

CUT THEN PASTE

BACKGROUND

The project started as an open cut mine – recently depleted – and now consists of an underground mine and a mill capable of processing up to 900,000 tonnes of nickel ore per annum.

The mine is located a short distance from a National Park and is in an environmentally sensitive location. This presents challenges to management, not the least being the tailings dam which was sized for the open cut operations and was nearing the limits of capacity. The likelihood of a new dam being approved is very slim.

OBJECTIVES

Head office management held the view that the introduction of a paste plant – utilising tailings from the mill to backfill underground stopes – could solve the problem of the dam capacity. However, they faced three issues:

1. Site management was unconvinced of the benefits of the paste plant.
2. Site management had no operational experience with this type of facility.
3. Site and head office management did not know how to go about effectively integrat-

ing the paste plant into the mining and milling processes, nor did they understand the operating requirements for the new plant.

GPR Dehler was commissioned to assess the impact of the paste plant on the life of the tailings dam, to determine what operational benefits would be achieved, and what conditions are needed for its optimal operations.

KEY RESULTS

A knowledge base was built and used to simulate the integration of the paste plant under a range of operating specifications and conditions. This demonstrated to all levels of management:

- That the paste plant would achieve the desired objective of extending the life of the tailings dam, enabling the company to continue its mining operations uninterrupted.
- What conditions are required in order to integrate the mine, mill and paste plant. One major finding was that the current design specifications would not meet operational needs.
- That a number of operational benefits would be achieved, including more effective recovery of nickel ore from the mine.



The process of developing the knowledge base, and using this to simulate and evaluate the operating conditions, resulted in an initially sceptical management team becoming overtly supportive of the introduction of the paste plant.

THANKS, BUT NO THANKS

At the outset, the site management team at the project were not enthusiastic about the introduction of a paste plant. They reasoned that the capital outlay (around \$15 million) was too costly and that, while there were potential benefits to be gained in productivity, the operating costs would be higher and backfilling with waste is simpler and familiar to the workforce. They regarded the addition of a paste plant as extremely complex, both in the process of making the paste and, more significantly, in the logistics of integrating the plant with the mining and milling operations.

Their view was that head office management was not fully aware of the logistical difficulties. The perspective from head office was different. Their issue was not 'if' but 'how'; the paste plant was deemed a necessary alternative to the tailings dam.

DAM FULL

The tailings dam was reaching capacity. It had been sized for the open cut mine and was not capable of handling the tailings from the underground stopes. Added to this were two key factors. Firstly, due to environmental sensitivities, it was improbable that a new tailings dam would be approved. Secondly, the likelihood of the company opening another nearby mine, with the nickel ore to be processed at the project. Considerable time and effort would be consumed by applications, commissioning of environmental impact statements, identification and analysis of alternatives, protracted negotiations and dealing with significant opposition. The most likely scenario would still be a 'no'.

SIX MONTH PLAN THEN WE STOP

In order to assess the effect of a paste plant on operations, some long term planning was needed. Short term planning at the mine was relatively smooth and reliable. However, when site management was asked to provide a longer term mining plan they couldn't.

Balancing the competing priorities and demands in an underground mine, working with the dependencies and interdependencies, can become a logistics nightmare. There were simply too many variables to be addressed; multiple stopes, different grades of nickel ore in each stope, mine development, storing tailings, access, production targets, time taken to fill stopes that had been mined, time between filling one stope and being able to mine the stope either side, above or below it, and many other factors. It took a significant amount of effort to map out six months of mining. At which point they threw up their hands and could go no further.

THIS SITE RULES

What is difficult to achieve through conventional planning techniques can be achieved by building a knowledge base and then using the data to graphically simulate the activities, sequences, specifications and operating conditions.

The site management team helped to assemble the raw data needed to construct the knowledge base, incorporating tough operating rules based around the mine schedule and paste plant requirements. Once constructed, the knowledge base

was reviewed with all key stakeholders in order to confirm the operating parameters and establish scenario options for simulation runs. This process also offered the first opportunity for all key personnel to review their considerations and opinions on operating philosophies and to see how these could affect the whole of the project's operations.

A SIX YEAR RUN

A valid long term schedule was developed and operations were simulated for a period of six years. A number of variables were introduced in order to allow management to evaluate different operating parameters and optimise the plant and the processes. These parameters included:

- Mill production schedule integrating Sales, ROM & Paste Fill
- Tailings feed direct to wet plant
- Tailings feed via tailings dam
- 24 hour versus 12 hour wet plant operations
- Varying paste and tailings densities
- Maintenance schedules
- Mining schedule alternatives
- Unscheduled backfill requirements
- Future mill feed sources
- Utilising the now-empty open cut pit as a reserve for paste.

The summary of each simulation was evaluated based on its positive or negative effect on the operations and presented to

key personnel. These demonstrated that, using the right processes, the paste plant would achieve the desired objective of extending the life of the tailings dam, would enable a more effective recovery of nickel ore from the mine and accommodate all the requirements throughout the life of mine; including the incorporation of additional nickel ore from the adjacent mine.

NOT ENOUGH PASTE

One very important output from the simulation run was that the design specifications for the paste plant were underdone. At speeds of roughly 76 tonnes per hour, the plant would not produce sufficient quantities of paste and would not utilise sufficient amounts of tailings. The excess tailings would then have to feed to the dam, partially-thwarting the key benefit of building the plant in the first place. As a result, management contacted the engineers and design changes were made that would enable the paste plant to operate at speeds of 100 tonnes per hour.

TUNING IN

Groundworks for the paste plant is currently underway and the plant is expected to be commissioned within eight months.

The knowledge base remains in place and can be further developed by the management team to allow current processes to be fine-tuned and additional scenarios to be run as the operations and supply chain requirements mature.

KNOWLEDGE BASED SYSTEMS (KBS)

KBS is a major leap forward from tradi-

tional business modelling systems.

Traditionally mathematical formulae are used to describe the components of a business – with limited scope. Change the business scenario and the formulae may no longer be valid.

KBS learns and understands the business in much the same way that people do. It can replicate the entire business, including human and operational subtleties within that business. It preserves the knowledge within the business's own computer systems, providing a maturing knowledge base on which to continually build.

That knowledge can be used to simulate any imagined business scenario, and to improve the planning and control of business processes.

Within a few weeks KBS can begin to provide management with previously unheard of decision making power. It can deliver immediate answers that may otherwise take a team of engineers many years to obtain.