

Abstract



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Belfast Coal Mine

Belfast Magnetite Consumption - 'Back to Basics'

Motivation

The only thing worse than losing clean coal for any coal beneficiation plant is losing magnetite. Medium loss accounts for about 20% of the plant's operational expenses. As a result, magnetite consumption is critical in evaluating the economics of any coal preparation plant. A low magnetite consumption rate is vital to keep the cost of coal beneficiation low and with the high-grade coal that the Belfast dense medium separation plant produces, magnetite consumption control is key.

Problem Statement

Since its inception, the Exxaro Belfast coal plant has had a high magnetite consumption rate. The plant was designed to consume 1.5 kg/ton run of mine. In both 2020 and 2021, the average usage was 3 kg/ton and 2.8 kg/ton run of mine respectively. The high consumption in 2020 led to a R5 million over expenditure in operational costs and a R2 million year-to-date over expenditure in 2021.

Methodology

There are typically only two routes for medium to leave the plant: either adhering to separation products after draining and rinsing on screens or being present in the final effluent from the magnetic separators. To find a solution, the following procedure was taken to determine the cause of the excessive usage:

1. Creating a sampling campaign to identify all probable magnetite exit streams,
2. Collecting representative samples from identified streams,
3. Analysing the samples for percent magnetics, and
4. Setting up a magnetite mass balance based on each stream's weighted contribution
5. Lastly, analysing the findings to generate strategies for improving the performance of essential equipment.

Key Business and Sustainability Drivers

The solutions proposed will ensure the following objectives are reached:

- ❖ Reduction of magnetite consumption at Belfast coal plant.
- ❖ Potential savings on the plant's yearly operating costs.

Findings and Recommendations

According to the findings, adhesion losses on the Low Gravity plant product drain and rinse screen were a significant contributor to magnetite consumption. This was seen by the 2.4 kg/ton weighted contribution of a 2.7 kg/ton overall plant consumption, also equivalent to 89 % of the overall consumption. The modest losses from the other streams became insignificant because of this. The magnetic separators were also found to be efficient, with an efficiency of more than 99.93 %, which is within the OEM's efficiency standards.

The following recommendations were made to improving the Low Gravity product drain-and-rinse screen, and are currently being implemented:

- ❖ The addition of two rows of L-shaped panels to improve material retention time on the screen for optimal medium drainage.
- ❖ Use L-shape panels with longer bars (75 mm vs 50 mm presently used).
- ❖ Replace the conventional sprayers on the drain and rinse screen with power nozzle sprayers.
- ❖ Addition of three rows of 3 mm aperture panels on the desliming screen to prevent -1 mm material from reporting to the coarse circuit

Conclusion

Magnetite recovery in a dense medium plant is greatly aided by drain-and-rinse screens. The correct screen panel configuration accompanied by the power nozzles will reduce magnetite losses through improved efficiency. This could lead to a potential saving of R5 million annually.