AMX AGITATORS
IN MINING & MINERAL PROCESSING

index

The following topics are discussed in this document:

1. Introduction
2. Gold Extraction & Processing
3. Cyanide Leaching
4. CIL & CIP
5. Bioleaching
6. Autoclaves
7. Solvent Extraction

AMX AGITATORS

IN MINING & MINERAL PROCESSING

introduction

Agitators are the mechanical equipment employed during the chemical processing of excavated ores, where the valuable minerals and metals are extracted. Extractive metallurgy focuses on the processes and methods of extracting metals from their mineral deposits. Ferrous and non-ferrous extractive metallurgy have common specialities, which are categorised as follows: mineral processing, hydrometallurgy, pyrometallurgy and electrometallurgy; according to the processes adopted to extract the metal. Certain metals undergo several extraction processes, which are determined by the metals occurrence as well as chemical requirements.

The exploration and extraction of gold, platinum, nickel, copper and uranium alongside other base metals, provides for a large variation of different process applications where the agitators are carefully calculated and designed. Ensuring that the individual processes are understood, AFX engineers have spent time on site and work closely with process engineers to provide the best solutions.

AFX has an exceptional track record throughout mining and mineral processing. Our attention to detail, as well as the years of accumulated knowledge, has allowed AFX to become the preferred supplier of specialised SX pumper mixers, bioleaching, cyanide detoxification, leach and CIP/CIL, iron removal, high-pressure autoclave agitators, backfill agitators and many other applications requiring unique solutions.

Although the spans of mining and mineral processing are more extensive than what we have listed below, we have elected only a few specialised and specific processes to highlight not only the extensive knowledge around the process application but to offer peace of mind relating to our agitator and engineering solutions. All metallurgical treatments have a common outcome namely the extraction of the mineral ore from the rock. The first step in the circuit would be to achieve particle comminution through accurate grinding.

AFX HOLDINGS

AMERICA: +1 604 380 4458
EUROPE: +44 1202 798452
AFRICA: +27 11 397 6911
WEB: www.afxholdings.com

AMX AGITATORS

IN MINING & MINERAL PROCESSING

gold extraction & processing

Principally, gold occurs as a native metal, usually alloyed with silver as an electrum, or with mercury as an amalgam. Gold may occur as sizeable nuggets, fine grains or flakes in alluvial deposits or microscopic particles embedded in rock minerals. Although comparatively rare, gold occurs in chemical compositions with other elements such as calaverite, sylvanite and petzite, to name a few. Historically, the extraction of the metal relied on gravity concentration, where simple tools such as pans and wash tables were used. Gravity concentration could be directly smelted too for gold bars if the gold was present in the ore as coarse particles. In today's era, which is continually demanding maximum yield and concentration from the mining process, there are a series of chemical procedures employed to extract the gold from the ore.

cyanide leaching

This is commonly used metallurgical extraction processing method. The process itself falls into the hydrometallurgy category, which is the use of an aqueous solution to extract the gold from the ore. Most leaching applications sparge oxygen into the leach tanks. Cyanide is a lixiviant, which is used to leach gold from solid matrixes to form a gold-cyanide complex. The concentration and dose of cyanide used are very low in comparison to the live liquid volume in the tank. The pH of the resulting slurry would be carefully controlled by adding lime or another alkali ensuring that the cyanide ions do not change into toxic cyanide gas. AFX carefully calculate and design the required agitators for the process, knowing that the slurry requires the solids to be in full suspension throughout the tank for the chemical process to efficiently take place. The agitator will also ensure the thorough distribution of the alkali chemical(s) being dosed into the mixing environment. AFX can offer advice on the sizing and installation configuration of baffles within the mixing tanks, which are vital for the mixing process. An adsorption process is employed after cyanide leaching, where activated carbon or an organic carbon may be used, depending on the ore. The below processes refer either to a particular process in a metallurgic extraction or through various metallurgical applications.

CIL & CIP

Adsorption is most commonly recognised as Carbon in Leach (CIL) or Carbon in Pulp (CIP), where the processes use activated carbon for the gold to leach onto. CIL is a process of cyanidation as the carbon is added into the leach or reactor tanks. Leaching, as well as adsorption, will take place in the same leach tanks.

AFX HOLDINGS

AMERICA: +1 604 380 4458
EUROPE: +44 1202 798452
AFRICA: +27 11 397 6911
WEB: www.afxholdings.com

AMX AGITATORS

IN MINING & MINERAL PROCESSING

CIL & CIP

CIL is the simultaneous process of leaching and adsorption. This process was specifically developed for the processing of gold ores containing “preg-robbing” materials i.e. organic carbon. These materials reduce the gold yield by attracting the gold meant for the activated carbon. The employment of leaching and adsorption assists in minimising this problem.

CIP differs from CIL in that the leaching process and the adsorption process take place in separate reactors or tanks. During the CIP process, pulp flows through several agitated tanks. The addition of oxygen and sodium cyanide is done before the CIP circuit to dissolves the gold into a solution. This is commonly known as gold dissolution. Activated carbon is present in the adsorption tanks, which the gold adsorbs onto. The activated carbon flows counter-currently to the pulp. Separation screens sort the barren pulp from the gold loaded carbon. Adsorption onto activated carbon is commonly categorised as recovery. Preceding recovery one would expect to encounter solution concentration, stripping or electro-winning.

AFX have a countless number of successful installations in Leach, CIL and CIP applications worldwide, using our F3 hydrofoil impeller system. Our agitators are robust in design and mechanically sound to withstand the harsh operating conditions some of these plants undergo.

AFX HOLDINGS

AMERICA: +1 604 380 4458
EUROPE: +44 1202 798452
AFRICA: +27 11 397 6911
WEB: www.afxholdings.com

AMX AGITATORS

IN MINING & MINERAL PROCESSING

bioleaching

Bioleaching is a method of extracting metals from their ores with the use of living organisms. Bioleaching is a cleaner and more environmentally acceptable means of extraction when compared to traditional cyanide leaching. Bioleaching is categorised under biohydrometallurgy and can be used in the recovery of copper, zinc, lead, gold silver, cobalt and nickel to name a few. Bioleaching also known as Bio-oxidation, uses bacteria for the further oxidisation of the ore. The bacteria oxidise the ore while regenerating the chemical oxidant. Bioleaching or bio-oxidation applications require the induction of oxygen into the process tanks, as the bacteria use the oxygen to carry out their required oxidising tasks. As the exploration into bioleaching's possibilities has expanded, AFX, working hand in hand with a specialist, have been at the forefront of innovation to deliver calculated solutions for optimal output results. AFX have, in the past, designed and commissioned pilot plants, which were used for testing. Once the testing was completed and the client was satisfied with the results of the agitators and sparging equipment, AFX was awarded the contract for the full-scale plant.

autoclaves

Pressure Oxidation (POX), can be employed for the leaching of ores and concentrates in the mining and mineral processing industry. Autoclaves operate under pressure as well as at high-temperature conditions in the presence of pure oxygen gas being required for the chemical reactions to take place. Efficient oxygen uptake, as well as dispersion throughout the autoclaves, is of utmost importance. AFX has spent time focusing on a mechanical solution of the autoclave systems. A dual agitator impeller system, with a P4 and P3 impeller, is installed with a mechanical seal, housed in a pedestal. The mechanical seal is rated to withstand the high temperatures as well as the pressure of the autoclave systems. AFX provide the solution, which has a proven industry track record throughout the international mining and mineral processing groups.

AFX HOLDINGS

AMERICA: +1 604 380 4458
EUROPE: +44 1202 798452
AFRICA: +27 11 397 6911
WEB: www.afxholdings.com

AMX AGITATORS

IN MINING & MINERAL PROCESSING

solvent extraction

Solvent extraction is the process used to recover base metals and uranium from solutions generated in atmospheric leaching reactors, as well as in pressure oxidation autoclaves. This solution is always referred to as the pregnant leach solution (PLS) and contains copper, nickel, uranium and other minerals in the solution. The metals are removed from the solution using the solvent extraction (SX) process. The SX plant consists of mixer units, which are attached to a large circular or rectangular settlers.

The organic solvent used in the application extracts the metal from the solutions and at the same time concentrates it into a much smaller volume, similar to the gold CIP process, where the gold absorbs onto the carbon. As an example, copper PLS is contacted with an organic solvent in the extraction settlers of the SX plant.

The extraction is normally carried out in three to four stages, with the two-phase (PLS aqueous and organic solvent) moving counter-currently. The two phases need to be mixed thoroughly with the organic solvent to extract from the metal. The aqueous phase gravitates, while the organic is pumped. Extraction mixers operate in the organic phase. The two phases then separate in the settlers, with the lighter organic phase being the top layer. The next stage is the scrubber mixer-settlers, where the solvent is washed with a low pH solution to remove impurities like iron and silica. Similarly, in the strip mixer-settler units, the Copper is stripped from the organic again, using high concentration sulphuric acid solution. This solution (electrolyte) is then pumped to the electrowinning plant to produce pure Copper cathodes.

AFX HOLDINGS

AMERICA: +1 604 380 4458
EUROPE: +44 1202 798452
AFRICA: +27 11 397 6911
WEB: www.afxholdings.com