

rational rules as to the most expedient relations of silver, sulphur, salt, &c., was a failure, most of the managers having determined their mixtures empirically, and knowing nothing definitely of the percentage-composition of their ores. The richer and baser the ore the more salt it requires.

*Duration of the Roasting Process.*—In the Howell and the White furnaces the ore is exposed to the flame from seven to twenty minutes; in the Brückner and reverberatory from five to twelve hours; and in the Stetefeldt it is about two seconds falling through the flame, and remains forty-five minutes at the bottom of the furnace.

*Oxidizing Roasting.*—Where ores contain much arsenic and antimony much salt is saved by exposing them to a preliminary oxidizing roasting. This may be easily done in the reverberatory or Brückner furnaces; but in the Stetefeldt, Howell, and White furnaces it is not practicable. In roasting ores free from arsenic and antimony there appears to be no advantage in delaying the addition of salt.

*Percentage of Salt used.*—When the salt is mixed with the raw ore there is not much difference in the amount required to roast a given ore in any of these furnaces; but the Stetefeldt and the Brückner are supposed to require a smaller percentage than the others. From 3 to 15 per cent. of salt, according to the character of the ore, are the usual limits, 8 per cent. being the average. Salt is usually the chief item of expense in roasting ores, and millmen frequently use more than the quality of the ore demands. They think it is always best to be on the safe side, and by allowing a certain margin of excess often considerably increases the expense.

*Sulphur-contents.*—The percentage of sulphurets in roasting-ores varies from 1 to 70 per cent. The closeness with which it is necessary to keep a given sulphur-content varies with the different furnaces. In the Stetefeldt there is but little latitude, from 3 to 5 per cent. sulphur being the limits. If this quantity will not liberate chlorine enough to chloridize the silver, the ore must be reduced in grade by the admixture of poorer qualities. In the White and Howell there are larger margins, and in the Brückner and the reverberatory the very basest ores can be worked.

*Percentage of Silver Chloridized.*—The percentage of silver chloridized varies from 75 to 90 per cent. in these furnaces, it seeming to depend more upon the character of the ore and the method of working than upon difference of construction and manipulation. The difference in this respect is perhaps a little in favour of the Brückner and the reverberatory, as these furnaces permit of an oxidizing roasting before the salt is added.

*Labour.*—In all these furnaces except the reverberatory a man can roast five tons of ore per shift. One man can easily attend to two Brückner furnaces. In the reverberatory it is fair work for one man to roast one ton per shift.

*Fuel.*—Wood is the fuel used in all these furnaces except the Stetefeldt, where some charcoal is occasionally burnt. This wood is of many different kinds, and its value as fuel is chiefly governed by its weight. The different furnaces require on an average the following weights of wood to roast one ton of ore: Stetefeldt, 200lb.; Howell and White, 300lb.; reverberatory, 600lb.; and the Brückner, 900lb.; the weights being calculated on the basis of 2,200lb. of wood to the cord. The Stetefeldt uses less wood than the others because it is solidly built of brick, and retains the heat better; the Brückner uses the most because it is a long cylinder, and it is necessary to reheat it each time it is discharged.

*Power.*—The power used to drive the mechanical furnaces is estimated at about two-horse power for the Brückner, and one-and-a-half-horse power for the White and Howell furnaces.

*Dust-chambers and Flues.*—The best arrangement of dust-chambers and flues is that of the Stetefeldt furnace. The system consists of a series of dust-chambers, sometimes as many as twelve, through which the dust and fumes must pass, giving the dust an opportunity to settle, and of a long flue connecting with a stack, which is generally placed on the hill-side some distance from the furnace. The dust-chambers nearest the furnace are opened several times a day, and the flue-dust raked out from doors at the bottom. The long flue is opened once in about six months, when the furnace is shut down. Two-thirds of the flue-dust is deposited in the first two or three chambers. The flues and dust-chambers of other furnaces are arranged in somewhat similar manner, except that they are not usually so complete. The dust-chambers are often placed under the dry-kiln, so that the heat from the furnace can be used to dry the ore, and the smoke-stack is often built in the mill itself.

*Amount of Flue-dust caught.*—The amount of flue-dust caught per ton of ore roasted depends on many circumstances, such as the character of the ore, its fineness, the style of furnace, and the draught. Those ores give the most flue-dust which, before they are roasted, are light and porous, and contain oxide of iron. The ores which give the least flue-dust are hard-quartz ores with sulphurets. Those ores which contain a large proportion of sulphurets do not, of course, need to be crushed as fine as those containing little, the sulphurets being readily attacked by oxygen and chlorine when unprotected by a coating of chemicals not affected by these gases. When there is no sulphur present it is necessary to add it as pyrites, brimstone, or, best of all, as copperas. The ore should then be fine, to facilitate the immediate and complete action of the chlorine. If the reverberatory furnace is properly handled it produces the least flue-dust, for the motion of the ore is less violent than in the others. With care in the reverberatory furnace the amount of flue-dust can be limited to 2 per cent. From the nature of the Stetefeldt furnace a considerable amount of the flue-dust passes into the dust-chambers, but as practically all of it settles there, and as, owing to the auxiliary fire, it is chloridized to a higher percentage than the ore itself, this fact is of no importance. As much as 10 per cent. sometimes passes over. This is also true of the Howell furnace, except that the dust is usually not so well settled as in the Stetefeldt. With the Brückner furnace the amount of fine flue-dust is usually not larger, but it is not chloridized so high as the ore, and sometimes requires a second roasting. The draught in all these furnaces can be regulated by dampers, one between the furnace and the dust-chambers, and the other in the smoke-stack.