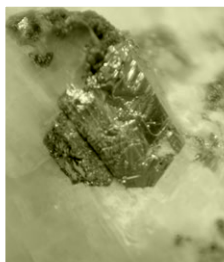




28

Ni

Nickel
58.6934 u
[Ar] 3d⁸4s²



CAN EQUIPMENT CONFIGURATIONS YIELD BENEFITS WITHOUT ADDITIONAL COSTS?

Knowing where the bottle-necks are, and how to overcome them is one of the most important aspects of being able to get the most from a metallurgical operation. Detailed models of the unit operations can assist, and that's where Cycad Process helps. In planning for the future projections of the mine plan, plant management wanted to increase capacity. The capacity study was led by a team of consultants, who used Cycad Process to identify that the autoclave leach was one area that would limit an increase in capacity (**Figure 1**).



Figure 1:
Pressure leaching autoclaves (Crundwell, et al., 2011, photo courtesy of M. Fox).

Parallel or series configurations?

The question then arose: if another autoclave is installed, should it be installed in parallel or in series with the existing autoclave? (See **Figure 2**).

Many operations run 'trains' or parallel streams of process units. For example, the bacterial leaching plant at Obuasi, Ghana, consisted of four parallel trains of four tanks reactors. In general, parallel 'modules' seem to be preferred over the series option, at least for leaching reactors.

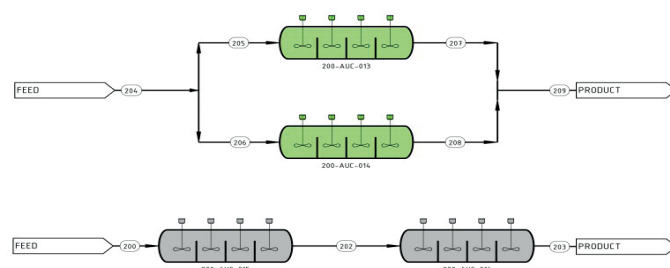
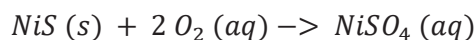


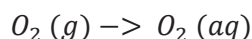
Figure 2:
Autoclaves in a parallel and a series arrangement.

Modelling Kinetic reactions

The engineers built a detailed kinetic model in Cycad Process to specifically explore this question. The primary reaction in the model was the leaching of nickel sulphide by oxygen:



The oxygen was provided from the gas phase (or gas-liquid mass transfer):



The model accounts for the rate of the reactions using kinetic expressions. This allows the model to account for the effect of concentrations on the rates of reaction.

In addition to the effect of the concentration of dissolved oxygen on the rate of dissolution, the simulations accounted for the particle size distribution of the feed and described its change through the autoclave compartments. The particle size distribution gets smaller with reaction (**Figure 3**).

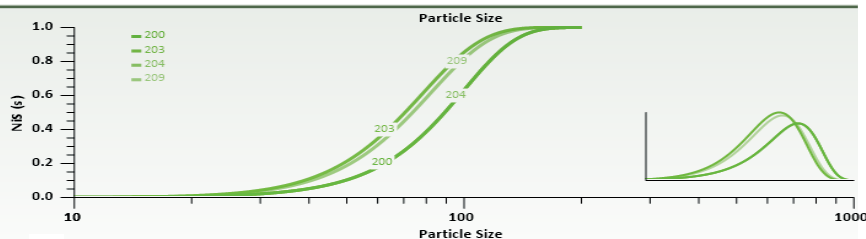


Figure 3:
Change in particle size distribution of the solids on leaching in the series and parallel circuits.

The simulations showed, contrary to expectations, that the series circuit performed significantly better over the entire range of residence times (**Figure 4**). The consultants recommended that when an expansion design is finalized the additional autoclave is fitted in a series configuration.

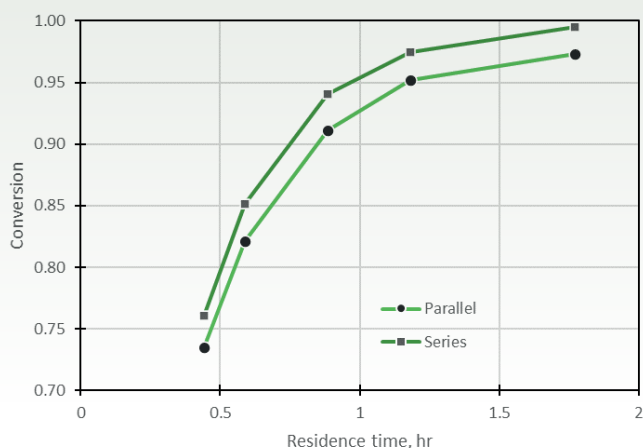


Figure 4:
The conversion of the solids (NiS, millerite) was greater in the series circuit than the parallel circuit.

Installing equipment in the most optimal configuration can yield benefits without additional expenses. In this case, improving the recovery from 91% to 94% directly improves top-line revenue and reduces costs of processing residues.

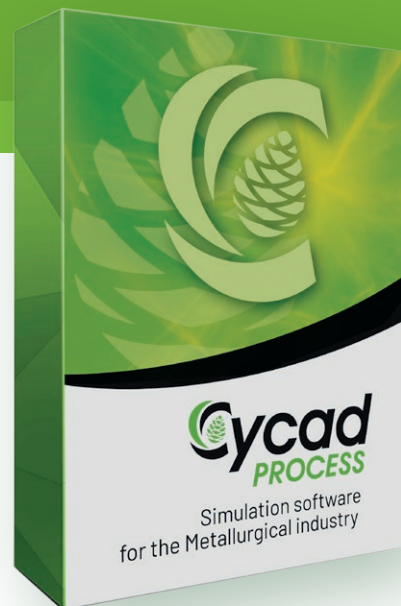
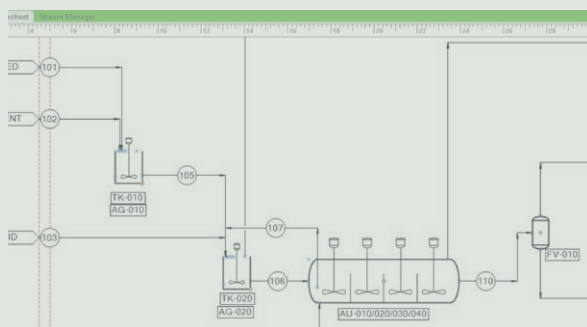
For this nickel producer, who had with an annual production more than 10 ktpa, this can amount to at least USD 9 million.

Simulation saves money

Good configuration => More Profit

How was Cycad Process® used here?

- Cycad Process has sophisticated modelling systems for reaction kinetics. Gas-liquid mass transfer and other homogeneous reactions can be solved simultaneously with the population balances models of the leaching reactions. The models were calibrated against plant data and literature, and then used in scenario analysis.



What is Cycad Process®?

- Cycad Process® is a **software product for modelling of metallurgical operations** – sophisticated models of unit operations are combined into a model of the process operation, allowing the user to design or optimize their operations.
- The outputs are the mass and energy balances for the plant, presented as **reports and process flow diagrams**.
- Cycad Process® has been used to **design plants and find solutions to metallurgical challenges** for the last 20 years.
- Our clients include leaders in **copper, gold, cobalt, lithium, vanadium, nickel, and the platinum group metals**.

Visit us on www.cycadprocess.com

To find out how Cycad Process can help you contact us at:

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