Magnetic and Electrical Separation, Vol. 10, pp. 209–211
Reprints available directly from the publisher
Photocopying permitted by license only

© 2001 OPA (Overseas Publishers Association) N.V.
Published by license under
the Gordon and Breach Science
Publishers imprint.

A CONTINUOUS BARRIER MAGNETIC SEPARATOR FOR THE TREATMENT OF WEAKLY MAGNETIC ORES

A. M. TURKENICH*

National Mining Academy of the Ukraine, Karl Marx 19, 49000 Dnepropetrovsk, Ukraine, Institute of Geotechnical Mechanics of the National Academy of the Ukraine, Simferopolskaya 2a, 49005 Dnepropetrovsk, Ukraine

(Received 19 March 2000; In final form 15 June 2000)

Keywords: Barrier magnetic separator; Permanent magnet separator; Induced magnetic roll separator; Mineral sands; Manganese ore

A serious disadvantage of induced electromagnetic roll separators used for beneficiation of weakly magnetic ores is the need for frequent maintenance of drives and bearings. In addition, power consumption of the roll drives used in the Ukraine and Russia is often greater than that of the magnetic circuits of these separators, as is shown in Table I. Rare-earth permanent magnetic roll separators and drum separators suffer from similar drawbacks.

These disadvantages are absent in continuous barrier magnetic separators. A material to be separated is fed into a zone of separation (matrix) and magnetic and non-magnetic fractions are discharged from the matrix continuously. The separator does not have any moving parts. It is thus not necessary to maintain the drives and bearings and it is possible to reduce the power input by 30 to 50 per cent.

The first barrier magnetic separator was patented by Frantz in 1936 [1]. New inventions in this field were subsequently filed in the USA

*e-mail: turkenich@mailcity.com

TABLE I Power consumption of induced magnetic roll separators

Type of separator	*Material treated*	*Power*			
			Magnetic	*Roll drive*	
		Total (kW)	*circuit (kW)*	*(kW)*	*% of total*
EVM-40/250	Manganese ore wet slimes	58	14	44	> 75
2EVS-38/100	Dry mineral sands	25	10	15	60

and Europe. However, these separators have not found industrial applications as a result of several drawbacks. The most significant impediment is the clogging of the separation channels by magnetic particles, which are attracted to the walls of the channels.

Nevertheless, it is believed that continuous barrier separation is one of the most prospective methods of beneficiation of coarse weakly magnetic ores. The initial results of our investigation in this area were described in several publications [2–4]. Further investigation has resulted in an advanced concept of continuous barrier magnetic separation. The above-mentioned drawback of barrier magnetic separators, namely the breakdown of the process of separation as a result of adhesion of magnetic particles at the walls of the separation channels, has been eliminated. Several applications for the Ukrainian patents have been filed [5].

An application of this new magnetic separation method to the treatment of coarse ores has been investigated in our laboratory. The results are summarised in Tables II and III.

For dry separation of a manganese ore from Russia in $-10+6$ mm size fraction, throughput was increased to 9 t/h/m. Dry separation of -6 mm size fraction of this ore allows to increase the throughput up to 18 t/h/m.

TABLE II Wet separation of -4 mm manganese ore of Marganetzki plant. Throughput: 3.5 t/h/m, magnetic induction: 0.85 T

Products of separation	*Mass yield (%)*	*Grade (%)*		*Recovery (%)*	
		Mn	*SiO_2*	*Mn*	*SiO_2*
Feed	100	33.1	31.9	100	100
Mags	77.1	42.3	13.48	97.6	34.6
Non-mags	22.9	3.5	82.82	2.4	65.4

TABLE III Dry separation of the conducting fraction of the gravity concentrate of the Volnogorsk mineral sands (rutile and ilmenite). Throughput: 3 t/m/h, magnetic induction: 1.1 T

Products of separation	*Mass yield* (%)	*Grade* (%)		*Recovery* (%)	
		Rutile	*Ilmenite*	*Rutile*	*Ilmenite*
Feed	100	26.7	59.4	100	100
Mags	62.0	0.73	94.0	1.8	98.1
Non-mags	38.0	69.1	2.9	98.2	1.9

Encouraging technological results of our investigations and demonstration of a laboratory-scale separator are of considerable interest to plant operators. Production-scale tests are being planned in two directions, namely wet separation of a manganese ore and dry separation of mineral sands.

A combination of the matrix-based continuous barrier separator and of rare-earth permanent magnets could result in a design of a separator with no moving parts and with nil energy consumption.

References

[1] Frantz, S. G. (1936). Magnetic separation methods and means. *US Patent No. 2,056, 426.*

[2] Turkenich, A. M. *et al.* (1997). Continuous barrier separation of weakly magnetic ores in the field of repulsive magnetic force. *Magn. Electr. Sep.*, **8**, 81.

[3] Turkenich, A. M. *et al.* (1998). Method of continuous magnetic separation of weakly magnetic materials and a device for its implementation. *Russian Patent No. 2103072.*

[4] Turkenich, A. M. *et al.* (1996). Methods and apparatus for making continuous magnetic separations. *US Patent No. 5,568,869.*

[5] Turkenich, A. M. (1999). Method of dry continuous magnetic separation of weakly magnetic materials and a device for its implementation. *Ukrainian Patent Application No. 99094872.*