VALVE EVOLUTION IN HYDROMETALLURGY

By

Ross Waters

C. G. Industrial Specialties. (CGIS), Canada

Presenter and Corresponding Author

Ross Waters

ABSTRACT

As demand for batteries and other technology commodities grows worldwide, and the supply of needed constituent metals is progressively limited, ore bodies which require a higher level of processing become more viable. Since the 1950s, pressure-based processes have grown in prominence, including high-pressure acid leach (HPAL) and pressure oxidation (POx). These niche hydrometallurgical processes use high temperature and pressure to accelerate their respective chemical reactions, which work to free target metals bound up with other materials in an ore body.

The centre of these pressure-based hydrometallurgical processes is the autoclave vessel, where high temperatures and pressures must be sustained for continuous reaction of the slurry process material. The valves upstream and downstream of the autoclave allow it to function reliably and safely, but unfortunately have traditionally been some of the most failure-prone points in the autoclave train. Examples of valve positions which see severe service in the autoclave train include feed and discharge isolation valves, pressure control and letdown control valves (LCV).

Valve cycling steady-state operation against both erosive and corrosive slurry flow result in very short lifespans for many valves. The severe service that these valves face, and their historic tendency to fail frequently within the autoclave process, combined with the high capital and operating costs for high-pressure hydrometallurgy facilities has spurred several innovations over the years. Most of these improvements have been in the selection or application of materials. Better combinations of alloys and ceramics, combined with certain valve design modifications have improved the life and reliability of hydrometallurgy valves. New coating and weld overlay applications have also extended the life of some valves, acting as a first line of defence against slurry media.

The autoclave letdown valve could be described as the linchpin of the entire process and sees the most severe service of any valve in these facilities. It functions to relieve the pressure of the autoclave slurry after discharge from the autoclave. The extraordinary speed of the slurry as it escapes the letdown valve, the capability necessary to control the level of the final compartment of the autoclave, and the three-phase nature of the media all place a high bar for the operations requirements of this severe service valve (SSV). It would be worthwhile if the challenging requirements would spur innovations in operating procedures and control as well.

In the view of the author, the future evolution of hydrometallurgy valves will be focused less on materials and more on data. The niche hydrometallurgical mining industry has lagged behind other industries such as oil and gas, which have embraced mathematical modelling, data analytics, enhanced algorithm-based control systems and information sharing to optimize output. As increased demand for battery and other technology metals increases, hydrometallurgy facilities will have an increased incentive to use holistic, science-based solutions which address not only the way valves are made, but how they operate within the autoclave system as well.

Keywords: hydrometallurgy, autoclave, valves, HPAL, POx, letdown valve, failures, innovation