

centrated), and waste. The heaps of best ore, varying in quality from 50oz. to 140oz. of silver and from 10dwt. to 1oz. 10dwt. of gold per ton, are then carted to the reduction works, a distance of about one and a half miles. The mode of treatment is that known as the "chlorinizing and amalgamating process," and it is based on the fact that all soluble salts of silver act on and decompose substances containing chlorine in such a way that the free silver and chlorine are liberated. These, through their great affinity to one another, combine, forming chloride of silver (75.25 per cent. silver, and 24.75 per cent. of chlorine); mercury, having also a great affinity for silver, easily combines with it when brought into contact with the chloride, thus forming an amalgam when dry of 84 per cent. of mercury and 16 per cent. of silver.

The reduction-plant consists of one 24-horse power horizontal steam-engine, which drives a battery of ten heads of stamps, a pulverizer or stone-breaker, four of Wheeler's pans, one berdan basin, one revolving-screen, and a force-pump to lift the water from a creek a little below where the machinery is placed. In addition to the foregoing, there are two reverberatory double-bed chlorinizing furnaces, each 26ft. in length by 11ft. in width and 6ft. in height; also a melting furnace, retort, assay office, and laboratory. The ore is first put through the pulverizer, after which it is taken to the stamping-battery with stamps of 6cwt. each, lifting nine inches and averaging seventy blows per minute, where it is crushed, dry, and sent through a smut wire grating having from 100 to 140 holes to the square inch, according to the nature of the ore to be operated on. A sample is taken from each wheelbarrow-load of the crushed ore taken from the battery to the mixing-floor in order to obtain a perfect average sample of the parcel for subsequent assay in the laboratory. The mixing-floor is level with the top of the reverberatory furnaces, so that the ore may be conveniently charged into them. When the value of each of the various crushed parcels is known by assay, they are intimately mixed together in one large heap of a convenient quality for treatment, ranging from 70oz. to 140oz. of silver, and from 14dwt. to 1oz. 10dwt. of gold per ton. This heap is now ready for chlorinizing, and is weighed out in charges of about 6dwt., according to the specific gravity of the ore, and is placed in the furnaces. Each furnace has two beds, which are termed respectively the hot and cold beds; the former being nearer to the fireplace. The cold bed is a little higher than the hot one, so as to facilitate the passing of the ore from the one to the other. At a part opposite to and further from the fireplace, there are two holes 8in. square to convey the smoke and fumes into the flues and thence to the chimney, which is a large brick stack 50ft. in height. The flues are 100ft. long, and are so constructed as to enable them to be readily opened for the purpose of taking out the dust which is continually passing from the furnaces and accumulating therein. The ore is first placed on the cold bed and spread over the floor, and is kept in motion by means of a long iron rake dragged to and fro by a man at the working door, so as to expose every particle of ore to the action of the heat. The ore is kept on this bed from one and a half to three hours, according to its nature and the quantity of sulphur, arsenic, and other volatile matter it may contain. If much sulphur is present, the surface of the ore is covered with a blue flame, and sparks are emitted in all directions in about three-quarters of an hour after the furnace is charged. When most of the sulphur has been volatilized, the charge is passed to the hot-bed from inside by means of long iron scrapers, where the last traces of sulphur, &c., disappear very soon under the increased temperature. During this process all the sulphides and arsenides of the metal contained in the ore have been decomposed and transposed to sulphates, part of the sulphur liberated combining with the oxygen forms sulphuric acid, which in its turn combines with the iron, copper, zinc, &c., and forms sulphates of these metals. On passing the ore to the hot bed a quantity of common salt (chloride of sodium) is added, varying in proportion to the weight of the ore from 2cwt. to 16cwt., according to the quality of silver contained, and also to the amount of iron, zinc, &c., present, as these metals also combine with chlorine, thus robbing, as it were, the more precious metal of part of that gas. It is therefore necessary to add more chlorine than is really required by the silver so as to insure the perfect chlorination of this metal. Under the influence of increased heat the sulphates formed on the cold bed are decomposed and the metals thus liberated, some as oxides, others in the free state. These sulphates, acting at the same time on the salt, decompose it, liberating sodium, which, combining with oxygen and sulphuric acid, forms sulphate of soda and chlorine gas; these instantly combine with the metals forming chlorides and perchlorides. The ore is also kept in constant motion throughout this process. About two hours after the last traces of sulphur have disappeared the chlorination should be complete. The ore is now drawn out into barrows and spread on the cooling-floor until cold enough to sift. As each charge is removed from the cold bed on to the hot one, a fresh charge is dropped in from the top on to the former bed, and so the process continues.

When cool enough the ore is elevated to a hopper which leads to a large circular screen, 9ft. in length by 2ft. 6in. in diameter. The first 6ft. are covered with fine wire gauze containing 2,500 holes to the square inch, and the remaining 3ft. with gauze containing 625 holes to the square inch. A feeder or bevelled roller is adjusted at the bottom of the hopper, so as to regulate the quantity of ore which falls into the screen and thus prevent a rupture. The dust which passes through the fine gauze is ready for amalgamation; the fine grit which sifts through the 625-hole gauze is again crushed through fine gratings, and is then also ready for amalgamation; but the coarse grit which falls at the end of the screen is not only crushed through fine gratings, but has to pass through the furnaces again for one and a half to two hours, as the silver contained in these coarse particles would not have been exposed to the action of the chlorine gas. When cool this is also ready for amalgamation.

The reason for not crushing fine in the first instance is that it is advisable to have a little grit in the ore so as to render it porous while in the furnace, and thus aid the free circulation of the chlorine gas throughout the mass.

A sample is taken of each charge as it is drawn from the furnace in order to ascertain whether the chlorination is perfect, as any silver not chlorinized would remain in the tailings after amalgamation.