

Valves for autoclaves – pressure oxidation (POX)

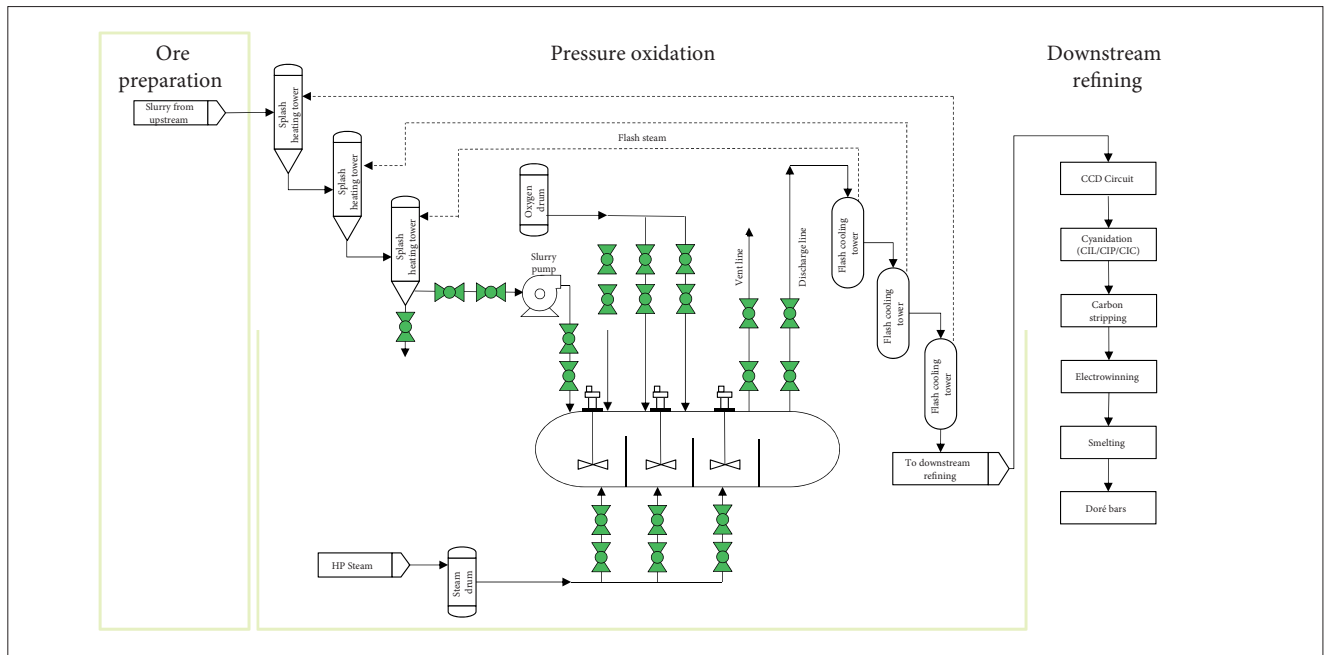


Fig. 1. Simplified representation of pressure oxidation (POX) process

Process overview

In the mining and minerals processing industry, autoclaves are utilized to extract metals from refractory ore bodies. Refractory gold ores require pre-treatment before the conventional CIL, CIC or CIC cyanidation process can take place. One pre-treatment option for the refractory ore is autoclave pressure oxidation (POx). This method is often used in the extraction of gold in cases where the gold is trapped in sulphide minerals, such as pyrite and arsenopyrite. Even though gold processing plants are the most common users of POx -technology, the process can be applied in the production of other metals also, such as copper, zinc and uranium. The two major benefits for POx are the quickness of the process and high recovery rates compared other pre-treatment methods. In the POx process, the ore is crushed and mixed with water to create aqueous slurry which is then heated and fed into an autoclave. Oxygen is added to the vessel to react with the slurry. The POx process utilizes high temperatures (approximately 200 °C / 400 °F) and high pressures (10-35 Bar / 150-500 psi) to facilitate the leaching process. The process requires tens of valves for the controlling of various liquid and gaseous flows. 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. 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 autoclave technology is utilized is high pressure acid leaching (HPAL). HPAL is usually used in the recovery of nickel and cobalt. Figure 2 shows the typical temperature and pressure ranges for POx and HPAL.

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

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

Process applications

Autoclave POx 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 oxygen feed valves. The high operating temperature and pressure in the autoclave combined with an oxygen rich environment, 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 POx 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 oxygen feed

Controlling the oxygen feed in the POx is one of the essential jobs in the process. In the event they are called upon, these valves need to provide absolute isolation. Valve materials need to be carefully selected and cleanliness is of paramount importance because of the inherent danger of oxygen reacting with any grease, oil, or combustible material left in a piping system. The evaluation of valves for oxygen application requires understanding of metallurgy as well as valve geometries.

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 POx process is highly erosive and corrosive. Solid particles can cause challenges in the process
- High temperatures
- High pressures
- Presence of oxygen needs to be carefully taken into consideration when evaluating the suitability of valves

Neles solutions

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

Valves

When deciding on valves for the POx process, coating choices as well as material selections will have a huge impact on the outcome and the profitability of the plant. Dependable coatings are needed due to the harsh nature of the autoclave processing.

Neles ball valves are an optimal choice for POx 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 POx 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
- Forerunner in material technology for valve body materials
- Prevent unexpected shutdowns
- Lasting valve designs, even under high cycle service, reducing maintenance costs
- Rotary designs and emission certified valves minimize fugitive emissions
- Ensure plant safety with an extensive portfolio of safety valves and equipment with third-party compliance certifications

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