The Outotec Silver Refining Plant solution covers the full range of process steps and material-handling streams, from silver Doré anodes to silver granules and bars. It offers an unbeatable combination of innovative process technology, efficient handling, high flexibility, and safety. We also offer a full suite of support services to help you maximize plant uptime, including spares delivery and installation, and remote assessment of equipment status.

**OUTOTEC SILVER REFINING PLANT**

**BENEFITS**

- Short process time and low inventory
- High total recovery (>99.99%)
- ≥99.99% Ag-purity in cathode silver
- Safe working environment with no toxic gas emissions
- Highly automated process with low maintenance and manpower requirements
- High throughput from Doré metal to fine silver
EASY OPERATION AND HIGH EFFICIENCY

The Outotec Silver Refining Plant is the result of more than 20 years’ experience in developing robust and cost-effective solutions for precious metals refining. The process has been successfully applied worldwide in installations with annual plant capacities ranging from 30 to 2000 tons. Our electrefining process produces fine silver, free from unwanted impurities, and separates valuable impurities such as gold and platinum-group metals (PGM) from silver for recovery.

The sophisticated control system monitors and controls the process, making it both easy to operate and highly efficient.

Silver Doré anode casting
We offer various solutions for silver Doré anode casting. Our portfolio includes six different designs of both casting wheels and machines for the casting of anodes of variable weights and shapes.

Outotec silver electrolysis tankhouse
The heart of the Outotec Silver Refining Plant process is the silver electrolysis tankhouse, which consists of electrefining cells, circulation tanks and pumps, sieve tanks, a cooling system, and a pH control and adjustment system. A sophisticated control system monitors and controls the process, making it both easy to operate and highly efficient. With Outotec HCD (High Current Density) silver electrefining cells, current densities exceeding 1000 A/m² are possible, depending on the composition of the silver Doré anodes being processed.

The electrefining process is continuous except when new silver Doré anodes are loaded in the cells and silver anode slime and anode scrap is discharged from the cells at the end of the electrolysis cycle.

The anodes continuously dissolve, depositing refined silver on the cathodes. The cell is equipped with an automatic scraper system that removes the deposits – the silver crystals scraped off the cathodes are collected at the bottom of the cells. At the end of the electrolysis cycle, a slurry containing crystals of cathode silver and electrolyte is discharged into a sieve tank. The quality of the silver crystals produced in the electrolytic refining process is ensured by electrolyte circulation.

PRINCIPAL PROCESS OPERATIONS AND EQUIPMENT
All this helps increase the efficiency of the process, decrease manual work, and increase the amount of silver recovered. The modular design makes it easy to scale the solution for your desired capacity.

Silver anode slime containing valuable impurities such as gold and platinum-group metals (PGMs) is also formed during the electrolysis process. The slime is collected inside anode bags surrounding silver Doré anodes and can be further processed using the Outotec Gold Refining process for recovery of gold and PGMs.

The non-dissolved anodes remaining after electrolysis are recycled for smelting and casting of new silver Doré anodes. Spent electrolyte withdrawn from circulation is replaced with fresh silver nitrate electrolyte in order to keep the silver content at a constant level.

Outotec silver electrolyte preparation system
Some of the silver crystals produced in the silver electrorefining cell are processed in the Outotec silver electrolyte preparation system, where they are dissolved to produce pure silver nitrate solution. The process and equipment design avoids the formation of toxic NOx gases, which improves the safety of the working environment. The system is also available as standalone equipment with its own control system.

Drying of silver crystals
The final product can be either silver bars or silver granules. In both cases the silver crystals are dried using the fully automated Outotec Silver Dryer, which consists of a fan, a heater, and a sieve tank for the silver crystals. The dried silver crystals are then melted using an induction furnace.

Casting and bar processing
Casting of silver bars is performed using an Outotec Silver Bar Casting Wheel for 1000 troy ounce (approximately 31 kg) ingots. The bars are then cooled in a water bath.

Further operations, such as polishing, weighing, marking, and stacking can be performed by the Outotec Silver PWMS Robot. The equipment produces silver bars that meet the requirements of the London Bullion Market Association’s Good Delivery standards.

Granulation and packing
Outotec Silver Granulation Equipment consists of an induction furnace, granulation equipment and a receiving tank. Granules are dried in the Outotec Silver Dryer and packed using a material-handling system that produces ready-to-ship bags that are sealed and marked.
Outotec provides leading technologies and services for the sustainable use of Earth’s natural resources. As the global leader in minerals and metals processing technology, we have developed many breakthrough technologies over the decades for our customers in metals and mining industry. We also provide innovative solutions for industrial water treatment, the utilization of alternative energy sources and the chemical industry. Outotec shares are listed on NASDAQ OMX Helsinki. www.outotec.com

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FROM SINGLE EQUIPMENT TO FULL TURNKEY PLANT DELIVERY

Outotec offers proven technologies and equipment packages for the whole silver production chain, from mine to refined metal, and from single equipment to full turnkey plant delivery. Through continuous research and development we ensure that you are always able to take advantage of the latest technologies for environmentally sustainable and economically viable silver production.

A lifetime of support
Outotec is committed to supporting your operations throughout the plant life cycle, helping you achieve and maintain peak performance levels and guaranteeing the best long-term return on your investment. Our global network of service centres covers more than 25 countries and provides lifecycle services covering everything from spare parts, maintenance, and technical services to modernizations, operations and maintenance agreements, training, and consultancy.

1. Design and installation
A good basis for future cooperation starts at the beginning. We design the most realistic and suitable process solution for you through active participation in feasibility studies and engineering. Then, efficient installation procedures and professional commissioning during the delivery phase ensure that planned time-to-cash remains on schedule. Comprehensive training before start-up establishes efficient operations right from the start.

2. Operation and maintenance
During the operation phase, you want to achieve as high production rates as possible. We are able to support this goal in several ways – from simple inspections and maintenance support to continuous site presence and operational responsibility for the entire plant. The various production challenges you face can be systematically targeted through process and metallurgical expertise, as well as maintenance excellence.

3. Modernization
Operating conditions tend to change over time, so the production process and equipment may need to be fine-tuned or modernized to meet new requirements. We maintain a wide portfolio of modernization solutions for precious metals technology to ensure you continuously achieve the highest production and quality levels.

Outotec offers proven technologies and equipment packages for the whole silver production chain