

a convenient method is to mix a suitable portion of chromic acid or other oxygen-producing agent with the concentrated ore. This treatment will partially oxidize and decompose the ore, and prepare it for roasting.

The ore which has thus been treated is next passed into a roasting-furnace, and may be conveyed backwards and forwards by a suitable conveyor until the roasting process is complete.

The furnace may be constructed from iron plates bolted together and arranged preferably to form a triangle in section—though I do not confine myself to this form—and adapted to carry a muffle-hearth.

The upper angle forms a flue-way for the fumes evolved from the roasting ore; the two lower angles form flues for the fire, which thus passes on each side (beneath the half-muffle) to the stack.

The furnace can be converted to a reverberatory by directing the flame over, instead of beneath, the hearth.

After roasting, the ore, if acid, may be neutralised with an alkali, such as ordinary ammonia or the waste ammoniacal liquors from gasworks, although caustic soda, or other suitable alkali, may be employed. The ore now passes into an extractor, which is preferably, though not necessarily, of cylindrical form, and may be made of any suitable material. In this extractor the ore is "boiled" with water at a considerable pressure. I have found from two to four atmospheres to give satisfactory results; and this has the effect of dissolving out the base constituents of the ore more effectually than occurs at the ordinary boiling temperature, leaving the ore in a fit condition to be acted upon by solvents for the extraction of the precious metals contained therein.

In extracting soluble sulphates from ore it is advantageous to keep the ore in motion, and for this purpose the extractor may be seated on a rocker actuated by cams, or other device worked by gearing; when the rocker is in motion the ore in the extractor will be thrown from end to end, and every particle effectually cleansed.

The apparatus employed may be varied without departing from the spirit of my invention, the main features of my system consisting in the oxidation by ozone, nascent oxygen, or other powerful oxidizing agent, aided by roasting and the dissolving-out of the base constituents of the ore thus rendered soluble by steam-pressure preferably exceeding two atmospheres.

Before the ore is subjected to my treatment it should be crushed so as to pass a 40- to 60-mesh screen, and then concentrated in any well-known manner, after which it should be dried. It is then ready for treatment according to this invention, the details of which are as follows:—

The oxidation and decomposition of the ore may be effected in various ways, the time required varying with the means employed. I do not confine myself to any one means, but may use ozone chemically or electrically produced, or I may employ hydrogen-peroxide or other powerful oxidizer. I obtain good results by taking imperfectly dried ore and intimately mixing this damp crushed ore with chromic acid, and, when the mixture has been thoroughly effected in suitable vessels, the vessels and their contents are covered and allowed to stand for, say, ten to twelve hours. The result is a partial oxidation and decomposition of the sulphides, which are partially transformed into sulphates, and thus prepared for roasting. While powerful oxidizers or ozonizers have been employed theretofore in the leaching of ores, the above treatment previous to, and thus preparatory to, roasting which operation is thereby much facilitated and its duration lessened is, to the best of my knowledge, entirely novel and very valuable.

After preparation in the above-described manner the ore is transferred to a furnace of any construction to be roasted, after which it is treated in an extractor as hereinafter described. Although other furnaces and extractors may be employed, I prefer to use a furnace and extractor of the special construction hereinafter described, and of which the accompanying drawings illustrate one form as constructed in accordance with this invention: Fig. 1 being a longitudinal section of a furnace on the line 1-1 of Fig. 2, Fig. 2 a transverse section of the furnace shown in Fig. 1 on the line 2-2 of Fig. 1, Fig. 3 a longitudinal section of an extractor on the line 3-3 of Fig. 4, and Fig. 4 an end elevation of the extractor shown in Fig. 3; Fig. 5 an elevation, and Fig. 6 a plan of a plough used in conjunction with the furnace; Fig. 7 a side elevation; Fig. 8 an end elevation in part section, and Fig. 9 a plan of concentrator according to this invention; Fig. 10 is a perspective view of an improved construction of amalgamating-plate.

With reference first to Figs. 1 and 2, A is a shell, built conveniently of cast-iron, forming a housing, triangular in cross-section, for the hearth, a fire-grate and bridge being provided at A⁸ and A⁹ respectively.

The hearth is shown at B, extending for the greater part of the length of the housing A, and is preferably of curved form in cross-section, as shown in Fig. 2.

The hearth thus divides the space within the shell into long compartments or flues, three in this case, and one of the most important features of this construction is that the furnace can be made to act as either a muffle or a reverberatory furnace by directing the fire either along the two lower flues, marked A¹, or along the upper one, marked A². Or the flame may be directed over the charge at the same time that heat from the fire is being directed under the hearth along the two lower flues. I have found this last method of using the furnace of very great efficacy in the roasting of ores giving off arsenical and other volatile or easily oxidizable fumes.

The direction of the heat or flame from the fire along the upper flue or under flues, or along both simultaneously, may be effected by dampers or doors in a well-known manner. The shell, whose iron walls are lettered at *a*, has preferably a suitable lining, as shown at *a*¹, and the whole shell may be conveniently mounted on brickwork, such a mounting being shown in the drawings and lettered C. The charge of ore already treated, say with chromic acid, is fed on to the hearth B through a hopper A³, seen in Fig. 1, and is caused to slowly travel the whole length of the hearth, on reaching the end of which it is discharged into wagons or other receptacles provided. Suitable sight-holes are provided at intervals in the length of the furnace, as are shown at A⁶. The means adopted to convey the charge through the furnace may be of any well-known kind, but I prefer a conveyor of the following special construction:—