

Utilizing Online Cyanide Analyzers in Heap Leach Operations

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Abstract

One of the major operational costs in heap leaching for the purpose of gold extraction is cyanide use. To maximize leach efficiency and save on costs, it is important to effectively control cyanide addition to the heap. A technique that has been widely and successfully used to control cyanide addition and improve cyanide efficiency – especially in milling operations – is the use of online cyanide analyzers. Analyzers such as Cyanco’s CCS[®] Cyanide Control Systems have garnered cyanide savings of over 10% in some mills. Mines using online cyanide analyzers can also expect a reduction of approximately 10% in detox costs.

Cyanco’s CCS[®] units accurately control leaching processes by analyzing free cyanide, minimizing interference from other cyanide complexes. The units enable continuous adjusting and monitoring of cyanide levels during leaching. Automated monitoring and control of cyanide levels means more predictable results, more accurate forecasts, and better use of resources.

To date, the application of online cyanide analyzers has not been as widely adopted in heap operations as in mills. However, at Cyanco we believe there is a strong cost/benefit argument for porting this technology over to the heap environment – making the costs involved and the dedication of time well worth the investment.

Introduction: the importance of cyanide optimization

For most process facilities, optimizing cyanide usage is one of the most effective ways to lower operating costs while maximizing gold recoveries. Controlling cyanide usage starts with measuring cyanide either manually or digitally, and adding only the necessary amount to reach the target cyanide dosage.

Manual cyanide control requires an operator to collect a sample, conduct a silver nitrate titration, and then manually adjust the cyanide dosage – either by modifying the pump speed or addition valve. This

process can be slow, and often results in either over-usage, which impacts operating costs, or under-usage, which could impact gold recoveries.

Continuous cyanide control requires an online cyanide analyzer that automatically takes samples and measures the cyanide concentration without the involvement of an operator. The cyanide concentration from the online analyzer can then be used to adjust the pumps or valves as needed.

Online cyanide analyzers are classified according to their analytical method. The most widely used methods in gold processing are potentiometric and amperometric. In the potentiometric method, **electric potential** across the solution is measured as silver nitrate is added to the process sample.

Conversely, for the amperometric method, the **electric current** is measured as the silver nitrate is added. The advantage of both methods is that they use silver nitrate and can easily be compared to manual titrations.

Some of the benefits of using online analyzers, as compared to manual measurements, are:

- Higher frequency of cyanide measurement.
- More accurate and consistent measurement of the cyanide concentration.
- Greater precision to control cyanide addition to the desired setpoint.
- Improved control, which may allow for lower setpoints to be established due to a reduction in fluctuations, and more confidence in the results.
- Better cyanide control may also lead to a reduction in detoxification costs. This is especially true for milling operations.

Success of online analyzers in mills

Cyanco has a good track record of installing online cyanide analyzers in milling operations. The examples below demonstrate some of the successes achieved to date:

Case study #1

The analyzer at this customer's site was taken down for a four-day maintenance period. During that time cyanide dosing was done manually. The resultant unstable cyanide dosing cost the client a total of \$186,000 in the four days that the online cyanide analyzer was down.

See Figure 1, which compares the fluctuations in cyanide use between manual control and an online cyanide analyzer.

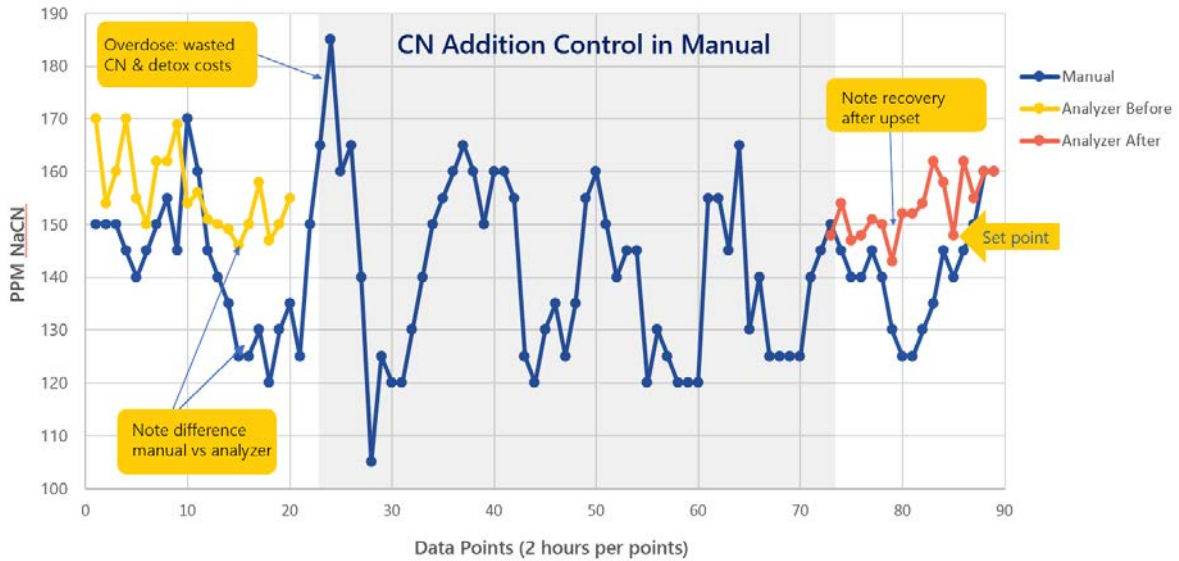
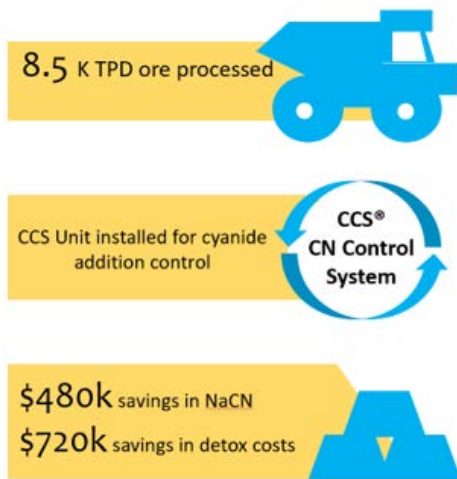


Figure 1: Cyanide control performed manually, vs. using an online cyanide analyzer

Case study #2

Figure 2 below shows another example of major benefits achieved in a milling operation after installing Cyanco’s CCS Cyanide Control System. In this example the customer achieved \$480,000 of savings in sodium cyanide addition, and a bonus of \$720,000 savings in cyanide detoxification.



Property: Open pit mine with agitation leach processes TPD of 8,500 tonnes per day

Customer need: After mine was commissioned and in production phase they approached Cyanco to see if they could help them with their cyanide addition control challenges:

- Difficulty in seeing the titration endpoint.
- Time lapses between analysis and addition rate adjustments.

Results: Cyanco designed a CCS to fit their specific needs with a high analysis frequency and multiple sample points to control the various addition points.

- Cyanco converted the results from the analyzer and automated them to feed the mill’s DCS system using a 4 – 20 mA signal.
- The DCS was able to vary the NaCN addition pumps to meet a specific setpoint with much greater accuracy.
- ~30% reduction in cyanide and another ~30% reduction in treatment costs.
- Savings of over 2.5 man hours per day.

Figure 2: Example of the benefits of installing a cyanide-control system

Cyanide control in heap leach operations

Challenges/issues/limitations

In general, heap leach operations have more challenges, as compared to milling operations, when it comes to cyanide control, including:

- remote locations;
- light staffing;
- spread-out operations;
- long retention times in the heap, making for difficulties in cyanide control;
- equipment infrequently visited; and
- difficult access to sampling locations and addition points.

Taken as a whole, we believe these issues argue strongly for automation. However, the application of online cyanide analyzers has not yet been as widely adopted in heap leach operations as in mills. For one thing, the return on investment (ROI) is challenging, as heap leach sites do not directly benefit from detoxification savings.

However, cyanide control is extremely important in heap leach operations. The result of today's addition rate may affect outcomes many months in the future.

Continuous cyanide control in heap leach operations

The expansive layout of heap leach operations compared to mills can also be a challenge in designing a control strategy to dose cyanide. Figure 3 shows one example of a cyanide control circuit created for use in heap leach operations.

Best practices

Dedicated personnel and defined maintenance schedules at the mines are prerequisites for the success of online cyanide analyzers. Other recommendations for continuous improvement include:

- better remote access to the analyzer
- simplified and robust equipment
- strategic location of sampling and addition points.

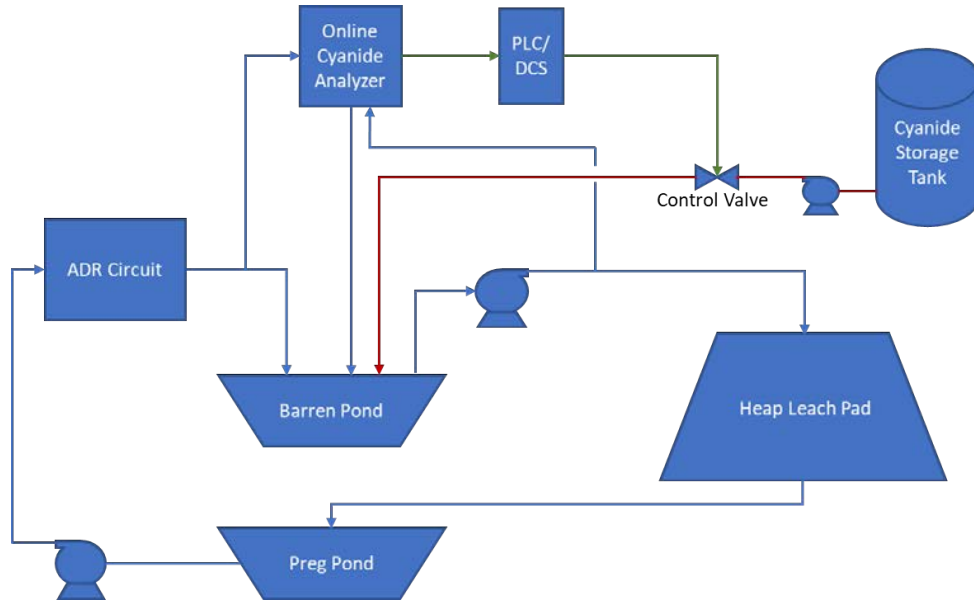


Figure 3: Schematic of cyanide control in heap leach operation

Conclusion

We believe that the successful implementation of online cyanide analyzers in mills, such as Cyanco’s CCS® Cyanide Control System, can be replicated in heaps. Porting over this cyanide control technology can enable significant new cost savings and improved efficiencies across the broader industry, representing a high-potential target for continuous improvement – as well as an opportunity for ESG (environmental, social, and governance) gains.

While Cyanco remains laser-focused on the quality and safety of our products, we also recognize that miners need more support than ever from their key suppliers. This is especially true as mining becomes increasingly advanced and complex, and as we all strive to meet the expectations of the new “circular economy.”

The presentation of this paper is intended to educate the 2022 Heap Leach Conference audience on this cost-saving opportunity, anchored by real-world examples. Cyanco will also share control strategies most suitable for heap leach applications, and new features of Cyanco’s CCS® Cyanide Control System that can increase the operational availability of these systems.

