty to thank Dr. Watson and Dr. Sudborough for their kind guidance and Mr. C. B. Oakley for generously providing the necessary facilities for the collection of the samples which were necessary for this work.

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