

Valves for autoclaves – high pressure acid leaching (HPAL)

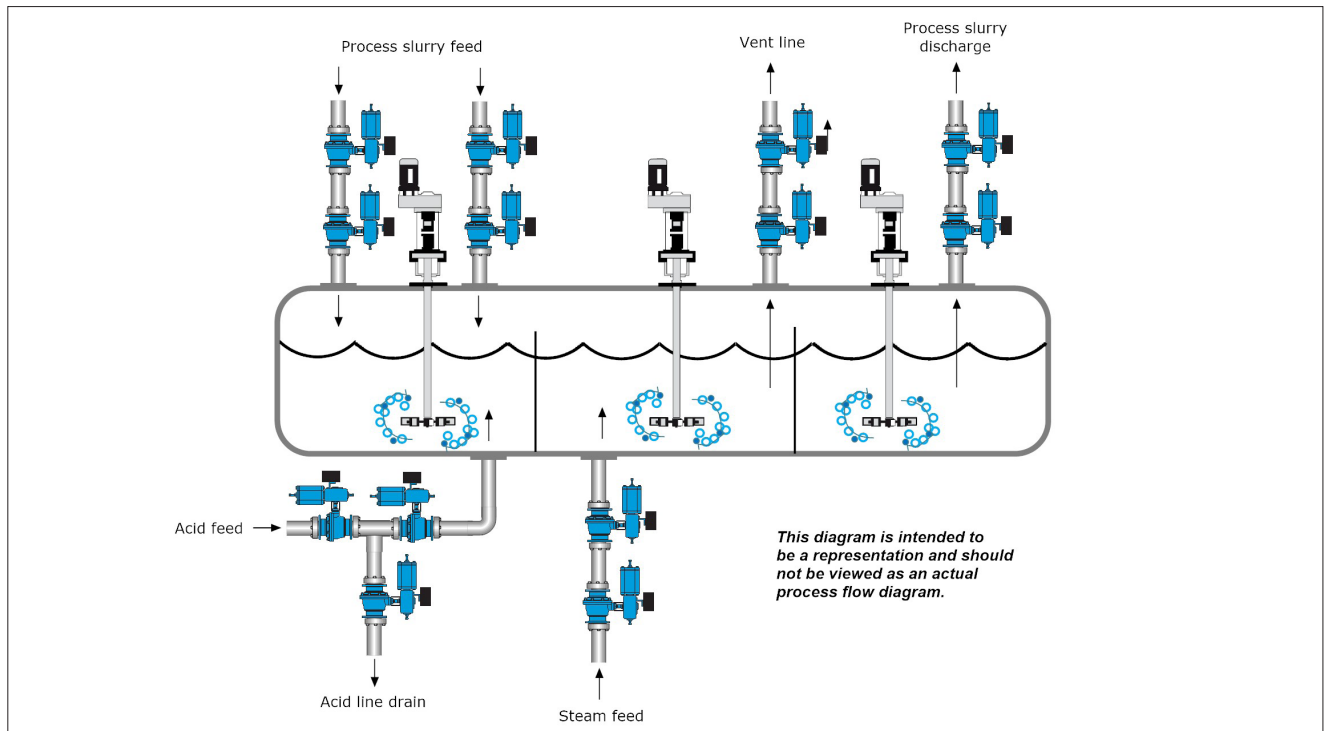


Fig. 1. Simplified representation of the high pressure acid leaching (HPAL) process

Process overview

In the mining and minerals processing industry, autoclaves are utilized to extract metals from refractory ore bodies. One of the typical processes for autoclaves is high pressure acid leaching (HPAL), which is often used for the extraction of nickel from laterite ore bodies but can also be applied in copper and cobalt production. The two major benefits of HPAL are the quickness of the process and high recovery rates compared to conventional leaching methods.

In the HPAL process, the ore is crushed and mixed with water to create slurry, which is then preheated and fed into an autoclave. Acid is added to the vessel to react with the slurry. The HPAL process utilizes high temperatures (approximately 250 °C / 480 °F) and high pressures (40–60 Bar / 580–850 psi) to facilitate the leaching process. A simplified flow diagram is presented in Figure 1. After the autoclave processing step, the slurry needs to be returned to atmospheric condition. This is achieved by taking it through two or more flashing/letdown stages and a neutralization circuit. Once at atmospheric condition, the slurry is washed and separated, at which point the metal can be recovered from the liquid portion.

Another typical process where autoclaves are utilized is in pressure oxidation (POx). POx is usually used in the recovery of gold from refractory ores. Figure 2 shows the typical temperature and pressure ranges for HPAL and POx.

High pressure acid leaching (HPAL)	
35	65
Min Pressure (Bar)	Max Pressure (Bar)
200	275
Min temperature (°C)	Max temperature (°C)
Pressure oxidation (POx)	
10	35
Min Pressure (Bar)	Max Pressure (Bar)
150	225
Min temperature (°C)	Max temperature (°C)

Fig. 2. Temperature and pressure ranges for HPAL and POx

Process applications

Autoclave HPAL operation includes several different types of valves, such as slurry feed and discharge, pump isolation, depressurization, steam supply and steam drum isolation as well as acid injection valves. The high operating temperature and pressure in the autoclave, combined with the acidic slurry, create an environment where the right valve selections will make a big difference in the operation's reliability. The following highlights some of the important valves in the application.

Valves for the slurry feed

The conditions that valves face in the HPAL process require the highest possible resistance against corrosion and erosion as well as deterioration caused by solid contents. To maintain the sealing abilities of slurry feed valves, the right material, seat and coating choices play an important role.

Valves for the acid feed

Controlling the acid feed in the HPAL is one of the essential jobs in the process. In the event they are called upon, these valves need to provide absolute isolation. In unstable situations, the valves and other process equipment in the acid feed line may face very high concentrations of acid. When making selections of valves, this needs to be taken carefully into consideration.

Valves for depressurization

Due to operational disturbances, emergency situations or to enable maintenance of the equipment, autoclave processes sometimes need to be depressurized. During depressurization, a vent line is used to reduce pressure and temperature inside the autoclave.

Process challenges

- The medium in the HPAL process is highly erosive and corrosive. Solid particles (typically 25–35%) can cause challenges
- High temperatures
- High pressures
- When sulfuric acid (H_2SO_4) reacts with the slurry water in the autoclave, a significant temperature increase occurs. This heat transfers to the piping and isolation valves, causing thermal expansion of components

Neles solutions

Autoclave leaching is one of the industry's most demanding processes. When it comes to environments with high temperatures, high pressures, acidic media and abrasive solids, Valmet is the right partner to turn to for the right flow control solutions.

Valves

When deciding on valves for the HPAL process, coating choices as well as material selections will have a huge impact on the outcome. Dependable coatings are needed due to the acidic nature of the hydrometallurgical leaching.

Neles ball valves are an optimal choice for HPAL applications. The valves incorporate robust stem-to-ball connection, which assures that the valves are delivering long-lasting performance in isolation and control applications. Application-based seat selection ensures that our valves are capable of delivering tightness even in the most demanding applications, including abrasive fluids and solids handling. Valve modularity widens the options in material selections, to meet the specific requirements of each HPAL process. Our valves meet and exceed modern industry requirements for reliability, performance and safety.



Neles ball valve

Actuators

Due to its robust design, industrial companies have standardized Neles pneumatic piston-type high-cycle cylinder actuator, which ensures longer plant operating time with less maintenance.

- Robust design – standard anodized/chromed cylinder pipe, hard-chromed piston rod, corrosion-resistant construction and high-quality springs
- Provides high torque when closing the valve, allowing the use of a smaller actuator and achieving tight shut-off for the valve
- A high-cycle design, which delivers over two million cycles due to a wear-resistant piston rod seal and special wear-resistant material in the lever arm bearings
- Modular design, simplifying maintenance and spare parts management
- Arctic service compatible – in case of extreme temperature conditions, the actuator can be equipped with a high-performance piston seal and steel materials, making it functional at temperatures as low as -55 °C (-67 °F)

Valve controllers

The intelligent valve controller Neles SwitchGuard™ offers maximum reliability in severe environmental conditions and provides extensive diagnostics for high-cycle on-off applications, enabling users to guarantee the availability of high-cycle valves.

- Configure to meet process demands – Neles SwitchGuard offers the ability to set the on-off valve stroking times and profiles according to process needs
- Operate millions of cycles without maintenance, due to the advanced design of the controller's pneumatics
- Reach fast stroking times without accessories, such as volume boosters or quick exhaust valves, due to the high pneumatics capacity of SwitchGuard
- Practice predictive maintenance with the help of the extensive diagnostics it provides for high-cycle valve performance
- Simplify the installation by placing different mechanical or inductive proximity switches inside the SwitchGuard housing
- Comprehensive hazardous area certifications for safe and flameproof applications are available for all valve control instruments

Benefits

- Improve process control, increasing product yield and profit
- Prevent unexpected shutdowns
- Reduce maintenance costs with long-lasting valve designs, even under high-cycle service
- Minimize fugitive emissions with rotary designs and emission-certified valves
- Ensure plant safety with an extensive portfolio of safety valves and equipment with third-party compliance certifications

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