

treatment via the ball mill discharge sump. The concentrates thickener overflow is used for dilution in the milling and flotation circuits while the thickener underflow is filtered on a three disc 1,22 m diameter Einco filter. The filter cake is discharged on to a conveyor which feeds the Edwards roasters.

Owing to a lack of thickening, filtration and roasting capacity, it is important to produce a comparatively small quantity of high grade flotation concentrates. Furthermore, since "slimes" have an adverse effect on flotation recovery, a comparatively coarse grind is practised and a slime depressant is added to the flotation circuit. Other flotation reagents are conventional in the form of:—

- (a) Sodium carbonate for pH control.
- (b) Xanthates as collectors.
- (c) Pine-oil and T.F.B. as frothers.
- (d) Copper sulphate as a promotor.

Flotation concentrate to feed mass ratio is approximately 0,055:1, yielding an arsenopyrite concentrate of approximately 255 grams gold per ton from a mill feed value of the order of 14,0 g/t.

#### *The Sheba Flotation Plant*

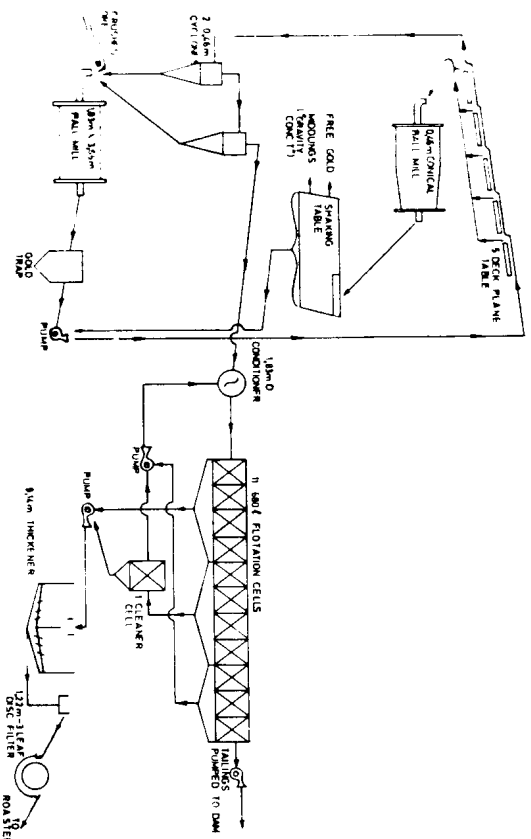


Figure 11. Flow diagram of Sheba plant

The ore milled varies in value and character depending on its source but it is always refractory in the sense that a high percentage of the gold is locked in the sulphide minerals. Carbon, antimony, and arsenic are common, while visible coarse gold is frequently present. The gangue rock types are mainly green schists, shale, cherts, and quartzites. Grinding to 73 per cent minus 200 mesh, the plant treats approximately 5 500 tons per month. Owing to the high percentage of coarse gold, about 40 per cent of the total recovery is made as free gold while an additional 20 per cent is recovered in the middling product which, after grinding, is transported separately to the New Consort roasting plant. Hydraulic traps, plane tables and shaking tables are used in the gravity concentration operation. Final mill pulp gravitates to a conditioner to which the reagents are added by means of a cup-and-disc feeder. Eight rougher cells are arranged in cell-to-cell flow with the necessary launder flexibility to suit varying conditions. A finished product is normally drawn off the first four cells; the froth from the following four cells is cleaned in a single cleaner cell while a scavenger concentrate from the last three cells is recycled together with the cleaner tails to the conditioner. Flotation tailings are automatically sampled and pumped to the disposal centre. Flotation concentrate is pumped to a thickener and disc filter to reduce the moisture content to approximately 16 per cent before dispatch to New Consort. Using mine water, the pH of flotation is 8,5. Average reagent consumption is:—

Pine oil	0,07 kg/t
Copper sulphate	0,025 kg/t
Secondary butyl xanthate	0,105 kg/t
Aerofloat 25	0,07 kg/t

Flotation concentrate averages 5,9 per cent of the ore milled, the gravity concentrate contributing another 0,6 per cent. Flotation recovers 75 per cent of the sulphur and 79 per cent of the gold present in the final mill pulp.

#### *The Agnes Flotation Plant*

The run-of-mine ore which originates from a number of individual reefs varying somewhat in composition contains visible gold as well as the sulphide minerals: pyrite, chalcopyrite, tetrahedrite, galena and sphalerite. The capacity of the plant is of the order of 7 250 tons per month, the final

grind being to 58 per cent—200 mesh Tyler in a single-stage circuit. A gravity concentrate is removed from the mill effluent pulp by means of plane table strakes and this primary concentrate is dressed continuously on a shaking table. Of the total recovery of the gold, some 35 per cent is recovered as free gold, which is amalgamated, while another 10 per cent is recovered in the sulphidic middling which is trucked to the New Consort roasting plant. The balance of the recovery is effected in the flotation plant.

Final mill pulp is conditioned with reagents and fed at 40 per cent solids to the roughers, giving a contact time of 16 minutes. The flotation cell and launder layout permits rapid alteration to the circuit to suit varying ore conditions. Normally the froth from the first three or four cells is sufficiently high grade to be accepted as final concentrate while the concentrate from the cells further down the line is cleaned in four cells which can be operated in counter-flow. The cleaner tails are recycled to the conditioner. The final concentrate is thickened and filtered on a disc filter to 14 per cent moisture before dispatch to New Consort for roasting. Plant dilution is effected with mine water, the pH of the flotation circuit being maintained at 8.2; soda ash has been used in the past when the alkalinity has required regulation. Reagent consumption averages:—

Pine oil	0,025 kg/t
Copper sulphate	0,035 kg/t
Secondary butyl xanthate	0,05 kg/t
Aerofloat 25	0,025 kg/t

The combined mass of the gravity and flotation concentrates is slightly less than 5 per cent of the ore milled, flotation accounting for 90 per cent of this bulk. The flotation plant recovers 90 per cent of the sulphur from a head value of 1,1 per cent S, and 82 per cent of the gold not recovered by gravity concentration. The overall tailing is sufficiently low in value to be discarded and is passed over a pilot table to afford a visual check of the sulphide residue before discharge to the slimes dam.

#### Transvaal Gold Mining Estates

As it is the most intricate and interesting gold plant designed and operated in South Africa the flow diagram of the process used by T.G.M.E. in 1971 is worthy of note. The following brief description should be of interest in

considering the possible treatment of gold ores that are not associated with the main series such as the Main Reef, Main Reef Leader, Ventersdorp Contact Reef, Carbon Leader or the Basal Reef. With several ore bodies all containing refractory constituents, this Eastern Transvaal producer offered problems in milling, flotation, cyaniding, filtering, roasting and smelting. Milling has to be carefully controlled as overmilling can have more deleterious results than under-milling, both with regard to gravity concentration and flotation. Approximately one third of the gold is recovered on corduroy tables and the concentrates washed, acid treated and smelted. Amalgamation is not practised. The presence of graphite is not only inimical to flotation recovery but has an adverse effect on filtration efficiency. Consequently dieselene is used at the first flotation stage for graphite removal. Thereafter gold and sulphides are successfully floated in a triple circuit flotation plant employing Denver special cells. A variety of reagents are used including T.E.B., pine oil, Aero-float reagents 25, 208, 301 and 350. Flotation concentrates are roasted to dispose of the sulphur and the calcine cyanided in an Edwards roaster but this was later replaced by a fluo-solids

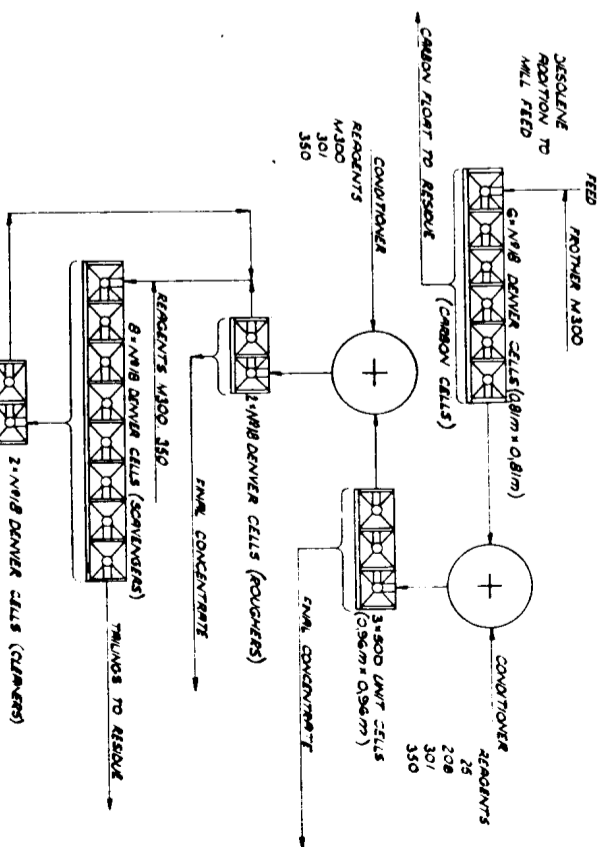


Figure 12. Transvaal Gold Mining Estates flow diagram