

“A continuous barrier magnetic separator for the treatment of weakly magnetic ores.”

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 1. Rare-earth permanent magnetic roll separators and drum separators suffer from similar drawbacks.

Table 1. Power consumption of induced magnetic roll separators.

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

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 S.G. Frantz in 1936 [1]. New inventions in this field were subsequently filed in the USA 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, 3, 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 summarized in Tables 2 and 3.

Table 2. 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

In case of dry separation of manganese ore from Russia of 10...6 mm in size throughput has been increased up to 9 t/h/m. Dry separation of this ore in size range less than 6 mm permits to increase throughput even to 18 t/h/m.

Table 3. 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 (%)	
		Mn	SiO ₂	Mn	SiO ₂
Feed	100	33.1	31.9	100	100

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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.

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References:

- S.G. Frantz: Magnetic separation methods and means. US Patent 2,056,426 (1936)
- A.M. Turkenich et al.: Continuous barrier separation of weakly magnetic ores in the field of repulsive magnetic force. Magn. Electr. Sep. 8 (1997), 81
- A.M. Turkenich et al.: Method of continuous magnetic separation of weakly magnetic materials and a device for its implementation. Russian Patent no. 2103072 (1998)
- A.M. Turkenich: Methods and apparatus for making continuous magnetic separations. US Patent 5,568,869 (1996)
- A.M. Turkenich: Method of dry continuous magnetic separation of weakly magnetic materials and a device for its implementation. Ukrainian Patent Application No 99094872 (1999)