Ref: PR0716

CASE HISTORY

7th December 2007

Crushers at a Bulgarian Copper Mine Protected by Eriez

The large Bulgarian mining concern, Ellatzite Med AD, has purchased and installed two large Suspended Electro Magnetic Separators to separate tramp metal that can easily damage crushers and conveyor belts. The Suspended Magnets have been selected, designed and manufactured by Eriez Magnetics Europe Ltd, based in the UK.

The mining industry is an important sector in Bulgaria's heavy industry, based on the existence of some relatively abundant and strategic mineral deposits. Many of the major mining companies recognise that equipment needs updating and that any new plant would need to comply fully with all relevant EU standards legislation.

Ellatzite Med AD is a joint-stock company, established in its current ownership structure following privatisation in 1999. The company is involved in the extraction

and processing of copper porphyry gold-bearing (Cu-Au) ore and its operations are based on a world-class copper deposit in the Balkans.

Eriez Magnetics Europe Ltd, a principle European supplier of magnetic separation, metal detection and sampling equipment, secured this important contract as a result of the close cooperation between the Eriez Bulgarian representative, Intertech Automation, and the Bulgarian contractor, Geotechmin. Eriez engineers had initially made a visit to the mine and linked up with the team from Intertech who made a detailed presentation to the contractor, Geotechmin. The management subsequently selected Eriez as the supplier for the Suspended Magnets, a contract won against strong European competition.

Ellatzite Med AD ordered two Eriez Model SE775SC2 Suspended Electro Magnetic Separators, complete with Transformer Rectifiers. One important requirement of the contract was to get the Suspended Magnets installed and operating quickly and this was achieved with satisfactory completion within a few weeks of the equipment arriving at site.

The Eriez equipment has been installed at the Etropole copper mine where the copper porphyry ore is extracted from an open-cast mine. This is a large-scale operation and around 12 million tonnes of ore is mined each year. The Eriez Magnetic Separators provide effective removal of general tramp iron from the conveyed material.

The rubber conveyor belt over which the separators are suspended takes the copper ore, now free of its tramp iron contamination, through a 6.3km tunnel to Mirkovo, the company's headquarters and site of the flotation plant. Here, Ellatzite produces copper concentrate from the Cu–Au ore, annually yielding more than 40,000 tonnes of copper in addition to approximately 1.5 tonnes of gold. The tailings are collected in the Benkovski 1 and Benkovski 2 tailings sites, located in the nearby villages of Benkovski and Chavdar.

The Suspended Magnetic Separators are approximately 2m wide and 3m long, weighing 6.5 tonnes. They are positioned across conveyors carrying up to 2,300 tonnes per hour of ore, into which they project a deep and strong magnetic field. Tramp metal, sporadically appearing in amongst the ore, passes into the magnetic field and is subsequently attracted up out of the burden and onto the magnetic face. A belt, with wipers, moving around the electromagnetic block then transfers the captured ferrous metals away from the conveyor, before discharging into a collection chute.

A typical Suspended Electro Magnet installed across a conveyor

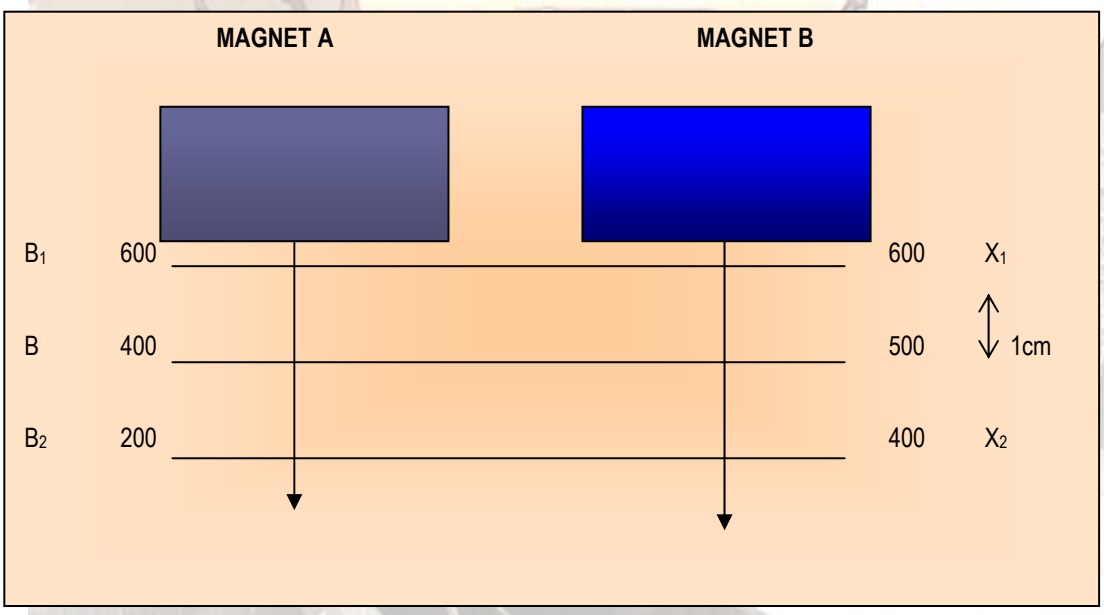
The selection of a Suspended Electro Magnet is critical to the success of the separation. In many plants, Suspended Magnets of insufficient strength are installed, resulting in crusher and conveyor damage, loss of production and expensive maintenance. Eriez use a bespoke computer programme to firstly determine the magnetic power required to meet a customer's separation objective and then design a Suspended Magnet to suit.

The ability of a Suspended Electro Magnet to lift and separate ferrous contamination is a function of the magnetic force imparted on an object located at a distance. This magnetic force is defined as being the force density. The term force density denotes a meaningful calculation based on gauss and gradients of a magnetic circuit. Force density is the force per unit volume exerted on a ferrous object at any given distance from the face of the magnet and is expressed in Dynes (a metric unit).

Ferrous metal being attracted to the magnet face before being transported and discharged away from the conveyor belt

The diagram (Diagram A) illustrates two hypothetical magnets with different gradient characteristics and gauss ratings. Although the explanatory mathematics of the new 'High-Gradient' circuits are not included, the calculation show how the one with a flux density of only 400 gauss at a specific distance has a greater magnetic attraction force than the one with a flux density of 500 gauss at the same distance. Therefore, a higher gauss does not necessarily mean a stronger magnet.

Diagram A



FORCE DENSITY

MAGNET A

$F_A = B\frac{(B_1 - B_2)}{(X_2 - X_1)} = 400\frac{(600-200)}{(1cm)}$ = 160 K DYNES/cm^3 with 400 gauss at distance B

MAGNET B

$F_B = B\frac{(B_1 - B_2)}{(X_2 - X_1)} = 500\frac{(600-400)}{(1cm)}$ = 100 K DYNES/cm^3 with 500 gauss at distance B

In a separation application, it is not always necessary to calculate actual forces unless an extraction prediction for a specific size and shape of iron is required. Then, it is vital that the force density figures are provided. Force density is in the GCS system and should not be confused with force index which mixes metric and imperial values.

Also, in the case of electro magnets, the force density figures provided must apply when the magnet is hot and not cold. The magnetic field of the Suspended Electro Magnet is stronger when the coil is cool than when the unit has been operating for some time and is operating in the hot state.

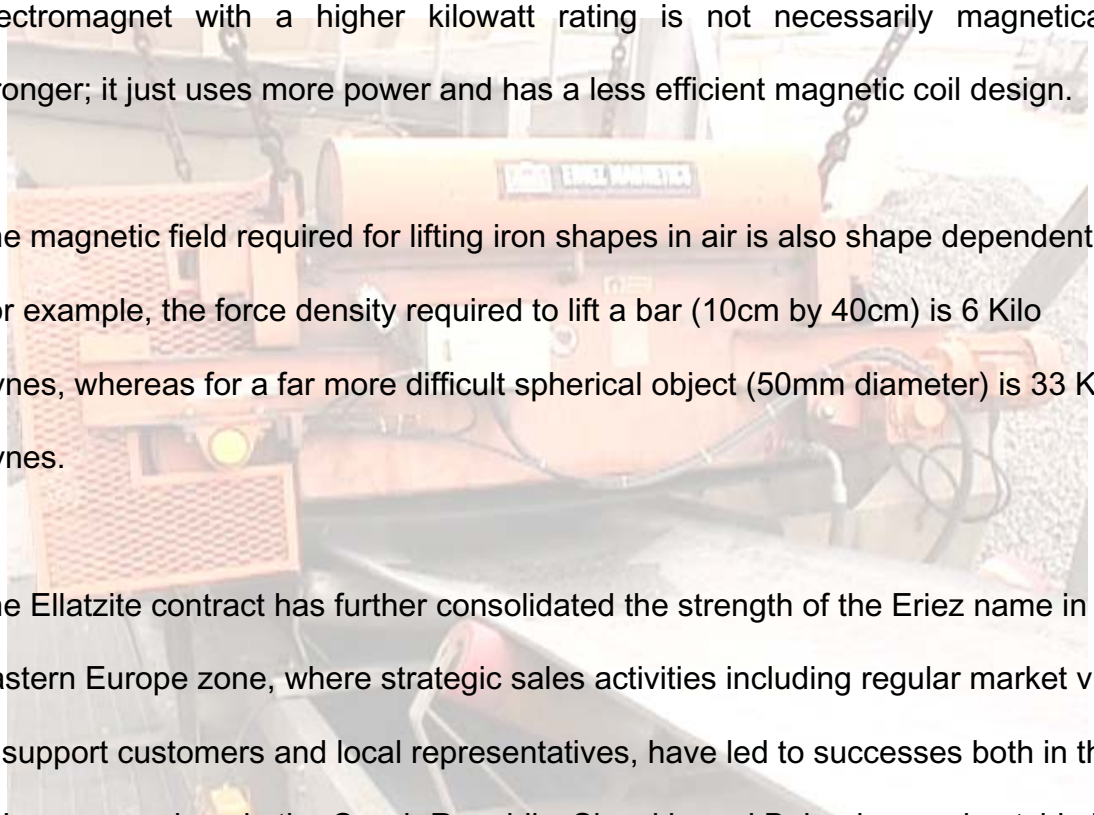
Other specifications of the Suspended Magnet, such as the kilowatt rating of the magnetic coil, are not clear indicators of the separation capabilities of the Suspended Magnet and must not be used when comparing different suppliers' Suspended Electro Magnets.

Kilowatt ratings must not be used for the following reasons:

- Magnets with the same kilowatt rating can be very different in overall size and weight.
- Magnets with the same kilowatt rating will have very different separation capabilities
- If two magnets are exactly the same size but one is of a significantly higher kilowatt rating than the other, it is probably due to there being less wire inside the magnet box making it cheaper to build; less efficient in transferring heat and therefore, poorer in magnetic separation performance

Eriez have designed their range of Suspended Electro Magnets to dissipate heat efficiently and produce a specific magnetic field to achieve a given separation objective.

Therefore, Eriez strongly recommends that the force density and not the gauss figure is used when assessing different suppliers' equipment. Also, an Electromagnet with a higher kilowatt rating is not necessarily magnetically stronger; it just uses more power and has a less efficient magnetic coil design.



The magnetic field required for lifting iron shapes in air is also shape dependent. For example, the force density required to lift a bar (10cm by 40cm) is 6 Kilo Dynes, whereas for a far more difficult spherical object (50mm diameter) is 33 Kilo Dynes.

The Ellatzite contract has further consolidated the strength of the Eriez name in the Eastern Europe zone, where strategic sales activities including regular market visits to support customers and local representatives, have led to successes both in the EU zone – such as in the Czech Republic, Slovakia and Bulgaria – and outside it, mainly in the Russian mining industry.

Eriez Magnetics Europe Ltd continues to work closely with customers to solve costly metal contamination problems. For further details on Magnetic Separators, Metal Detectors and/or Sampling equipment, please contact the Eriez sales team at the address below.

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