

underneath the copper gratings A^1 . By the combined action of the aqueous and gaseous HCl the ore is gradually disintegrated, and passes, with the aqueous HCl , through the gratings A^1 into the crucible B. The crucible B is constantly heated in order to maintain the aqueous HCl , which now contains metallic chlorides of lead and zinc at the boiling-point. The digesters A and crucibles B being arranged in series, the aqueous HCl is discharged from the crucible B, No. 1, and raised by any suitable means into the tank D, No. 2 of the series, leaving the gangue and any partially-undecomposed ore with the adhering silver-chloride in the crucible. From tank D, No. 2, it is sprayed as before over the ore in the No. 2 digester, and is passed in this way from one digester to another until the HCl has become neutralised and a neutral saturated solution of metallic chlorides of lead and zinc obtained. This saturated solution is then returned to crucible B, No. 1 of the series. In the meantime the whole of the ore contents of the digester A have become disintegrated, and have passed into the crucible B. The digester A, No. 1 of the series, is then disconnected, and No. 2 in the series now becomes the first, and the digester A, when refilled, the last of the series, and so on in turn, the order always changing as each digester is emptied and refilled with supplies of raw ore for treatment.

Having detailed the circulation of the aqueous HCl , and its return in the form of neutralised solution of metallic chloride of lead and zinc, before detailing its further treatment for the recovery of the metals I will explain the circulation of the gaseous HCl .

The gaseous HCl rising through the contents of the digester A, No. 1, liberates H_2S by its action upon the sulphides of the ore. The gases so formed in digester No. 1 are carried by suitable pipe-connections, and are discharged underneath the copper gratings of digester A^1 , No. 2 in the series. After passing through the ore in the digester No. 2, they pass to the next in the series, and so on until the HCl gas becomes neutralised and the H_2S practically free from HCl . To eliminate any final traces of HCl the gases are conducted through a purifying-chamber S filled with crushed antimony-blende, and the pure H_2S led for storage purposes into a gasometer N of any ordinary construction. From the gasometer N the H_2S is drawn for use as fuel wherever required, it being intended that the H_2S so obtained shall be used for all purposes for which heat is required, thereby effecting a considerable saving in fuel. The products of the combustion of the H_2S as fuel, which are sulphur-dioxide (SO_2) and aqueous vapour mixed with nitrogen from the air, are collected by means of suitable flues, then passed through drying-towers F for extraction of the aqueous vapour, as hereinafter more particularly referred to, and finally discharged into cylinders R arranged conveniently to the digesters A. The cylinders R are filled with briquettes of sodium-chloride, and are maintained at a temperature of about $500^\circ C$. By the action of SO_2 , together with air and steam upon the sodium-chloride in the cylinders R, HCl gas is evolved, and sodium-sulphate, or salt cake, produced as a residue or by-product. The latter is subsequently removed and heated with carbon in the ordinary way in order to produce sodium-sulphide for use in the recovery of zinc, as hereinafter described in a subsequent portion of the process, or converted by any known process into caustic soda and other soda products. The HCl gas from the generating-cylinders R is conducted into a suitable tower L, through which a continual stream of brine, obtained in the manner hereinafter described, is being passed from a reservoir K placed overhead. By the action of the gaseous HCl upon the brine sodium-chloride is precipitated, and aqueous HCl is produced. The aqueous HCl is collected in a suitable receptacle L^2 at the base of the tower, and is carried from this to the aqueous HCl storage-tank D for use in the continuance of the process the nitrogen which has passed with the gaseous HCl from the cylinders R being meanwhile drawn off by a chimney-stack, or otherwise eliminated.

Returning to the former portion of the process, the contents of the crucible B, No. 1 of the series, now consist of disintegrated particles of gangue and undecomposed ore (which may be blende, galena, or argentiferous galena), with which has remained the insoluble silver-chloride, and of the concentrated solution of aqueous zinc- and lead-chlorides, which has been returned thereto after the circulation as detailed. The temperature of the mass in the crucible is gradually raised until it reaches about 300° Celsius. The lead- and zinc-chlorides, as the heat rises, gradually fuse, and by the action of the fused zinc-chloride the silver-chloride dissolves in the fused mass. The fused mass of chlorides having a specific gravity of about 4, any particles of ore still undecomposed sink to the bottom of the crucible, and can be removed later for further treatment. The gangue meanwhile becomes suspended in the fused mass of chlorides, and the whole is removed whilst still hot to suitable closed drying-towers F. The towers F are preferably placed within a water-tank F^1 , so that the heat evolved by the hygroscopic action of the zinc-chloride may be absorbed by the water, which latter is used as may be required in other parts of the process. Into the upper portion of these drying-towers F the SO_2 aqueous vapour, and other products of combustion of the H_2S , are discharged from the collecting-flues as before described. The aqueous vapour is then absorbed by and dissolves the soluble metallic chlorides, whilst at the same time any chloride of gold in the fused mass is reduced to the metal state by sulphurous anhydride. The fused mass (as the chlorides are dissolved by the aqueous vapour) passes through gratings at the bottom of the drying-towers F into a lower chamber, where it is boiled with water acidulated with HCl . The hot aqueous solution of chlorides, together with the gangue, is then drawn off into a lixiviating-tank, which forms the first of a series of precipitating-tanks. As the gangue settles the aqueous chlorides are drawn off into a second or cooling-tank. The residue of gangue left in the first tank is then washed with boiling water until free from lead-chloride. The first tank now contains gangue, metallic gold, and silver-chloride, which may be recovered by any well-known means. The liquor drawn off from the first tank, together with the washings, is now placed into a second or cooling-tank, and the lead-chloride settles out. When the liquor in the second tank has cooled down the clear liquor is removed to the third tank of the series. In this any remaining traces of lead-chloride are decomposed by means of sodium-sulphate obtained from the HCl generators R. Lead-sulphate is thus precipitated, and the sodium-sulphate contained in the solution becomes sodium-chloride. The