Slurry Density **Control**

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A typical mining operation spends over R1 billion a year on electricity bills and uses about 820 million litres of water a year.

In recent years, the mining industry has been put under considerable pressure due to an increase in the price of electricity and the scarcity of water. Water as well as electricity are used for agricultural, industrial, domestic and recreational activities and are essential elements to modern society's development and security.

Electricity is produced using fossil fuels which contribute to pollution, particularly greenhouse gases. Saving energy on a site amounts to reduced electricity consumption and therefore less pollution as well as reduced electrical bills.

Water scarcity and electricity price hike

Mines use water for transporting and processing minerals. Due to the water scarcity and electricity price hike, innovative ways to save electricity and conserve water have become a priority for mining companies. This is where Ensight Energy Solutions (further referred to as the company) has found numerous ways to assist companies in developing and implementing energy (electricity, gas etc.) as well as water saving and optimisation initiatives.

Slurry

Water in a mining plant is generally used to transport minerals in a slurry form. Slurry is a liquid containing solid particles. Transportation of a slurry requires more factors to be taken into account than a pure liquid. The benefit of a slurry is that the density of the slurry can be altered which allows for optimisation opportunities. It is however critical to understand the boundaries of the system within which the slurry is transported to allow for the most effective optimisation opportunities.

The density of the slurry will determine the energy that is required to pump the slurry and the amount of water that will be required to fluidise the slurry. If you control density you can reduce the energy used for pumping and reduce water consumption.

One particular project that we are carrying out at a leading titanium mine in South Africa, is the control of slurry density. This project not only saves vast amounts of water and energy but has also proven to improve throughput and process efficiencies as well as reduce maintenance costs.

High Material Concentrate (HMC)

The area of the mine that will be focused on in this case study is where the raw material is gathered. The raw material in this case is the HMC which is acquired from sand dunes using a dredger to break the material down and form a slurry. The slurry is collected in a central area, referred to as a feed bin (buffer), and pumped to the Materials Concentrator Plant (MCP) for further processing. The central collection area is key to ensure a constant volume and quality of product so that it can be transferred to the MCP.

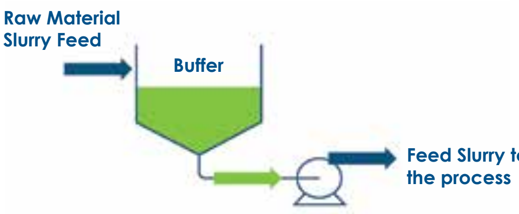

Figure 1: Basic outline of the process. There are four different areas from which the sand is collected.

Process

To start, the company's team set about understanding the mine pond recovery process in detail. Specifically investigating the purpose of the system and how it was currently performing. This investigation was done with the help of the operators responsible for the process as well as the technical support team and maintenance crews. The current operation was then compared to the original system design as well as industrial standards. It was the team's responsibility to identify any variance from the original design, the causes of this variance as well as any wastage that could be observed. It was also important to take note of any operation or production changes that had oc-

TAKE NOTE!

1. Water scarcity and electricity price hikes have put the mining industry in South Africa under pressure.
2. Innovative ways to save electricity and conserve water have become a priority for mining companies.
3. The project described in this article has achieved spectacular savings of 88 393 MWh energy, which equates to R56 M and water savings of 3 646 ML – in the period May 2014 – May 2017).

ABBREVIATIONS

CV – Carrying Velocity
HML – High Material Concentrate
MCP – Materials Concentrator Plant
OEM – Original Equipment Manufacturer
SG – Specific Gravity
TPH – Maximum Throughput
VSD – Variable Speed Drive

curred deviating from the original design. After this understanding was obtained, the team set out with the onsite production and maintenance teams to evaluate all the possible optimisation opportunities. The teams debated the feasibility of each opportunity and how they'd implement them to maximise energy and water reduction.

What was found

It was discovered that the Original Equipment Manufacturer (OEM) specified that the slurry's Specific Gravity (SG) should be at 1,5 at a flowrate of 3,0 – 3,5 m/s. However, analysis of the current operational data showed that the slurry's SG was at 1,2 – 1,3 SG and at flowrates of between 3,5 – 4,0 m/s. This showed that the process was operating differently from the original design and indicated room for possible saving opportunities.

Throughout the team's evaluation, it was also found that the plant was running all the pumps at low densities and increased speeds so as to achieve maximum throughput (TPH) irrespective of the actual material movement. This was done without prioritising efficiency, resulting in the plant consuming significantly more energy needed to produce each ton of HMC. A factor that was also taken into account when deciding which changes to implement was that the quality of the HMC is sometimes negatively affected by the metallurgical constraints of each system.

How it was solved

The approach taken by the team was incremental. The system was first restored to the original design as there were no changes made to the intended design however the operating parameters had changed over time. The team discovered that the specification of the flowrates and SG had changed – they had potentially drifted over time or changed due to some challenge experienced in the past but had never been reverted back after the challenge had been overcome. After these changes, other areas of wastage were investigated and eliminated or reduced as far as possible.

The SG was restored to the original specification of 1,5 by first making sure that the feed of the material to the buffer was sufficient. The solids in the bin needed to be maintained at a specific level to ensure a sufficient buffer for downstream processing. To address the flowrates which were higher than specified, the possibility of slowing down the pump was investigated. Through the use of a Variable Speed Drive (VSD) the flowrates could be managed effectively. Energy consumption of the pumps would be significantly reduced as an added bonus.

The pumps were slowed down to reduce the flowrate or stopped when not required to run (no feed). When slowing down the pumps the critical Carrying Velocity (CV) of the mineral sand needed to be considered as going below the CV can cause settling and lead to blockages. In order to achieve this and as a safety measure, when the feed was off or there was no sand for 20 minutes the pumps reverted to the critical carrying velocity to ensure maximum energy saving. If after 20 minutes no sand was processed in the plant, some equipment was even switched off to reduce the energy consumption further.

An important factor for the team throughout the evaluation and implementation process was to ensure that the changes made did not affect the mines production output at all. The company's primary focus was to implement management of change projects before capital projects were considered.

Conclusion

This project has achieved savings of 88 395 MWh of energy which equates to R56 M and water savings of 3 646 ML from inception to date (May 2014 – May 2017). Furthermore, throughput increased by 20% and maintenance breakdowns reduced by 50%. The company remains on site at this particular mine and, to date, has achieved over R261 M worth of savings for the company through its energy saving and optimisation projects – translating into 164 000 tonnes of greenhouse gas emissions saved.

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