

Refining

Refining is the fourth and final step in the copper production cycle (mining, concentrating, smelting, and refining) and is the stage in which precious metals are separated from copper and recovered. Refining takes place at Kennecott Utah Copper's Refinery about two miles east of the Smelter.

The Refinery began operating in 1950 and completes the production cycle necessary to produce copper ready for sale to fabricators. In 1954 and 1955, it was expanded to better meet customer demands in a highly competitive copper market. In 1994, it was again expanded and modernized. In August 2008, the Automatic Guided Vehicle system was replaced by a new Transfer Car System.

The modernized refining process begins when 750-pound anodes arrive from the Smelter. Stainless steel cathode blanks are interleaved with these anodes and transported to the tankhouse by the Transfer Car System.

In the tankhouse, the anodes and cathode blanks are placed in cells containing an acidic copper sulfate solution called electrolyte. Electric current is applied to the cells for 10 days. The anode copper dissolves into the electrolyte and migrates to the cathode where the copper ions are deposited as 99.99 percent pure copper. Impurities and precious metals settle to the bottom of the cells and are collected and later refined on site at the Precious Metals Plant.

An anode will produce two cathodes, each weighing about 300 pounds. At the end of the cycle, approximately 18 percent of the anode remains. This anode scrap is returned to the Smelter to be re-melted and re-cast into anodes.

The cathodes are removed from the cells with a crane and transported by transfer cars to be washed and placed in an automated cathode stripping machine, which flexes the blank, releasing the copper cathode from the stainless steel blank. These stainless steel blanks are re-used many times. A small sample button of copper is removed from the cathode and tested for its quality and purity in the Central Laboratory.

Before banding, weighing and shipping, which are also automated, every other cathode is corrugated to improve melting characteristics in customers' facilities.

The new Precious Metals Plant technology produces gold in only five days, as opposed to the 45-day cycle required in the old Refinery. Everyday, approximately 129,000 gallons of anode slime from the tankhouse are pumped to the Precious Metals Plant as a slurry mixture of solids, electrolyte, and wash water. The slurry is then pumped into receiving tanks where the precious metals slime settles and the electrolyte is filtered and returned to the tankhouse. The settled solids are processed through a series of autoclaves, tanks and filters where the precious metals are extracted and purified.

Chlorination leaching oxidizes and solubilizes the precious metals in the slime using a hydrochloric acid leach. This leach solution contains essentially all of the gold in the electrolytic slime. The gold is further refined using solvent extraction, finally producing gold sand, which is charged into an induction furnace where the gold is melted and cast in 400-troy ounce bars with a purity of 99.99 percent. In a similar process, silver is produced and cast into 1,000-

troy ounce bars.

The Precious Metals Plant produces approximately 460,000 ounces of gold per year and 4,150,000 ounces of silver per year.