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## MINING.

## THE F. L. BARTLETT ZINC-LEAD PROCESS.

This process is used at Canon City, Colorado, for the treatment of argoniferous zinc-lead sulphide ores. The process in general consists in separating the zinc and lead by volatilizing them in the form of a zinc-lead fume, from which a marketable pigment is obtained, while the silver is left behind with the other non-volatile metals, and is collected in a copper matte. The process is based on the fact, discovered by Dr. Bartlett, that when silver-bearing zinc sulphide ores are burned and the zinc is volatilized the amount of silver dragged off with it is much less than was previously thought to be the case. Two methods of treating the ores are adopted according to the proportions of zinc and gangue they contain. Those containing about 25 per cent. or more are treated by the first method; those containing about 22 per cent. of zinc or less by the second.

The following are the examples of ores actually treated at Canon City:

	Silver.	Lead.	Zinc.	Iron.	Copper.	Silica.
1.....	10 cz	30 p c.	24	38	0	5
2.....	25 "	18 "	25	10	0	18
3.....	4 "	2 "	12	24	10	38
4.....	29 "	15 "	28	15	6	12

The requisites for the process are: 1. Cheap flaming fuel—e.g., bituminous coal. 2. An iron ore either as oxide or iron pyrites, the latter being especially desirable if it contains silver. 3. A copper ore containing about 3 per cent copper for the formation of the copper matte to collect the silver.

The ores containing 25 per cent. of zinc and over are crushed to pass a 4-mesh screen, and are then mixed by an archimedian screw with an equal bulk of fine coal. The mixture is then moistened and charged in lots of 600 lbs into a furnace, of which the grate consists of perforated plate, the charge being spread on the grate in a layer about 4 in. deep. Air is forced through the charge from below at a pressure of about 2 cz per square in., and a sufficient quantity of air is also forced through openings in the sides of the furnace above the layer of the ore to prevent the formation of sulphuric acid with the hydrocarbon vapors. The burning is completed in about 4 hours, when the charge, which has not been touched during the operation, is in the form of a sintered mass, ready to go to the blast furnace, containing the silver and other non-volatile metals and some zinc. The sulphur is driven off, and all the lead and most of the zinc is volatilized; being collected in the form of a fume, out of which the pigment is made.

Iron pyrites, when necessary for a flux, is charged into a somewhat similar furnace and treated in a similar manner, except that only enough slack coal is used to start the pyrites burning, their sulphur contents being sufficient to supply the requisite fuel heat, while a higher blast (4 cz per sq. in.) is used, the burning being completed in from three-quarters to one hour.

Sinter from the zinc ore is mixed with the burned pyrite, copper ore, fluxes and fuel in the requisite proportions, and is smelted at a high temperature in a water-jacketed furnace of a greater proportional length than that of the ordinary blast furnace. Most of the zinc left in the charge passes off in the form of a fume which is saved, while the copper matte which collects the silver runs into an outside crucible with the slag, and is tapped from time to time.

The ores containing about 22 per cent. of zinc or less are smelted directly in a special furnace with the proper mixture of copper ore, fluxes and fuel. This furnace is water-jacketed and has two rows of tuyeres on each side, the upper ones being about 10 in. above the lower. The lower blast is supplied under a pressure of about 2 lbs. to the sq. in., and is preferably a hot blast. The upper blast is cold and run under a light pressure. The ore and fuel are fed together continuously in a thin layer from 12 to 18 in. deep. For fuel, a mixture of coke and coal screenings is used amounting to one-quarter of the weight of the ore. The blast from the lower tuyeres plays upon the bath of molten matter, scorifying it, and volatilizing all the lead and most of the zinc, which pass off, through the thin layer of the unmelted portion of the charge, in the form of a fume. The upper tuyeres deliver a blast at the top of the charge, thus serving to keep up the necessary combustion, and preventing the condensation of the volatile compound rising through it. The copper matte which collects the silver, as in the first method, runs into an exterior crucible with the slag, and is tapped from time to time.

The matte contains as much as 65 per cent. copper and 250 ozs. silver per ton. The slag contains 6 to 10 per cent. zinc and from  $\frac{1}{2}$  to 1  $\frac{1}{2}$  czs. silver per ton of ore treated, no lead and only a trace of copper.

The fumes from the furnaces, consisting of the zinc, lead, and other volatile elements, are drawn from into chambers by means of exhaust fans and then forced through iron cooling conduits into long bags hanging from the roof of a building at some distance from the smelters. The gases pass through the bags, where the solid contents of the fumes are caught and from time to time shaken down into cars and taken to the refinery. This is subjected to a low, red heat in a closed tube containing a screw, which keeps the material in constant motion. By this means all the deleterious volatile elements are removed and the product is a marketable white pigment containing from 35 to 40 per cent. of oxysulphate of lead and from 55 to 60 per cent. of zinc oxide.

Some ores lose silver heavily and others hardly any, ores containing cop-

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