

THE ACCUMULATION OF AMALGAM ON COPPER PLATES.

[Paper read before the American Institute of Mining Engineers by R. T. Bayliss, Marysville, Montana (Pittsburgh Meeting, February, 1896).]

Although every mill-man of even limited experience in the amalgamation of gold-ores is probably aware that copper plates will in time become coated by the accumulation of gold-amalgam, it may be that many do not know to what extent this accumulation occurs in the treatment of ores dissimilar to those with which they are familiar, and under conditions foreign to those with which they have to contend in any given locality. The writer, therefore, feels relieved from the necessity of offering an apology for dealing with such an elementary subject, believing that certain facts in reference thereto which have recently come under his personal observation will be interesting to many, and possibly instructive to some persons engaged in the amalgamation of gold-ores.

The facts hereinafter stated were observed in the fifty-stamp "combination"-mill, owned by the Montana Mining Company (Limited), of England, operating the Drum Lummon Mine, situated at Marysville, Montana.

The material treated in this mill consists of quartz and ores of somewhat variable character, containing gold and silver in native form, as well as in chemical union with the sulphides of iron and copper. There is also present a little lead, some arsenic and antimony, and a little zinc. The last four minerals, however, are of irregular occurrence, and but sparingly distributed throughout the ore, and yield only a trace in the analysis of the average material in this mill. The free gold, which is in a condition of fine division, and rarely visible to the naked eye, carries silver as an alloy; and the native silver, which is only occasionally observed, is present in the richer ores in wire- and in leaf-form.

Of the two precious metals, the ore worked during the past three years and ten months, the period under review, contained about $\frac{1}{2}$ oz. of gold, and from 7 oz. to 12 oz. of silver per ton of 2,000 lb.

The ore, after being crushed in the stamp-battery and passed through a thirty-mesh steel-wire screen, runs over amalgamated copper plates, and is then concentrated on Frue vanners, to the distributor of which is affixed a small copper plate for saving any amalgam escaping from the battery-plate, the tailings from the vanners being subsequently amalgamated in pans.

Amalgamation upon copper plates placed inside the mortar is not practised in this mill, better results having been obtained by amalgamation on outside or apron plates only. It is not the purpose of this paper to enter the wide field of discussion as to the relative merits of inside and outside amalgamation; but it may be observed in passing that an extended experiment upon the two methods proved that a higher percentage of saving was gained by amalgamation outside the battery than by the use of inside plates in addition to the apron-plates.

The apron-plates in use in this mill are 54 in. wide and 8 ft. long, made of $\frac{1}{8}$ in. rolled copper plate, electro-plated with 1 oz. of silver to the square foot. They are set with a fall of $2\frac{1}{2}$ in. to the foot; are cleaned up once in twenty-four hours; and dressed once every two, three, or four hours, as may be deemed necessary by reason of their surface-condition, which varies according to the mineral contents of the ore submitted to them. In dressing, a weak solution of cyanide of potassium is used when necessary. The copper plates upon the Frue vanners are 46 in. wide and 18 in. deep, made of $\frac{1}{8}$ in. rolled copper plate, electro-plated with 1 oz. of silver to the square foot, and are subjected to the same treatment as the apron-plates.

At the daily clean-up the surface of the apron-plates is first washed; then the amalgam which has collected during the preceding twenty-four hours is slightly softened and loosened by sprinkling a small quantity of mercury over the plate and rubbing the surface with a cloth or whisk-brush, after which the amalgam is removed with a stiff rubber scraper, 4 in. wide, made out of rubber belting. In this process the daily accumulation of amalgam is removed as completely as possible without the application of a steel scraper, the use of which is not permitted, except for the removal of blisters or any fixed impurity which may occasionally be found upon the plate.

The foregoing brief summary of the method employed in this mill will be sufficient to explain the general conditions surrounding the amalgamation of the free gold contained in the ore, and the treatment to which the copper plates are exposed.

To return to the special subject indicated by the title of this paper: One of the copper plates employed in this mill was recently removed, after having been in continual service for three years and ten months. During this period the battery of five stamps which it served crushed 14,942 tons of ore, yielding from amalgamation on this plate 6,426 oz. of bullion, 541.5 fine in gold, and 443.9 fine in silver, giving a standard assay-value of \$11.70 per ounce, and showing the recovery of \$5.03 per ton of ore crushed. In fixing the total tonnage of ore passed over this plate, and the yield in bullion therefrom, the total tonnage and production of the mill during this period has been divided by ten. As all the stamps have been operated continuously, this proportion should correctly represent the duty performed by the particular plate under consideration.

The agreeable task of removing the amalgam known to have accumulated upon this plate (which was new when put in) was then undertaken, and the accumulation or scale was removed by striking the back and front of the plate with a light hammer, a small block of wood being used to deaden and distribute the blow. By this means the plate is slightly buckled, causing the amalgam to scale off, and leaving upon the original electro-plated surface but an insignificant film or layer, which is subsequently removed with a chisel or scraper.

Other methods, such as sweating with hot water and immersing the plates in chemical solutions, have been tried, but have proved unsatisfactory; and the process of buckling the plate, although a somewhat drastic and unscientific method, has been found to effect the recovery of the highest percentage of the accumulated amalgam. After this treatment, the plate is usually so damaged as to be unfit for further service; but, notwithstanding that every visible portion of