
NOTES ON THE MOLESWORTH CALCINING PROCESS.

84
Mr. C. Ballard, Secretary of the Molesworth Ore-reduction Company, Limited, of Adelaide, has been good enough to send me copies of the specifications of the Molesworth Process Patents, and copies of newspapers describing the trials.

Mr. F. H. Molesworth is the inventor of the process, which is designed to greatly facilitate the roasting of metallic sulphides and arsenides. The calciner is a variety of the rotary type, and consists of a cast-iron cylinder wider at the end at which the ore is fed in than at the outlet end. It is rotated by suitable gearing outside, and runs on friction wheels so as to turn easily. Rows of small shelves are provided inside for raising the ore as the calciner revolves and showering it through the oxidising current of air. The cylinder is fixed so that the ore keeps constantly travelling downwards towards the outlet end, and, by altering the inclination and the number of revolutions, the time required to pass a charge through may be varied. So far, the description would answer for numerous revolving continuously-discharging roasting furnaces in common use. In these, however, the flames from the fireplace pass directly through the calciner, and the draught is always so great as to winnow out all the finest dust from the charge of ground ore, thus necessitating the use of long dust chambers. The new calciner is heated from the outside, and the draught through it need only be sufficient to supply the air necessary for combustion of the metallic sulphides. The roasting, it is said, need not be done at such a high heat as to injure the iron cylinder. A low temperature of roasting, which is, for many purposes, a great advantage, is therefore another point claimed in favour of the process. To economise fuel, and yet heat the cylinder as evenly as possible, the fireplace of the furnace used is built under the discharge end of the apparatus, where the greatest heat is required. The flames and hot air pass round this, and then are made to circulate round the remaining part of the cylinder by means of a spirally-arranged flue. The ore is ground to whatever fineness is deemed desirable, and fed continuously from a hopper into the wider end of the calciner. Up to this point there is still nothing very new about the arrangement, and if the only improvement consisted in heating the calciner from outside instead of sending the furnace gases through it, it would probably be found to be more expensive and less efficient than the common types. The novelty, which is the real heart of the invention, is the use of nitrogen peroxide gas to assist the oxygen of the air in burning off the sulphur and arsenic. This gas is a powerful oxidiser, giving off half of its contained oxygen very readily, and so becoming reduced to nitric oxide gas. This latter gas, in contact with air, at once combines with more oxygen from it, and is reconverted into nitric peroxide. This gas acts, therefore, as a carrier of oxygen from the air to the substances to be burned. Were it possible in practice to avoid loss of gas, it would be possible theoretically for a very small amount of nitrogen peroxide to work in the roaster for ever. The action of the gas as a carrier is well known and taken advantage of in the manufacture of sulphuric acid. The narrowing of the cylinder at the outlet end is said in the patent specification to be for the purpose of applying the gas there in its most concentrated form, just as it is delivered from the retorts. These are placed on top of the flues of the heating furnace, and contain crude nitrate of soda and sulphuric acid. The temperature is sufficiently high to break up the nitric acid formed by the reaction of these substances into water, nitric peroxide, and free oxygen. These are drawn from the retort into the calciner along with the necessary supply of air by means of a suction fan in the flue leading the products of combustion away from the cylinder. In order to recover the nitrogen oxides, and also to prevent the escape of the acid gases from the process generally, the products of combustion are drawn through water. As crude nitrate of soda

contains a good deal of chloride of sodium, a quantity of hydrochloric acid comes into the apparatus, as well as oxides of nitrogen, and, as the sulphur of the ore burns to sulphur dioxide gas, and the arsenic to arsenious oxide, the water through which the gases are drawn becomes highly charged with nitric, sulphuric, hydrochloric, and arsenic acids. According to the patent claims, this acid mixture is to be used to dissolve gold from the roasted ore when auriferous pyrites have been treated.

As far as the roasting is concerned, the process seems to make excellent use of a well-known chemical principle, and accordingly the results claimed to have been obtained are quite credible, but I cannot say the same of the alleged treatment of the gases after they leave the furnace. In the first place it is notoriously a difficult matter to arrest furnace gases by drawing them through water except by the use of costly and cumbrous coke or flint washing towers. Secondly, the acid obtained would be so impure as to be unfit for use in dissolving out gold. Moreover, it would be mostly sulphuric acid, formed by the oxidation by the nitrous gases of the sulphur dioxide from the combustion of the ore. Even if it were nitro-hydrochloric acid, however, it could not be used for the purpose of dissolving out the gold from roasted pyrites, for *aqua regia* is not like chlorine, able to exercise a selective action on the gold without attacking the oxide of iron, but would dissolve the latter and expend itself in doing so. The waste acid might possibly by boiling be made to give off chlorine, which could be used for chlorination, but I am afraid that the claims made for this part of the process have not been practically worked out. Even on theoretical grounds they are open to many objections.

The claims in the patents as to the use of the waste products of combustion do not affect the main issue—the success of the roasting. It is clear, however, that the construction of the furnace renders it possible to make sulphuric acid from the waste gases with a success shared by none of the calciners where the products of combustion of the fuel are mixed up with those of the ore, and a saving of cost might be effected by doing so. The rapidity of the roasting, implying a very copious evolution of fumes of sulphur dioxide, would be very favourable for the supply of this gas to sulphuric acid chambers in a sufficiently undiluted condition.

The process has been introduced at the New Alma and Victoria gold mine, Wankaringa, South Australia, and is reported to be working very well. The newspaper reports are very favourable as to the great rapidity, cheapness, and thoroughness of the roasting, and private information given to me confirms them. Very little nitrate of soda is required, and very little fuel for the heating furnace, the combustion of the sulphides itself supplying the greater part of the heat required. Though still hardly past the experimental stage, the results of Molesworth's treatment appear to be so good that the process deserves the attention of all concerned in the roasting of sulphide ores. Probably experience will result in numerous changes in the details of the plant, and very likely in its entire remodelling: such changes are a part of the evolution of every new process. Should the use of the oxides of nitrogen come up to the claims made for them in assisting oxidation, the new treatment will mark an important advance in one of the most important, universal, and expensive processes of metallurgy.

A. MONTGOMERY, *Geological Surveyor.*