EPRON TECHNOLOGIES

Process and Project Consultants to the Mining and Minerals Beneficiation Industry

Performance Optimisation of Fine Coal Washing Circuits

Introduction

Coal washery circuit and equipment design in South Africa have not changed significantly over several decades.

Due to its high middlings content, South African coal is relatively hard to beneficiate. An abundance of easily available deposits available in the country may have in the past permitted sub-optimal exploitation of available resources.

On the other hand, external factors such as quality of the mined deposit, cost and availability of operational resources such as energy and skilled labour, environmental and other regulatory factors continue to increase pressure on plant operators in maximising revenue and minimising costs.

The interactions between unit operations in a processing plant are complex. The use of process simulation packages is effective in supporting plant operators in their effort to extract maximum revenue out of the mineral resource.

However, incorrect or misleading results may easily be produced as a consequence of incorrect use of simulation techniques, with severe consequences.

The role of the consultant

Clearly, the operators of the plant have a wealth of experience in the way their plant responds to the changes in orebody or other daily changes in their operation.

However, it is almost impossible for the operator to know whether their plant is performing at the best possible operating point without being able to quantify the complex interaction between the process variables and the equipment.

In order to perform this optimisation task to the optimum level, one requires reliable modelling techniques and dependable process models; often, this information is not available, or operations are not equipped to conduct this type of work.

At EPRON, we aim to combine four key factors in our optimisation strategy:

1. A sound theoretical understanding of the physical models of unit operations
2. First-hand experience in the design and operation of key process equipment, and modelling thereof
3. State-of-the-art modelling technology
4. Objective and critical analysis and interpretation of results

A fines optimisation strategy

The classic South African coal preparation circuit consists of drum separators, dense medium cyclones and for the coarser spiral concentrators for fines treatment.

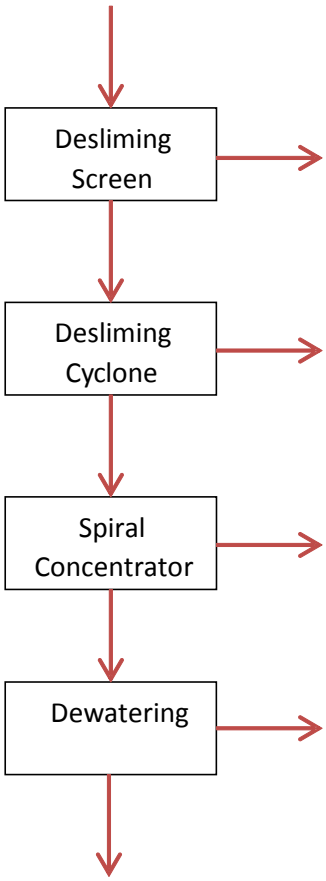

Figure 1: Fine coal processing block diagram

The duty of the desliming screen is to direct coal slimes to the spiral circuit and prevent them from entering the DMS circuit. The DMS circuit is not able to effectively treat the slimes for a number of reasons. These are, impaired cyclone performance for a broad size distribution, and technical hurdles in effectively separating coal fines from medium solids.

Spiral concentrators rely on hydraulic effects and are increasingly nonselective for finer particle sizes, where viscous effects begin to dominate gravity effects.

Desliming cyclones are often interpreted as classifiers but perform a density-based separation too, which leads to the counterproductive effect of rejecting lighter, coarser-than-average–cut-size clean coal particles to the overflow while concentrating gangue particles into the underflow.

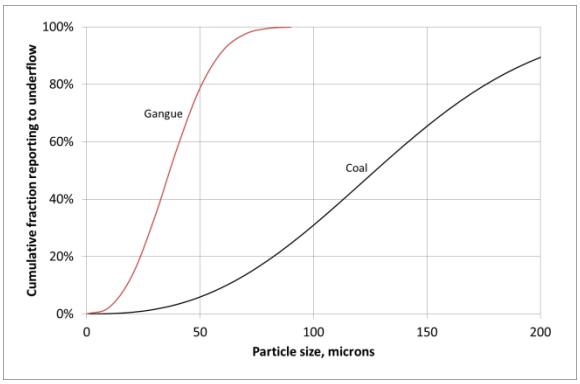

Figure 2: Cyclone partition curve for different density particles

The fine gangue is not effectively rejected by spiral concentrators and reports to a significant degree to the light product. This has two important consequences:

Firstly, the contamination of clean coal product with gangue, and secondly, the lowering of particle size which in turn increases the surface moisture retained by the product, and consequently lowers the CV of the product on an 'as received' basis.

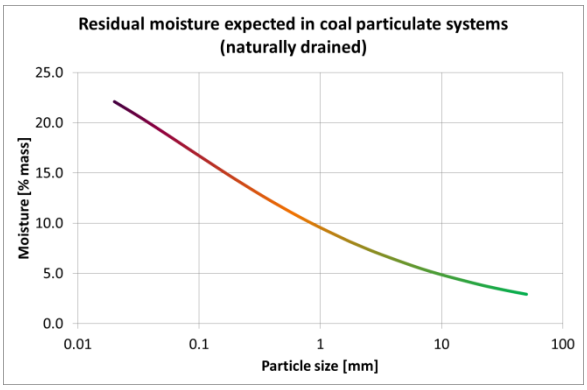

Figure 3: Moisture retained in naturally drained coal particulate systems

Rather than focusing on isolated unit operations, a comprehensive optimisation strategy must focus on several factors and their respective interactions, with the overall aim of maximising profitability. These can be:

Optimisation of total revenue generation under consideration of the key factors, i.e. yields, product qualities, product market values, minimisation of product moisture.

Understanding the limitations and opportunities in the combination and interaction of unit operations. For example, these can be fines minimisation strategies, replacement cycles of wear items or optimisation of equipment operating settings

Payback and ROI

Optimisation strategies aimed at yield improvements generate fast paybacks. A single percentage point in yield improvement usually means millions of Rands of additional revenue per month.