COPPER LEACHING AND ELECTROLYTIC PRECIPITATION AT CHUQUICAMATA, CHILE*

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The Chuquicamata copper mine is located at Chuquicamata, a station on a branch of the Antofagasta and Bolivia Railroad, in the Province of Antofagasta, Chile, between 22 and 23 degrees south latitude. Chuquicamata is 165 miles by railroad from Antofagasta, and 82 miles in a straight line from the coast and lies at an altitude of 9,500 ft. above sea level.

The deposit has long been known as the atacamite deposit of Chile, and for many years past has been mined by the natives. As evidence of their operations we find in the old workings many stone utensils, hammers, etc.—and mummies.

The deposit is a brochantite mineral contained in the cleavages of the granodiorite, mixed in part with chalcanthite and to some extent with atacamite, and with a deposit of salt. A small amount of caliche containing nitrates is also present in the upper layers of the ore-body.

The so-called Llampera ore-body extends for a distance of approximately 8,000 ft. with an average width of about 500 ft. Throughout the whole length of the deposit numerous tunnels have been run and a very large quantity of ore has been left on the dumps from these tunnels. From the tunnels raises have been made almost to the surface, leaving in places a shell over the workings 8 to 12 in. thick. A few shafts have also been sunk in the ore deposits, the deepest one to a depth of 110 meters.

Acquisition and Development of the Property.

The property was acquired by Mr. Albert C. Burrage of Boston, who, in connection with the firm of Messrs. M. Guggenheim's Sons, formed the Chile Exploration Company, which company now owns the property.

The property has been explored by churn-hole drilling. The drilling has developed an ore-body in excess of 200,000,000 tons. Most of the drill holes, however, were stopped while the bottom of the hole was still in ore.

The general direction of the ore body is north and south. Lately a number of drill holes have been sunk at a considerable distance west of the Llampera, and after going through from 300 to 400 ft. of capping, chalcocite and chalcopyrite have been encountered, giving indications of a very materially increased tonnage over that reported up to date.

In the Llampera zone, of the 200,000,000 tons of ore so far developed, approximately two-thirds is brochantite and one-third sulphides. No change in the formation has been shown, even in the deepest drill holes, the ore still appearing to be in the cleavages of the granite. The lower drill holes show primary ore. From the amount of ore developed and indicated, it appears that the Chuquicamata mine is probably the largest copper deposit known to-day.

It was generally assumed that this large and well-known deposit of ore was atacamite, and as such could not be treated at a profit by any of the established methods; first, on account of the highly siliceous nature of the ore and the absence of sulphides and water, and, secondly, on account of the volatilization in smelting of the copper chloride.

It was demonstrated that the mineral was not atacamite (oxy-chloride) but brochantite (oxy-sulphate) and that mixed with the brochantite in the upper parts of the ore-body was a deposit of salt. The brochantite, being an oxy-sulphate of copper, is insoluble in water but very readily soluble in dilute sulphuric acid. It was, therefore, evident that the way to treat the brochantite ore-body would be by wet methods.

Design of Plant Now Building at Chuquicamata.

On account of the very large ore body already developed at Chuquicamata the first unit of the plant now building has been designed to treat about 10,000 tons of ore per day. The electrolytic refinery will have a capacity of about 335,000 pounds of copper per day.

The ore will be mined by steam shovels, practically no stripping being necessary. The ore will be transported to the mill, distant about 2½ miles from the mine, in standard American gauge railroad cars of 60 tons capacity each.

Arriving at the plant, the ore will first pass through gyratory crushers, thence through 48-in. Symons disc crushers, and finally through Garfield rolls until a product is obtained of about ¼ in. mesh. The ore will be carried on conveying belts from the crushing plant, after sampling, to the leaching vats. Each of the leaching vats has the following dimensions, 110 ft. wide, 160 ft. long and 16 ft. high. The leaching vats, six in number, will be placed end to end.

The belt delivering the ore from the crushing plant will be discharged into the leaching vats with the aid of an electric traveling bridge, spanning and traveling the entire length of the leaching tanks. The leached and washed residue will be removed from the leaching tanks by a 15-ton grab bucket traveling on an unloading bridge and, after sampling, will be delivered onto a conveying belt for disposal to the tailings dump.

The tanks are being built of heavily reinforced concrete, and will be lined with mastic asphalt 1½ in. thick. This tank lining has been developed by the Vulcanite Paving Company of Philadelphia, and consists of a specially refined Trinidad asphalt mixture, to which is added crushed quartz or granite.

In our experimental plant, where this lining has been in use for considerably more than a year, both in the leaching and electrolytic tanks, absolutely no difficulty has developed—not even a single leak. We have tested the material at a temperature of 50 deg. C. without finding any signs of softening, and as this is far beyond the range at which we intend to operate tests at higher temperatures have not been made, although the temperature limit, so far as softening is concerned, will probably lie somewhere between 50 deg. and 70 deg. C.

Tests have also been made to try the strength of this material from a physical standpoint, and in one case a 250-pound cathode was elevated about 5 ft. above the bottom of the tank and then dropped in such a way that one of the sharp corners of the cathode hit the bottom of the asphalt-lined tank. In this case a piece of the lining about ⅛ in. thick and

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