

veyor, or (3) belt conveyor. The second method is used at only one property, the Brakpan mines, where it is reported to be giving satisfaction; the third method is used on two mines, but whatever advantages it may possess have not been generally recognized; while the first method, namely, truck haulage by surface cable, is in general use. It is considered the cheapest, most flexible, and best adapted to local conditions, and will probably continue to be the favorite means of disposing of sand residue.

Treatment of Slime.

Since 1894, the continuous treatment of slime by the so-called decantation method has meant the recovery of over 80 per cent. of the gold from a very considerable portion of the total ore crushed, and has been retained by the majority of operating mines. In most cases, however, it has been retained, not because its limitations have not been recognized, but because possible improvements in recovery do not always justify the sacrifice of capital involved in replacing old plants with new, especially on mines of short remaining life.

The technique of decantation, which is well described in several technical works, need only be briefly touched upon here. The slime pulp from the classifiers is settled in what are known as collectors, large cone-bottom tanks, provided with an overflow rim and adjustable decanter, in which the slime settles to the bottom, the water escaping at the overflow rim. The settled slime charge after decantation, containing approximately 50 per cent. of moisture, is then sluiced out with a weak cyanide solution into the intake of a centrifugal pump connected with the centre of the cone bottom, and transferred to another tank, known as the "first settlement tank." Here the charge is kept in circulation by means of a pump, then allowed to settle, as in the collector, and the gold-bearing solution is decanted off to the zinc boxes. This decanted charge is again transferred, subjected to a similar settling and decantation in a "second settlement vat," and finally discharged to the dam with water or a very dilute precipitated solution. Settlement in these tanks is hastened by the use of lime, which is applied in a variety of ways, being either periodically fed to the stamps or tube mills, or to the slime pulp in slaked form, by means of feed hoppers, or as milk of lime from a grinding pan.

The limitations of decantation are obvious: The displacement of the dissolved gold is only practicable within certain economic limits, so that a certain definite gold loss in the final discharge to the dam must always be reckoned on. This loss is necessarily variable, depending upon capacity, difficulties in settlement, and general design of plant. On the other hand, the process is simple and comparatively inexpensive in operation, and, in spite of the losses through imperfect washing, is peculiarly applicable to the low-grade slime of the Rand. Even the advocates of more exact and positive methods of treatment must admit that in the latest and best designed decantation plants, in which large capacity is allowed for settlement and dilution, and all other conditions are favorable, the margin between results so obtained and the net results of filtration is not a wide one.

The first important innovation in slime treatment was the introduction of the Butters vacuum filter in 1910. The essential features of this device are too well known to require description here. There was from the first no question as to the additional recovery obtainable by the filter; the doubtful point was whether the cost of operation would offset the gain in recovery to the extent

of nullifying its advantages. This, however, has not proved to be the case. The prevailing cost of operating the filter on the Rand is from 2½d. (5c.) to 4d. (8c.) per ton of slime filtered, depending upon tonnage treated; and the additional gold recovered ranges from 6d. (12c.) to 2s. (48c.) per ton, depending upon the efficiency of the decantation plants superseded by the filter.

The vacuum filter is now generally admitted to be applicable in the following cases: (1) Where it is desirable to extend a decantation plant of inadequate capacity or obsolete design; (2) where difficulties in settlement make it impracticable to use decantation without prohibitive extension of plant; (3) in all new plants. The most notable instances of (2) were the case of the Randfontein Central mill, where a comparatively new decantation plant treating 2,000 tons of slime per day was replaced by a Butters filter, resulting in a considerably increased recovery of dissolved gold; and the case of the Robinson Gold Mining Co., where the expenditure of £32,000 in 1911, on filter and Pachuca agitators, resulted in an increased net profit of £2,500 per month.

The slime treatment in the modern plants consists in settling the slime in the same type of settlers as is used in decantation, namely, in tanks as large as 56 ft. in diameter, provided with cone bottoms, decanters and overflow launders. When the charge is settled and decanted down to about 50 per cent. moisture, it is transferred with cyanide solution to the Pachuca tanks. These tanks are of standard size, 15 ft. in diameter and 45 ft. deep, and hold between 80 and 100 tons of slime (dry weight), depending upon dilution. This agitator, requiring air representing in volume and pressure an expenditure of about 3 h.p., is considered, by reason of its simplicity and low operating and maintenance cost, to possess advantages over the various mechanical types, in spite of its great height. Agitation is continued from 6 to 8 hours, and the pulp is then transferred to a large storage reservoir, whence it is delivered to the Butters filter plant, as required.

Two modifications of this procedure will be adopted in the next plant to be erected by the Rand Mines, Ltd. The old system of intermittent slime settlement will be replaced by continuous settlement in Dorr thickeners. In trials conducted with this device it was found impossible to reduce the slime to the same low moisture as the intermittent system, without a much larger capacity than is allowed in American mills, where this device is chiefly applied to the much more simple settlement of slimed mill pulp containing a considerable quantity of fine sand. To compete with intermittent slime settlement on the Rand, a Dorr thickener 40 ft. in diameter cannot handle more than 150 tons of slime per day; but even so, in view of the labor and power consumption involved in handling intermittently settled charges, and the high capital cost of slime settlers, the continuous system would appear to possess distinct advantages.

The continuous agitation of slime is made possible by the system just described; and is particularly well adapted to the newer plants where the height of the Brown agitators can be utilized for the required gravity flow into the Butters stock tank. This system of allowing pulp to flow slowly through a series of agitators was first applied in Mexico; its first application on the Rand was at the East Rand Proprietary about two years ago. It seems likely that all plants to be erected in the future will adopt continuous slime settlement and agitation, followed by vacuum filtration.