

OVERVIEW

LeachStar is Mintek's advanced control suite, specifically designed for gold circuits. It incorporates leading technology to optimise the performance of the various process units found on gold circuits, including thickeners, leaching circuits and carbon circuits.

The LeachStar suite of controllers increases plant performance and improves safety by deploying:

- Advanced signal fault detection.
- Safety checks, ensuring safe control of especially cyanide.
- Advanced control techniques, especially designed for each process unit.

The LeachStar suite comprises of the following controllers:

THICKENER CONTROL

When thickeners are located between unit operations, such as between milling and leaching, they present an opportunity to be used in an integrated control strategy. It is possible to significantly stabilise individual thickeners as well as downstream circuit operation by employing an effective thickener control and optimisation solution.

The LeachStar Thickener Controller is aimed at providing the following benefits:

- Reduction in flocculent consumption.
- Improving the clarity of the thickener overflow water.
- Ensuring stable thickener operation by minimising bed slides or high rake torque scenarios.
- Stabilising the flow rate and density of the underflow, thereby improving the performance of downstream processes.

The following thickener control and estimation modules are available as LeachStar modules on StarCS:

Flocculent Controller

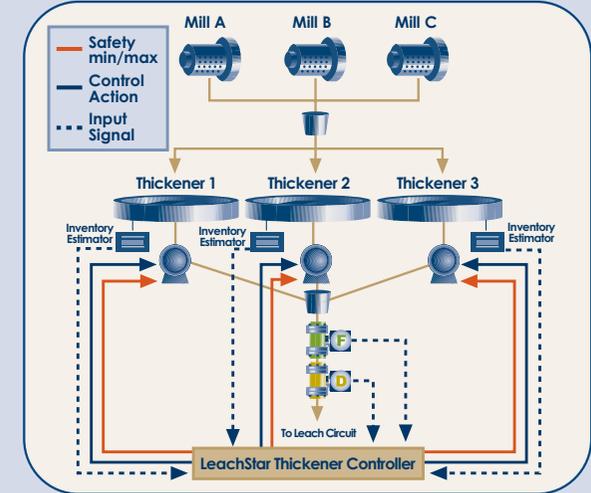
Flocculent consumption contributes a significant cost to operational expenditure. Efficient control of flocculent addition will ensure that thickener operation is stable, whilst minimising flocculent consumption.

The flocculent controller incorporates the following features:

- A ratio controller, adding flocculent in a litre/tonne ratio with the feed entering the thickener.
- When used in conjunction with Mintek's Thickener Profiler, it characterises the settling characteristics of the thickener and defines the sludge blanket level. This information is used to optimise the flocculent addition ratio.
- Can be used in conjunction with overflow turbidity meters.

Thickener Stabilising Controller

In most gold leaching circuits the primary function of the thickeners is to provide the leaching circuit with a stable product in terms of density and volumetric flow rate. However, often the thickeners themselves are poorly controlled resulting in process instability that is eventually passed to the leaching circuit. As shown in the diagram below, the LeachStar Thickener Controller attempts to accomplish the following:



- Stabilise flow and density to the leaching circuit
- Balance the inventories in each thickener
- Observe all constraints such as minimum or maximum underflow density.

Thickener Stabilisation Control

- Controls Thickener Underflow Density
- Estimates Thickener Inventory Continuously
- Safety Loops for Turbidity in the Overflow and Low Underflow Densities

Leach Feed Control

- Stabilises Flowrate and Density to the Leach Circuit
- Balances out the Inventories in each Thickener

The above objectives are achieved by manipulating individual thickener underflow pumping rates and when/if required, the leach feed rate in a multivariable control strategy.

Thickener Inventory Estimator

This module performs online mass balance calculations around a configurable number of thickeners. In so doing, it is possible to estimate the inventory of solids in each thickener. It also provides static and dynamic inventory predictions at user selectable times in the future. This is useful in scheduling mill feed rates, plant stoppages and changes to the leach feed rate.



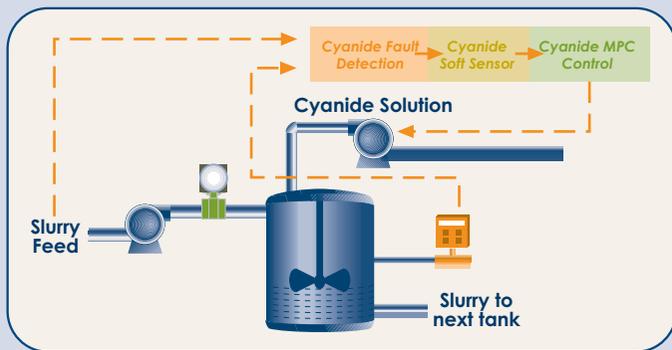
GOLD CIRCUIT CONTROL



Cyanide is a significant operating cost. It's effective use requires a dosage rate related to the operating conditions on the plant and the pH of the solution must be held in the correct range.

Furthermore, cyanide represents probably the most significant health and safety risk on gold circuits. Safe control of the cyanide dosage is imperative.

The following cyanidation related control and estimation modules are available as LeachStar modules on StarCS:



Dissolved Oxygen Controller

A specialised controller has been developed to deal with Dissolved Oxygen control. Better control of Dissolved Oxygen will result in reduced oxygen consumption and a more efficient leaching process.

Cyanide Concentration Signal Fault Detector

Cyanide concentration meters are complex devices. They do not provide a continuous signal, measuring cyanide only every 3-30 minutes. Furthermore, these devices require frequent re-calibration. The signal fault detector observes the cyanide concentration signal and detects any significant deviations from normal signal behaviour. This information can be used to prompt maintenance action and is also used as an input to the LeachStar Cyanide Controller.

Cyanide Concentration Soft Sensor

Infrequent cyanide measurements are detrimental to cyanide control performance. Mintek has developed a soft sensor that estimates the cyanide concentration between measurements. The soft sensor makes use of a leaching differential equation model. The soft sensor has shown to be accurate and dramatically improves cyanide control.

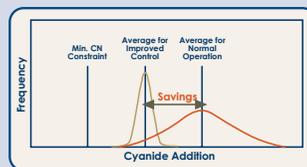
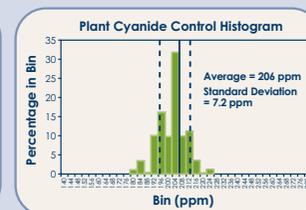
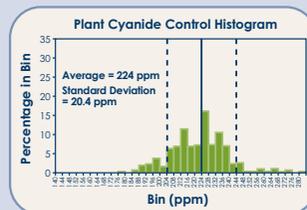
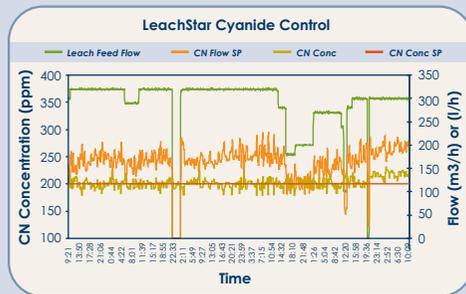
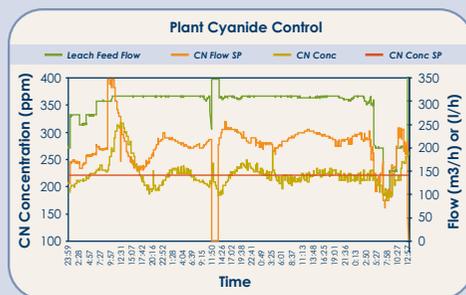
Cyanide Controller

Cyanide concentration/consumption is affected by several factors including leach feed rate and cyanide dosage rate. The LeachStar Cyanide Controller compensates for variations in leach feed rate and tightly controls the cyanide concentration within the leach tank to setpoint.

Leading MPC control technology is used to control the cyanide concentration. Furthermore, the controller interacts with the Cyanide Concentration Signal Fault Detector. If the cyanide measurement signal fails, the controller automatically reverts to ratio control (g cyanide / t ore feeding the circuit) until the signal comes good. Also, a built-in safety feature cuts the cyanide feed if the pH drops below a certain value. This ensures that HCN gas formation does not occur.

If multiple cyanide addition and measurement points are available, the cyanide profile across the leaching circuit can be controlled. Typically it is possible to ensure that "just enough" cyanide is added by monitoring and controlling the cyanide concentration in the tails leach tank. Together these strategies result in much tighter cyanide control and less overdosing, thereby reducing cyanide reagent costs by up to 20%.

The graphs below show actual Plant Results. As can be seen, it is possible to reduce the normal cyanide operating setpoint since tighter control of cyanide concentration reduces the probability of the cyanide concentration from dropping below the minimum value which may result in gold losses. A further positive is that less cyanide is present in the tailings stream which is important from an environmental perspective.



Carbon-in-pulp plants offer the potential for excellent recoveries of gold, but the operating conditions must be correct. Upsets to the plant must be detected early enough so that appropriate action can be taken.

Apart from the cyanide and pH controllers already mentioned (and applicable to adsorption control) the LeachStar control suite also includes a carbon management strategy that efficiently moves carbon upstream.

Adsorption Carbon Transfer Controller

Carbon is typically transferred via transfer pumps upstream to the slurry flow. Carbon can be transferred to control the concentration of carbon in each tank to setpoint, or the transfer is simply based on a timed schedule. The Adsorption Carbon Transfer Controller automates this transfer process, ensuring that an ideal carbon concentration profile is maintained throughout the circuit. The features of the Carbon Transfer Controller can be summarised as follows:

- Advanced fault detection of carbon concentration meters, (C2 Meters) if present.
- Automatic blow casing of carbon into the circuit.
- All carbon movement is timed according to an elution schedule.

Environmental legislation dictates maximum permissible levels of WAD (Weak Acid Dissociable) cyanide in the tails stream from treatment plants. In some cases it is required to employ a cyanide destruction process to adhere to environmental legislation.

Cyanide Destruction Controller

If WAD cyanide concentration is measured online, the Cyanide Destruction Controller can be employed to ensure that WAD cyanide levels remain below prescribed limits. This controller will manipulate destruction reagents and activators in such a way that their consumption will be minimised without exceeding the prescribed WAD cyanide limits.

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