

CONCENTRATION IN CONNECTION WITH CYANIDE TREATMENT OF LOW GRADE ORES

In the November bulletin of the American Institute of Mining Engineers, Thomas Crowe and G. H. Clevenger discuss this subject. Mr. Crowe says:

"The interest manifested of late in the treatment of low grade ores, together with Mr. Clevenger's discussion of the mill and metallurgical practice of the Nipissing Mining Co., prompts me to add a few remarks to concentration in connection with cyanide treatment of low grade ores. Mr. Clevenger in this discussion does not condemn concentration in this connection, but, nevertheless, the tone of his remarks would lead one to believe that his conclusions are like those of many others; that concentration is often turned to as a last resort in an attempt to improve or obtain an extraction upon an ore by the recovery and sale of the refractory portion of the ore. This, I will attempt to point out, is not always the case. Concentration in connection with cyanidation often performs an entirely different function, i.e., one of saving fine grinding.

"Economy being the keynote of successful treatment of low grade ores, the problem often becomes more commercial than metallurgical, and, as there is generally a definite ratio existing between cost of operation, degree of comminution, and percentage of extraction, the grade of ore under treatment usually imposes a limit upon these factors.

"With many ores grinding is the most expensive single item in their treatment, therefore the degree of comminution is very apt to be governed by the allowable cost of operation. With most ores the degree of comminution controls to a great extent the percentage of extraction. So in the treatment of low grade ore it often becomes necessary to sacrifice extraction, through coarse grinding for the benefit of cost, in order that the greatest ultimate profit may be obtained, and it is under those conditions that it is possible for concentration to play an important part in overcoming to some extent the effect of mesh.

"The precious metals occurring in an ore are usually closely associated with the metallic portion of the ore, and as this metallic portion is generally fairly well liberated from the gangue at comparatively coarse meshes, further grinding of the ore is necessary only in order that the metallic portion may be reduced sufficiently fine that the precious metal part of it may be dissolved by cyanide solutions in a reasonable length of time.

"A concentrating table under these conditions would have the effect of removing this refractory metallic portion, it being especially efficient in removing that portion which is not sufficiently fine to be readily dissolved by cyanide solution (the coarse), putting the small amount of high grade concentrate in a separate pile where it can be dealt with by more extensive methods of treatment, it being of sufficient value per ton to justify further grinding, longer contact, and more elaborate methods, at the same time simplifying the subsequent treatment of the bulk of the ore and accomplishing the same result as though the whole mass of ore were ground to a very fine mesh.

"An exemplification of the effect of concentration in connection with cyanidation in the treatment of low grade ores may be found in the mills of the Cripple Creek district, which are treating the sulpho-telluride dump ores. Here concentration performs another function besides that of saving grinding as described above.

On account of the peculiar occurrence of the values in these ores, the sulpho-tellurides occurring upon the faces and seams of the rock, when the ore is crushed to 30 mesh it is found that the sulpho-tellurides are liberated to such an extent that, after concentration and classification, the sand product of this operation is of such low value that it can be rejected as a tailing, leaving only the enriched concentrate and slime to receive further treatment.

"The low treatment costs allowable by this rejection of 50 per cent. of the ore in the form of low grade sand can be well imagined. In fact, the success of these mills in the treatment of this low grade by-product is only made possible through the continual elimination of that material which will not withstand further treatment. This is practised by other methods of concentration besides table concentration, such as hand sorting, coarse crushing and trommeling, etc., and I would like to make a long range prediction that in the future low grade milling selective methods will prevail and concentration become an important factor."

Replying to Mr. Crowe, Mr. Clevenger says:

"The whole question of ore treatment is, of course, an economic one and frequently our pet metallurgical theories have to be sacrificed upon the altar of greatest ultimate profit. If the recovery of a portion of the gold and silver can be more economically made by concentration than by solution in cyanide, obviously concentration should be practised. The case cited by Mr. Crowe is an unusual one in that his strongest argument for concentration is that the sand be rejected without further treatment if the concentrate is removed. It must be remembered, in this connection, that the ore treated runs less than \$3 per ton and that a large proportion of the minerals carrying the gold occur along the cleavage planes. Even with the same character of ore, if of considerably higher grade, it would not be possible to reject the sand without incurring a serious loss. The character of many of the low grade ores of other districts would render this type of practice impossible. Lack of suitable mill sites for a large expanse of leaching tanks, together with favorable smelter contracts, are factors in the Cripple Creek district which are not without their influence.

"There are a number of possible variations of concentration in conjunction with cyanidation, the more important of which are:

1. Crushing of the ore in water concentration, either directly or following another recovery operation, as amalgamation; rejection of the tailing, and cyanidation of the concentrate. This method is most suitable for use upon very low grade ore or tailing. A good example of such practice is the Treadwell, where the tailing from the amalgamation of the very low grade ore treated could not be profitably treated directly by cyanidation; but cyanidation of the concentrate recovered from the tailing by concentration returns a handsome profit.

2. Crushing of the ore in cyanide solution; concentration, followed by cyanidation of the sand and slime. Concentrate treated by one of three methods:

- (a) Shipment of the concentrate to the smelter.
- (b) Special local treatment of the concentrate.
- (c) Special treatment of the concentrate stream, as, for example, fine grinding or amalgamation, etc., and return of the concentrate stream to the balance of the pulp for cyanidation.

Method (a) of concentrate disposal has been very generally practised in the past, but care must be exercised in adopting this practice, for the reason, as I have previously pointed out, that one may pay the