# IDAHO STATE HISTORICAL SOCIETY

# REFERENCE SERIES

## RECOVERY PROCESSES FOR IDAHO ORES

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Miners in Idaho had to use several different recovery processes to handle varying kinds of ore. Of these, stamp milling-mercury amalgamation of gold ore, Freiberg and Washoe processes (either one with or without roasting) for silver ore, and blast furnace smelting of lead-silver ores were the four important early processes. Cyanide and floatation processes were important later developments. A few others (Von Patera hypo leach for silver, and copper blast furnaces, for example) also were tried.

1. Free milling gold ores could be processed with stamp mills and mercury amalgamation plates. This is an old European process used in Georgia and widely in the west. The Homestake in South Dakota, and many Idaho districts including Rocky Bar, Warrens, Florence, Elk City, Boise Basin, Buffalo Hump, and Thunder Mountain, could operate stamp mills. Arastras often were used initially in place of stamp mills in this process, especially in remote districts.

2. Silver ores required a more complex system. The traditional, patio process, used in Potosí, Bolivia, was improved and mechanized in the western United States. Greatly speeded up, the new process required six hours, compared with six weeks for the old patio. Ores encountered near the water line and the level of surface enrichment generally contain varying amounts of silver chloride (which amalgamates) and silver sulphide (which does not amalgamate), and thus vary in their degree of recovery. Ores which cannot be amalgamated are called refractory, and silver sulphide ores are one kind of refactory ore. The patio process worked for surface ores which were not too refractory. As used at Potosí, the patio process started with ground rock amalgamated on a rock-surfaced area (patio) and treated with iron, copper, and salt as agents for chemical replacement of sulphide with chloride, so that refactory silver sulphides became silver chlorides subject to amalgamation. (The chemical reactions of this process are highly complex and imperfectly understood even yet.) Heat is required in the process. At Potosí, direct sunlight was used as a heat source. The ore and chemicals had to be stirred for six weeks in the patio to complete the reactions; at Potosí the stirring was done by burros

strolling around. Several sets of burros were necessary for each month's batch of ore, since their feet were dissolved in the process. Burros were rounded up in the hills, and then turned loose to grow new feet. The survival rate among patio burros was a good deal less than it ought to have been. Lack of fine-grinding helped reduce the efficiency of the patio process to about a 25% maximum. Slave or forced labor and plenty of free burros were essential for profitable operation of the incredibly slow patio process. Since these essentials were unavailable in the United States, improvements were necessary. The Washoe process, developed on the Comstock, employed the same chemistry, but operated more quickly and efficiently. Washoe amalgamating pans were substituted for a rock-lined patio, and steam for sun heat.

An expensive alternative to the Washoe pan process is the Freiberg barrel process ($50 a ton, compared with $10 a ton for Washoe), which gave extremely high silver, but poor gold recovery. Washoe pans saved more gold, and when gold values were important (as on the Comstock, where ore values ran half silver and half gold), the Washoe process was preferred even though some of the silver was lost. With straight high-grade silver ore (simple chloride or sulphide), Freiberg barrels saved enough more silver to justify the high additional cost of the process. Silver City could use the Washoe process, but Reese River (Nevada), Atlanta, and perhaps Banner tried the Freiberg process.

Some highly refractory ores require expensive salt roasting, followed by either the Washoe or Freiberg Process. Salt roasting of silver sulphide converts the compound to silver chloride which generally will amalgamate. In some of these highly refactory ores, the silver mineral is finely divided in other sulphides, particularly antimony, arsenic, or lead. The salt roasting process often produced antimony, arsenic, copper, or lead compounds which flour and contaminate the mercury, thus interfering with amalgamation of silver chloride. For some sulphide ores in which the silver is disseminated in antimony, arsenic, or lead, the silver chloride particles resulting from salt roasting were too small to amalgamate. In this situation, the Von Patera process was employed in place of Washoe or Freiberg recovery methods following salt roasting. Silver chloride is dissolved with hypo solution, and then precipitated as a pure sulphide. Finally the silver sulphide is roasted without salt to drive out the sulphur to leave pure silver. This clumsy, expensive double-roasting process (of converting contaminated silver sulphide to chloride and back to pure sulphide) was used for some high-grade ores at Silver City and Atlanta. In form and machinery, but not in chemicals, the Von Patera system is antecedent to later cyanide (as well as to recent uranium recovery) processes.

3. Lead-silver ores present different problems of recovery.

These had been solved before 1880 when Idaho commenced this kind of mining. An experiment by W. S. Keys (Argenta, Montana in 1866) who had studied at Freiberg led to perfection of lead-silver blast-furnace smelting at Eureka, Nevada. This process differed from the cold-copper-silver smelting developed at Black Hawk, Colorado (and not used in Idaho), and was available for large scale use at Leadville, Colorado before 1880. Both Eureka and Leadville had replacement ores which could use the same process. Then when Wood River, Sawtooth, Vienna, Bayhorse, Little Smokey, and Coeur d'Alene lead-silver properties were developed in Idaho, they used the Eureka process, which greatly improved the traditional lead-silver smelting methods. Gravity concentration mills often were used prior to smelting.

4. Later processes used for various Idaho ores include cyanide, developed in Australia, for some finely divided gold and silver ores where copper is absent after 1893. Copper blast furnaces, developed in Baltimore and used in Arizona, also were tried in Idaho in remote camps such as Yellow Jacket and the Lost Packer on Loon Creek. Finally floatation, invented in 1910 and used widely after 1920, was available for gold, silver, copper, or lead ores. Wood River, Coeur d'Alene, Stibnite, and Atlanta used floatation to advantage. In Atlanta an amalgamation jig with a Washoe pan, followed by floatation, finally solved the recovery problem.

Information supplied by Ernest Oberbillig.