



## SAFETY PRECAUTIONS FOR COAL CRUSHER FROM UNWANTED FERROUS MATERIAL

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**Abstract:** *Magnetic separators and filters are successfully used for separation of undesirable ferromagnetic particles in solid or liquid substrates. Exactly and suitably chosen magnetic separation system will significantly increase work efficiency without negative effects on the production process. There are several reasons for the use of magnetic separators: the protection of their own expensive technological equipment, consumer protection, risk of loss of reputation or to meet legislative standards of protection of consumer rights. The aim of this paper is to find the optimal combination of different types of magnetic separators for the transportation of coal from the rotation tilter for the coal crusher.*

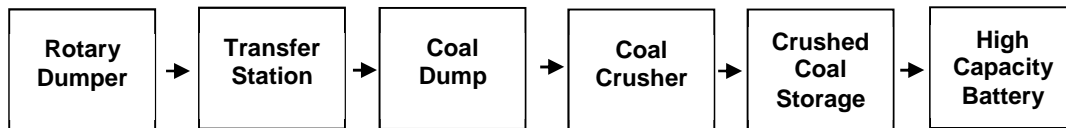
**Key words:** *Magnetic separator, Coal crusher, Safety precautions*

### 1 INTRODUCTION

Magnetic separators and filters are successfully used for separation of undesirable ferromagnetic particles in solid or liquid substrates. There are several reasons for the use of magnetic separators: the protection of their own expensive technological equipment, consumer protection, risk of loss of reputation or to meet legislative standards of protection of consumer rights [6,7]. Magnetic separators can be equipped with ferit or neodym magnets. Suitably selected magnetic separation system works effectively without negative effects on the production process. The aim of this paper is to find the optimal combination of different types of magnetic separators for the protection of expensive technological equipment.

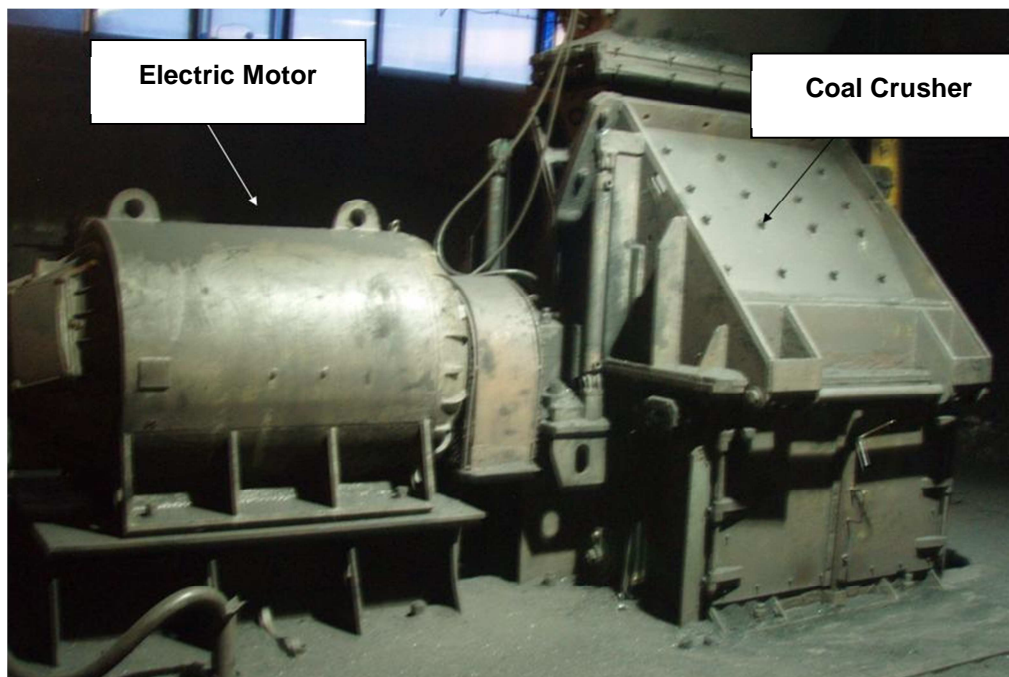
### 2 CURRENT SITUATION OF PROTECTION OF COAL CRUSHER

The flow of material (coal) in the production process is depicted in Fig. 1. The transportation of material between items in the scheme is provided by belt conveyors.



*Fig. 1 Scheme of material flow*

Currently, the coal crusher is not protected from unwanted metal materials. The operation of coal crusher over time showed that without any separator of unwanted ferrous material the various parts of the coal crusher are being seriously damaged. The mentioned coal crusher which is electrically powered is depicted in Fig. 2.



*Fig. 2 Coal crusher*

Fig. 3 shows the opened coal crusher with its hammers in early stages of deterioration. The crushing hammer is made of casted iron.



*Fig. 3 Coal crusher – view of the hammers*

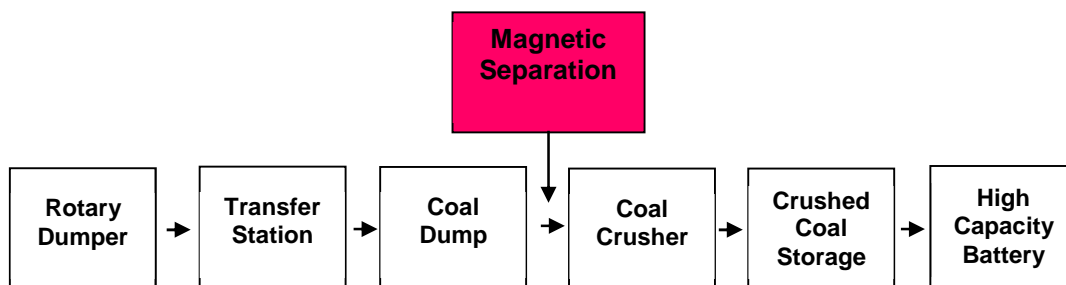
The coal crusher parameters:  
the weight of hammer: 17,5 kg,  
number of hammers in the crusher: 120 pcs,  
price of one hammer: 40 €,  
number of crushers: 6 pcs,  
total value of hammers: 28 800 €,  
deterioration time of hammer: 6 months,  
monthly costs of hammers: 4800 €.



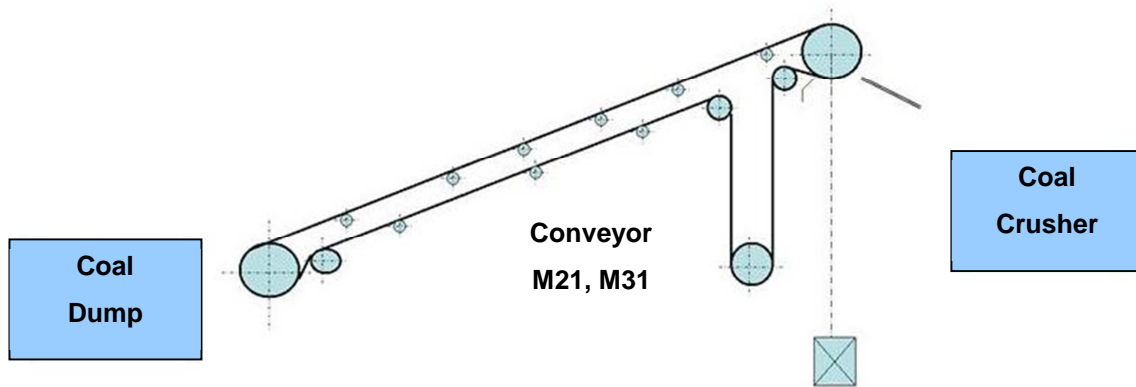
*Fig. 4 Deteriorated and new coal crusher hammer*

### 3 PROPOSAL OF SEPARATION POINT

The rail cars come to the rotary rail car dumper. The coal in the rail cars often contain unwanted material such as wood, wires and other metal waste. From the rotary rail car dumper, the coal with unwanted material is transported by conveyor M21 or M31 through the transfer station to the storage container from which it is gradually transported to the coal crusher. Fig. 5 shows the proposed point of separation



*Fig. 5 Block scheme of material transportation with the proposed separation point*



*Fig. 6 Belt conveyor M21, M31*

The belt conveyors M21 and M31 which are 150 m long [1], provide the transportation of coal from coal dump to the coal crusher (Fig. 6). The number of conveyors is two due to ensure continuous production. The width of the conveyor belt is 800 mm, the conveyor speed is  $0.6 \text{ ms}^{-1}$ . A smooth, rubber fabric conveyor belt is used and it is supported with idler housings. There are side idlers to prevent the belt from swerving. The belt is tightened by weight [4,5]. The electric motor with gear box and the brake is located on the unloading side. Fig. 7 shows the belt conveyor M21, the other conveyor M31 is located parallel and is used as a backup conveyor.



*Fig. 7 Belt conveyor M21*

#### **4 PROPOSAL OF MAGNETIC MATERIAL SEPARATION**

Magnetic separation is proposed to:

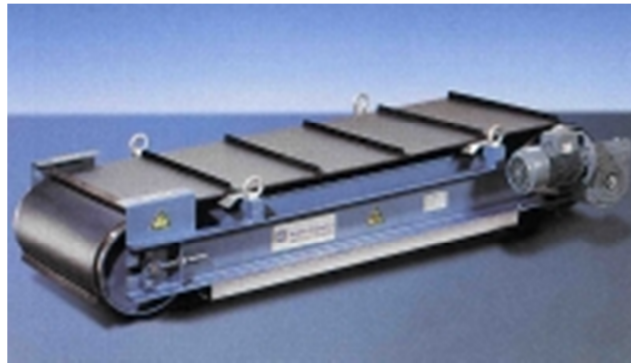
- decrease deterioration of hammers in the coal crusher,
- to prevent damage of belt conveyors from metal material.

Following facts were taken into account during the search for optimal combination of magnetic separators:

- the conveyor cannot be shut down (nonstop production process),
- the cleaning of the separator has to be mainly automatic,
- separator has to be strong enough to separate large area of conveyor belt,
- the separated loose material can be wet or in pieces.

The result of analytic multiple level method of multicriterion decision making applied to problem is that the most suitable separator is permanent separation ramp with catch driver

which has also self cleaning function (Fig. 8). The separator can be located across the conveyor.



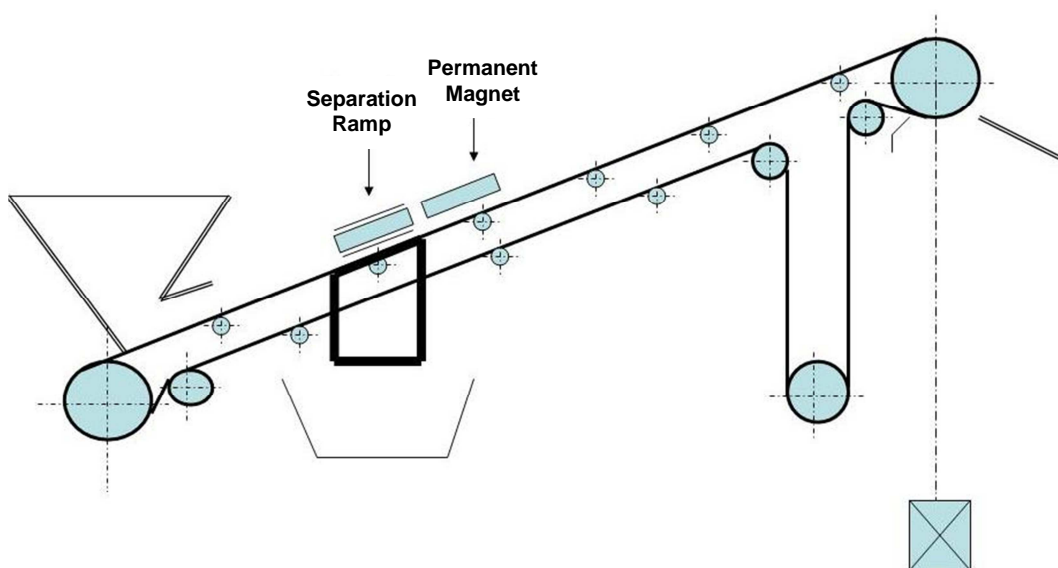
**Fig. 8** Permanent magnetic separation ramp

The separator consists of belt conveyor and permanent magnet adjusted to transported layer of material and the size of metal particles [2,3]. Magnetic system pulls the metal particles from material flow which fall off under the conveyor belt and slide along the chute to the container or collecting bin.



**Fig. 9** Permanent magnet

The separation effect can be increased by locating a permanent magnet after the separation ramp (Fig. 9) which is also proposed by separation ramp manufacturer. Easy installation without any changes to the conveyor belt construction and a possible adjustment of distance of the separator to the separated material as close as possible is an advantage. The separation ramp and the permanent magnet are suspended above the conveyor belt (Fig. 10).



**Fig. 10** Installation of permanent magnetic separation ramp and permanent magnet

## 6 CONCLUSIONS

Optimal combination of magnetic separators with proposed point of installation will be proved in real production of the plant. Detailed economic analysis could be made afterwards.

### References

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