Magnetic and Electrical Separation,
Vol. 11, No. 1–2, pp. 1–8

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A LARGE SCALE APPLICATION OF SLON MAGNETIC SEPARATOR IN MEISHAN IRON ORE MINE

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(Received 18 September 2000; In final form 12 October 2000)

Meishan Iron Mine processes 4 million tons of iron ore and produces about 2.6 million tons of iron concentrate annually. Because of a relatively high content of phosphorus, the iron concentrate does not meet the market requirements. In recent years, 18 SLon-1500 magnetic separators have been applied to reduce phosphorus to upgrade the concentrate quality. This paper describes research, test work and industrial application of SLon magnetic separator in the mine.

Keywords: Hematite; Siderite; Dephosphorisation; SLon pulsating magnetic separator

INTRODUCTION

There is a large iron ore deposit at Meishan Iron Mine in Jiangsu Province of China. In 1970s, a iron ore mining and processing line was built up, producing about 1.3 million tons of iron concentrate a year. The iron concentrate was used as raw material for pellets. However, because of a relatively high content of sulfur and phosphorus (phosphorus is very difficult to remove by metallurgical method). the iron concentrate could not be used alone as a raw material for pellets but as an auxilliary material. Thus, the production of the iron concentrate was limited by the market.

In 1980s, the mine planned to expand its mining and processing scale to 4 million tons a year. The biggest problem was how to reduce phosphorus in the iron concentrate. The mine cooperated with several

ISSN 1055-6915 print:
DOI: 10.1080/07313630290002554

research institutes and conducted various research work and tests. Finally a magnetic flowsheet and a flotation flowsheet were chosen to carry out separate commercial tests in 1995. Both flowsheets obtained very close results but the magnetic one at much lower cost and much more environmentally friendly. From 1996 till 2000, the mine innovated its first processing line and built a second processing line with the magnetic flowsheet and 18 SLon-1500 Vertical Ring and Pulsating High Gradient Magnetic Separators (SLon-1500 VP HGMS) were applied in the 4 million ton production line.

THE PREVIOUS PROCESSING FLOWSHEET

In 1970s, Meishan Iron Mine built its first iron ore processing flowsheet as shown in Figure 1. The mined ore was crushed and screened to $-30+2$ mm, then treated by a gravity vibrating chute.

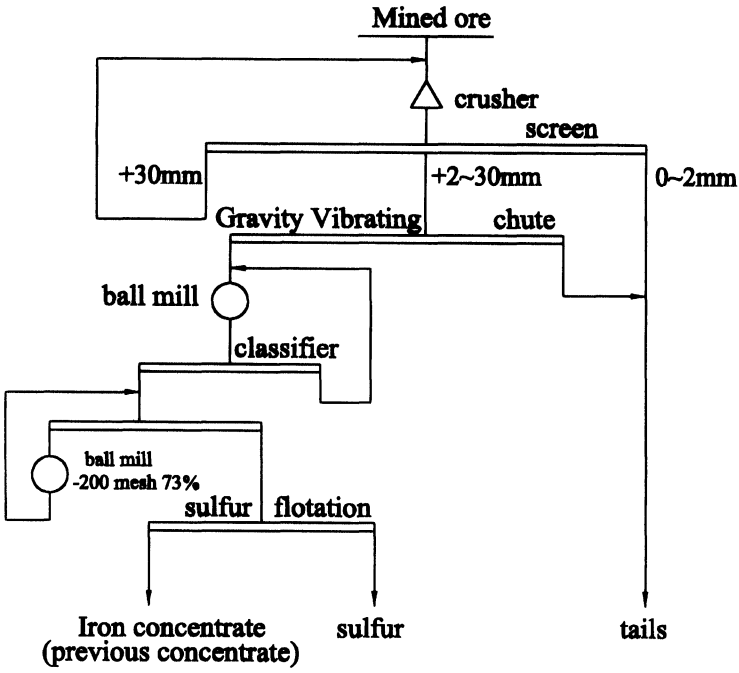

FIGURE 1 The previous processing flowsheet of Meishan iron ore.

The enriched iron ore was milled down to about 70% −200 mesh with ball mills and treated by flotation to remove sulfur minerals such as pyrite. The concentrate was the final product but it contained too much phosphorus.

MINERALAGICAL STUDIES OF THE MEISHAN IRON ORE

The mineralogical compositions of the Meishan mined ore and the concentrate are shown in Table I.

The assay of the Meishan mined ore and the assay of the iron concentrate (see Fig. 1) are shown in Table II.

Table I shows that the iron minerals in the mined ore and the concentrate consist mainly of magnetite, siderite and hematite. Table II shows that the concentrate contains 0.393%P, which is much higher than the metallurgical requirement of $< 0.25\%$. Sulfur is also higher than the metallurgical requirement of $< 0.35\%$.

A COMMERCIAL TEST OF THE FLOTATION FLOWSHEET

In order to compare the results and reliability of the magnetic flowsheet, a commercial test of the flotation flowsheet was carried out in 1995 before magnetic flowsheet test. The flotation flowsheet is shown in Figure 2. In the flowsheet low intensity magnetic separators

TABLE I Mineralogical composition of the Meishan mined ore (Fe %)

Iron mineral	*Magnetite*	*Siderite*	*Hematite*	*Pyrite*	*Silicate*	*Total*
Mined ore	21.84	10.32	8.58	2.76	3.00	46.50
concentrate	26.92	10.34	14.46	0.441	1.60	53.76

TABLE II The assay of the Meishan iron ore and concentrate (%)

Element	*Fe*	*S*	*P*	SiO_2	Al_2O_3	*CaO*	*MgO*
Mined ore	46.5	1.91	0.366	9.98	1.87	4.87	1.85
Concentrate	53.96	0.45	0.393	5.07	0.86	4.10	1.81
Metallurgical requirement		< 0.35	< 0.25				

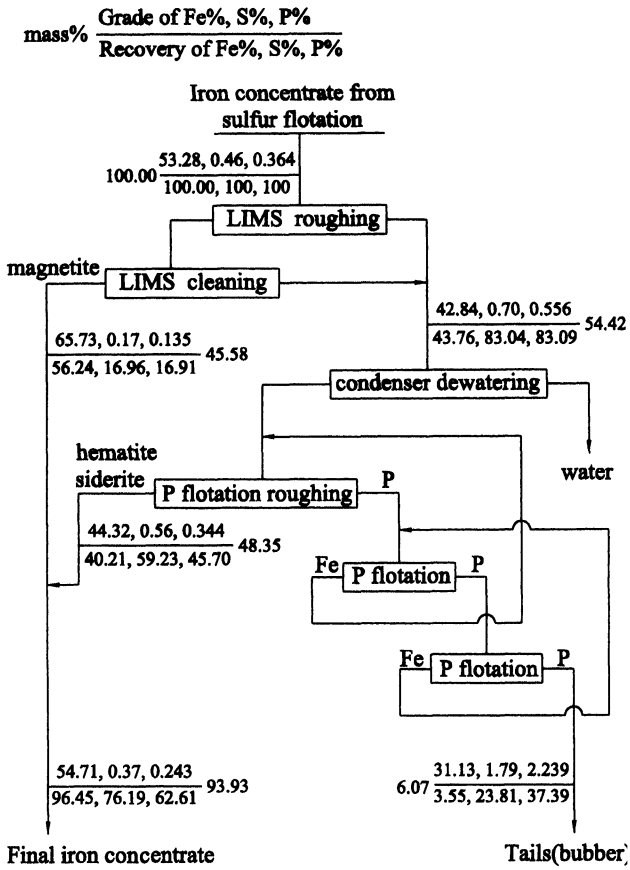

FIGURE 2 A flowsheet and results of the flotation commercial test.

(LIMS) were used to remove magnetite, the nonmagnetic fraction from LIMS was dewatered and then fed into the flotation stage to remove phosphorus. The 176hour commercial test results of flotation flowsheet are shown in Table III.

TABLE III 176h commercial test results of flotation flowsheet (%)

		Grade			*Recovery*		
Product	*Mass*	*Fe*	*S*	*P*	*Fe*	*S*	*P*
Feed	100	53.28	0.46	0.364	100	100	100
Concentrate	93.93	54.71	0.37	0.243	96.45	76.19	62.61
Tailing	6.07	31.13	1.79	2.239	3.55	23.81	37.39

A COMMERCIAL TEST OF THE MAGNETIC FLOWSHEET

In 1995, a commercial test of the magnetic flowsheet was carried out following the flotation commercial test. The magnetic flowsheet is shown in Figure 3. In the flowsheet, low-intensity magnetic separators (LIMS) were used to remove magnetite. A SLon-1500 VP HGMS as rougher and another SLon-1500 VP HGMS as scavenger were applied to recover hematite and siderite. These two SLon-1500s shown in Figure 4 effectively recovered fine hematite and siderite, controlled the tailings grade, and guaranteed the total results to

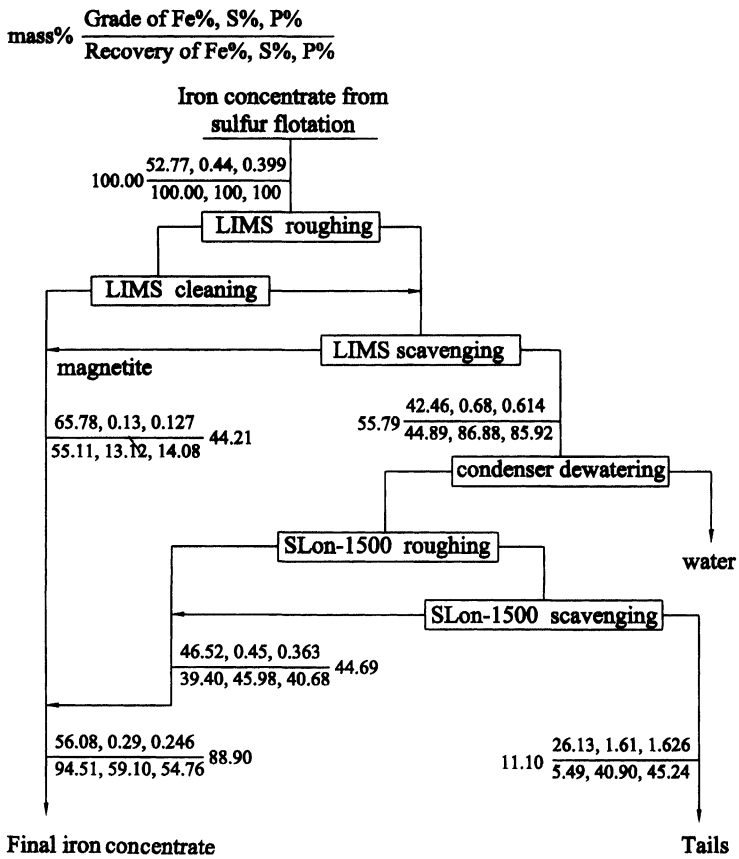

FIGURE 3 A flowsheet and the results of the magnetic commercial test.

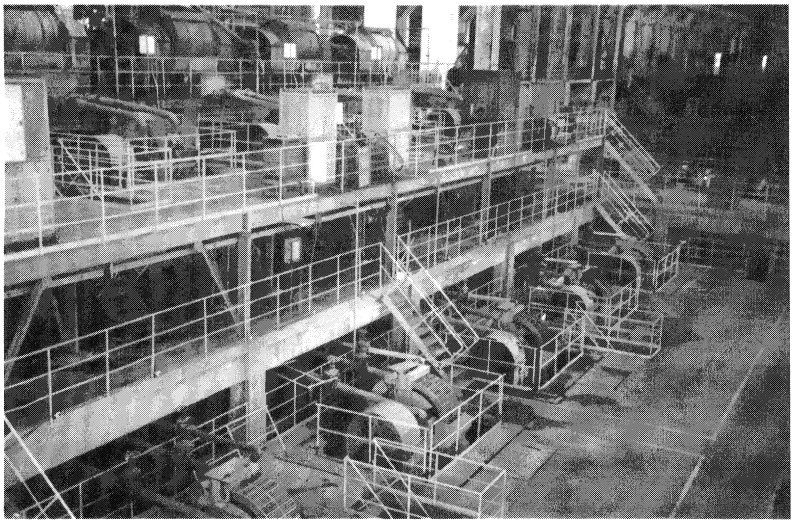

FIGURE 4 SLon-1500 VP HGMS magnetic separators applied in the Meishan Iron Mine.

TABLE IV 276h commercial test results of magnetic flowsheet (%)

		Grade			*Recovery*		
Product	*Mass*	*Fe*	*S*	*P*	*Fe*	*S*	*P*
Feed	100	52.77	0.44	0.399	100	100	100
Concentrate	88.90	56.08	0.29	0.246	94.51	59.10	54.76
Metallurgical requirement		> 55.0	< 0.35	< 0.25			
Tailing	11.10	26.13	1.61	1.626	5.49	40.90	45.24

the metallurgical requirements. The commercial test was run for 276 hours, and 15,393 t of the ore were treated. The results are shown in Table IV, which shows that the quality of the concentrate was considerably improved and met the metallurgical requirements.

A COMPARISON OF THE MAGNETIC FLOWSHEET WITH THE FLOTATION FLOWSHEET

Comparing the results of the magnetic flowsheet and the flotation flowsheet, one can see that the magnetic flowsheet possesses the

following advantages:

(1) The Fe grade of the iron concentrate is higher (56.08% to 54.71%)
(2) The S grade of iron concentrate is lower (0.29% to 0.37%)
(3) The P recovery in the iron concentrate is lower (54.76% to 62.61%)
(4) Magnetic flowsheet does not need any reagent. Its running cost is much lower.
(5) Magnetic flowsheet does not cause any environment problem.
(6) Magnetic concentrate is much easier to dewater.

INDUSTRIAL APPLICATION OF MAGNETIC FLOWSHEET

Because the magnetic flowsheet possesses a number of advantages compared to the flotation flowsheet, Meishan Iron Mine finally adopted the magnetic flowsheet to reduce phosphorus in the iron concentrate. Since 1996, the mine has innovated its previous flowsheet with 8 SLon-1500 vertical ring and pulsating high gradient magnetic separators. After several years of running, SLon-1500 showed good performance and reliability. The mine acquired confidence and bought further eight SLon-1500 separators to build additional 2 million ton production line from 1998 to 2000. Moreover, in order to increase the iron recovery, the mine bought another two SLon-1500 separators to recover iron minerals from the −2 mm screening products (see Fig. 1) in 1999. Up to now, Meishan Iron Mine installed eighteen SLon-1500 VP HGMS magnetic separators in its mineral processing line. This is the largest application of SLon VP HGMS separators in China.

CONCLUSIONS

In order to solve the biggest problem of a high conclusions of phosphorus and sulphur in the the iron concentrate the Meishan Iron Mine arranged for two commercial tests in the 1995. One test was the flotation flowsheet and the other was the magnetic flowsheet. Through comparison of hundreds of hours, the magnetic flowsheet showed a

number of advantages, namely better processing results, much lower cost, environment friendliness and easier dewatering of the iron concentrate. The mine finally adopted the magnetic flowsheet for innovation and expansion of its production line. In the course of several years of operation SLon-1500 vertical ring and pulsating high gradient magnetic separators demonstrated their high efficiency and reliability. Up to now eighteen SLon-1500 VP HGMS magnetic separators have been installed in the 4 million ton iron ore processing line of the Meishan Iron mine.

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