

permissible within a wide range, and has enabled us to obtain a charge of sand so permeable and uniform that after practical trials the separate sand collector is now recognized to be superfluous, and will be omitted in forthcoming plants to be erected by the Rand Mines group.

We have then at the present time on the Rand two very satisfactory methods for classifying sand: (1) the Caldecott sand-filter table, and (2) the system of hydraulic cones just described. The former possesses the advantage of delivering a solution-borne sand to the treatment tank, and so shortening the time of treatment and increasing the capacity of existing plants, which is a very desirable thing, especially where the saving of capital outlay is imperative, as at the City & Suburban, where the sand-filter table obviated an expensive and awkward extension of plant. But for new mills adopting single treatment of sand, the indirect saving in sand plant would appear to be offset by the lower initial expense of the hydraulic-cone system itself, the small amount of attention required, and its negligible cost of maintenance and operation, as compared with the filter table.

Treatment by Cyanide.

It was only after the introduction of the cyanide process that the distinctive terms "sand" and "slime" came into common use. In the early days of cyaniding the bugbear was slime, or the unleachable, finely divided portion of the mill pulp, which the mill man endeavored to avoid making, in order to secure as large a proportion as possible of leachable sand. Until a method of treating slime was devised, this product was impounded in dams; these accumulations have been for the most part treated.

When the decantation process made it possible to deal with current slime direct from the stamp mill, the production of the latter was no longer avoided. Until vacuum filtration was introduced, the slime represented between 30 and 40 per cent. of the total product of crushing; but this proportion has gradually increased with the progressive improvements in treatment, until now as high as 60 per cent. of the pulp is treated as slime. We may say, therefore, that tube mills, improved classification, and the vacuum filter have made possible (1) the treatment of a greater proportion of slime than formerly, which has improved the total extraction, and reduced the cost of treatment, since slime can be more cheaply treated than sand, and (2) the treatment of more finely crushed sand, with consequent improvement in extraction. In the best plants, a recovery of 90 per cent. of the gold from sand and 93 per cent. from slime is now being obtained, or a total recovery of 96 per cent., which is probably the highest extraction economically attainable on the Rand. The metallurgist in Johannesburg to-day is therefore chiefly concerned with those improvements in appliances, general technique, and administration, which, in view of the much reduced grade of ore, will minimize cost of treatment.

Treatment of Sand.

The treatment of the sand by leaching with cyanide solution in steel tanks, ranging in size between 45 and 56 ft. in diameter, is still the accepted practice. In the early days an attempt was made to collect and treat sand in the same tank, but an imperfect knowledge of classification, or a failure to recognize its importance, made this scheme impracticable. Until very recently, the prevailing practice was to collect the sand in a series of tanks, known as "collectors," from which it was shoveled out by natives and transferred to the treatment tanks. The majority of plants

were built with the collector superimposed on the treatment tank, but this arrangement was finally superseded by the erection of collectors and treatment tanks on the same level, the transference of sand from one to the other being by means, first, of trucks, and later, by belt conveyor. The latter was supposed to be cheaper in first cost, as it eliminated the expensive steel superstructure for supporting the enormous weight of superimposed tanks, and also reduced the height of pulp elevation. But it would appear now, after a pretty thorough experience with both systems, that, as regards first cost, the superimposed system has a slight advantage; while owing to the rapid disintegration of conveyor belts in the dry atmosphere of the Rand, and the considerable maintenance cost of conveyor systems in general, the superimposed tanks are less expensive to operate, in spite of the higher pulp lift required.

Methods of collecting sand—At the present time there is still considerable variation in the modes of collecting sand. The following methods are in use:

1. In the older plants all the mill pulp is run into a collector, through a rubber hose 4 to 6 in. in diameter, manipulated by a Kaffir who moves about in the tank changing the position of discharge to prevent undue slime accumulations; the slime and water, with varying proportions of fine sand, overflow through discharge gates provided with an adjustable canvas blind, which is raised to suit the overflow as the tank fills.

2. The total mill pulp is distributed to the collector by means of a peripheral launder provided with outlets; the water and slime overflow through an adjustable opening at the center.

3. The sand is classified and thickened in diaphragm cones, dewatered on a sand-filter table, and delivered in cyanide solution either to a collecting or treatment tank by means of a Butters and Mein distributor.

4. The sand is classified in hydraulic cones and delivered in water to a collecting tank by means of a Butters and Mein distributor; in one plant the sand will go direct to the treatment tank.

It was formerly customary in some plants to give the sand a preliminary treatment with a weak cyanide solution in the collectors; this practice has now been generally abandoned, and the only operation that takes place in the collector is the forced drainage of the charge by means of pumps, thus reducing the moisture to about 14 per cent. The sand is discharged from the collectors by (1) hand shoveling through discharge doors into treatment tanks or to belt conveyors; (2) by means of the Blaisdell excavator. The high capital outlay required for the latter, without compensating economy in operation, has led to the retention in newer plants of the older system of hand shoveling by natives. All plants using a belt conveyor from collectors to treatment tanks have, however, retained the excellent Blaisdell distributing mechanism for distributing the sand in the treatment tank.

The system of applying cyanide solution to the sand does not differ essentially from practice elsewhere, and need not be particularized here. The standard strength of strong solution used ranges between 0.10 and 0.25 per cent., depending upon local conditions, the tendency in recent years being to use weaker solutions than formerly. From 6 to 8 days' contact is usually allowed in the treatment tanks, and about 2 parts of solution to 1 of ore is the average quantity required for leaching purposes.

The methods in vogue of disposing of the residue are by hand shoveling or excavation with the Blaisdell machine into (1) trucks, (2) Bleichert aerial con-