1910

The concentration of a pyrolusite ore

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T H E S I S

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OF

BACHELOR OF SCIENCE

-SUBJECT-

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THE CONCENTRATION OF A PYROLUSITE ORE.

This is the history of an attempt to produce from a pyrolusite ore, a material sufficiently rich in manganese to be of value in the various industries such as the making of speigeleisen and ferro-manganese, the glass manufacturing and the chemical industries.

The greater part of the manganese used in the United States comes from Brazil, India and Russia. Our American ores are, in general, low grade and requires various preliminary concentration to fit them for use. Although we possess in this country a great deal of manganese ore, which could be put into suitable condition for the market, there has, up to this time, been little done with these ores.

Virgina, Georgia and Arkansas are the most important manganese producing States. The ores are usually mixtures of pyrolusite, and psilomalane, with some braunite and manganite. These ores are found, in pockets or lenses of various sizes, in nodular form and mixed with clay.

In the Crimora mine, one of the largest in Virginia, the ore is found as rounded concretions and in irregular stringers and masses in a red clay. The metallic manganese content varies from 12% to a 60% product which may be obtained by careful picking.

The ore here is mined by hydraulicing, the water and ore being run into a sump. From the sump the material is hoisted to an inclined log-washer to clean the clay from the manganese nodules. The nodules are then crushed and sent to another horizontal log washer where the last of the clay is removed. The concentrate from this washer goes to a trommel with 5/8 inch holes. The trommel oversize is sent to hand-picking belts, from which are obtained a picked concentrate ready for market and a reject ready for the dump. The trommel undersize is further screened into a number of sizes and jigged. The jig concentrates join the hand picked ore and both go to the market, all of the concentrate averaging about 48% manganese.

The ores of Arkansas are largely mixed with iron and are generally considered manganese iron ores. These ores occur in continuous veins or beds and do not require concentration.

The Franklinite ores of New Jersey furnish a large quantity of manganese. The manganese in this case is separated from the iron of the zinc residuum by magnets. There is obtained a manganese product sufficiently rich to be marketable.

In Colorado large quantities of manganese silver ores are mined. The lead and silver usually are of small

value and the ores are used chiefly as flux in the lead furnaces. The chief district is Leadville.

The material upon which these experiments have been made is from the Kerber Creek District of Saguache County, Colorado. The ore occurs in fissure veins in a quartz porphyry. The veins vary from an inch to six feet in width. Free quartz is mixed with the pyrolusite.

Our experiments show that the quartz exists in all sizes from that which will not pass a three inch ring to some which will pass a one-hundred-mesh screen. The manganese coats the quartz and is of varying sizes from chunks the size of the fist to material which will pass through a two hundred mesh screen. The larger part of the manganese will pass a one-hundred-mesh screen with very little rubbing. The pyrolusite is decomposed and soft.

Two hundred pounds of the ore was carefully sampled as follows:-

The entire ore was crushed through a ring and then cored and quartered, followed by subsequent crushing of the sample through one-half inch. The sample was again cored and quartered and the Jones sampler used to reduce the sample to two hundred grams, which was put through eighty mesh for assay.

The following table shows the analysis:

Mn.	17.81 %.
Fe.	5.61 "
S I O 2	46.44 "
A i 2 O 3	4.32 "
C a O	1.42 "
P	0.00 "
S.	tr
O2 and other substances(by difference)	24.40 "
	100.00

The first concentration attempted, was by means of hand picking, four pounds of ore being taken, making three products, hand picked waste, hand picked concentrate and fines.

The following results were obtained.

Waste	480. Grams
Conc.	370 " "
Fines.	1060 "

Each product was carefully crushed and sampled and the following analyses were obtained.

	Mn.	Fe.	Si02
Waste	6.02	5.40	54.30.
Conc	27.80	12.10	20.60.
Fines	17.20	8.90	39.20.

Sufficient concentration could not be effected by hand picking, since too small a percent of concentrates were obtained.

We next made a series of sizing tests, by putting a two pound sample thru a series of screens, ranging from 2 mesh to 100 mesh, weighing and analyzing the part left on each screen.

The samples assayed as follows.

Mesh	Wt	% Mn	% Si 02	% Fe.
On 2	160 gms	12.7	66.4	6.86.
" 2 1/2	74	12.9	64.2	6.61
" 3	56	14.08	52.01	6.47.
" 3 1/2	38	14.5	52.3	7.33.
" 4	18	15.2	50.7	9.26.
" 5	6	14.7	47.82	8.41.
" 6	27	15.5	48.3	7.37.
" 8	55	15.93	46.9	7.62.
" 10	37	16.2	46.8	8.10.
" 12	27	15.81	44.2	7.26.
" 14	35	16.37	41.27	7.84.
" 16	16	16.41	41.16	8.28.
" 18	29	17.1	40.4	8.95.
" 20	13	17.43	37.6	9.71.

No	Mesh	Wt	% Mn	% Fe	% Si02
"	24	26	18.1	9.54	35.8.
"	30	33	21.61	9.12	37.2.
"	35	9	24.2	9.76	33.6.
"	40	19	24.21	10.84	31.5.
"	50	43	24.76	11.63	32.3.
"	60	16	25.3	9.87	28.6.
"	70	12	27.1	11.42	30.06.
"	80	14	27.6	13.47	25.1.
"	90	3	31.4	12.34	14.7
"	100	129	35.8	13.91	12.1 .
		742 gms.			

We used 2 pounds of ore 138 grams of them were lost in the screening.

These results suggested that concentration might be effected by removing the fines from the ore and that the manganese would be mostly in these fines while the quartz remained mostly in the coarse material. Gentle crushing or abrasion seemed to disintegrate the pyrolusite without greatly abrading the quartz.

Following up this suggestion, the ore was passed thru a tube mill, with the quartz of the ore as the grinding agent. The tube mill was followed by a log-washer.

The product from the lower end of the washer, was manganese concentrates, the quartz being delivered at higher end and discarded as waste.

48 ounces of ore gave 15 ounces of concentrate .The assays of the concentrate was as follows.

Mn----------33.2 %

Fe---------- 8.6 "

SiO2---------- 29.1 "

The percent extraction, was as follows.

Mn---------- 44. %

Fe---------- 30.6 "

The manganese concentrates must be sent to a settling tank, and the water syphoned off from the settled pyrolusite. The manganese percentage in the concentrate from this experiment was lower, and the SiO2 percentage higher than desired.

We next followed the tube mill with a classifier the overflow being concentrates and the settlings waste.

Results were as follows, a product obtained which analyzed.

Mn---------- 37.16.

Fe---------- 8.20.

SiO2---------- 24.30.

The percent extraction of manganese ----------62.0 %

The percent extraction of Iron---------- 59. "

This last method of concentration gave us our best results. It is very simple as to machinery required and the cost should be low.

Prices;

The prices per long ton paid by the Cambria Steel Co; for manganese ores F. O. B. furnaces are as follows,

Above 49 % Mn----------$0.30 per unit

46 to 49 % (Indusive)---------- 0.29 " "

43 to 46 " " ----------0.28" "

40 to 43 " " ---------- 0.27 " "

On Ores with less than 40 % Mn, two cents per unit is deducted. The Fe content is paid for at six cents per unit.

For Silica in excess of 8 % a deduction is made of $0.15, per unit. A deduction is also made for Phosphorous of $.02 per unit of Manganese, for each 0.02 % phosphorous or fraction thereof in excess of 0.25 % Phosphorous any ore with SiO2 in excess of 12 % or Phosphorous in excess of 0.27 % is subject to acceptance or refusal at the buyers option. Settlements are based on analysis of sample dried at 212 degrees F, and the % of H_2O is deducted from the gross weight of ore.

High grade manganese ores are used in the chemical and electrical industries, also in the manufactures of

glassware, the prices for the ore ranging from $.01 to $0.20 per pound, depending sometimes upon the Mn content and sometimes on the available oxygen content.

Conclusions.

From this series of experiments we have found that the ore may be successfully and cheaply concentrated by the following scheme.

The ore from the mine is roughly hand picked and the sent to a tube mill, using the quartz of the ore for pebbles. From the tube mill the pulp is sent to a one-half inch trommel, where large particles of quartz are eliminated. The trommel is followed by a classifier, which makes two products; overflow, which is saved, and spigot which is discarded. The overflow is sent to a pond where the slimes are settled, and the water decanted or syphoned off. The concentrates may be shoveled out and sent to manufactures of spiegeleisen or ferro-manganese. We believe that, by this scheme, we can obtain cheaply a product containing above 40% metallic mangenase.