THE ROASTING PLANT
Que Que, Southern Rhodesia, Africa

By T. S. Cleary, Manager, The Roasting Plant

Introduction

Que Que (pronounced Kwek-we) is approximately a geographical centre of the Colony of Southern Rhodesia.

The town, elevation 4,000', is on the main line of the Southern Rhodesia Railways, and the main road which parallels the rail passes through the town. From Que Que a spur 1¼ miles long terminates at Plant siding.

Function, of the Plant is to be of assistance to Southern Rhodesia mining by purchasing and treating gold-bearing concentrates, slag, or other valuable metal bearing products.

At any given time from 40 to 60 mines or prospects depend for revenue by sales to the Plant. Lacking this disposal and sale facilities many mining operations could not function. Annual purchases by the Plant average £100,000.

Some of the supplying properties are short-lived, some have many productive years history, and mines as far apart as the Eastern Transvaal and the Northern Congo sell products here.

Control, in matters of policy, etc., is exercised by a Board. Funds where necessary and essential, are provided by the Southern Rhodesia Treasury in terms of Parliamentary votes.

History

First operations were commenced in 1938, and were confined to the purchase and treatment of concentrates. By the end of 1945 some 45,000 tons of concentrates containing over 100,000 ounces of gold have been dealt with.

The original plant consisted of an Edwards type 56 rabble Duplex Furnace with flue system, and Cottrell precipitation unit. The roasted product was concentrated on James tables and the high grade portion amalgamated or sold as "black sands" when amalgamating difficulties arose. Table tails were dewatered, classified, ground in tube mills, cyanided in pachucas, filtered and discarded. Precipitation was effected with zinc shavings. True recovery of gold averaged 60% AS_{208} with 10 to 15 dwts gold per ton content.

It became imperative that resulting financial losses be halted. From mid 1942, use of a new 56 rabble Edwards furnace, combined with improved roasting, reduction of dust losses, and better usage of the old cyanide section and Cottrell, brought gold

Mr. T. S. Cleary, Author and Manager of The Roasting Plant, Que Que, pauses a moment with his favorite dog outside the family home in Southern Rhodesia.

recovery to +90%, and an arsenic product to 85% AS_{208} with gold content of 3 to 4 dwts per ton.

Simultaneously, construction by Plant Staff of a new cyanide circuit commenced. Contractors constructed a Tavener type Pan and Cupel furnaces, and in 1945 an additional 56 rabble Edwards furnace was completed. To this was added a new dust-settling system and stack. An up-to-date metallurgical laboratory was also built by Plant staff.

This renewed and reconstructed Plant, now in full use, is the subject of this article.

Power. Power is purchased from the Southern Rhodesia Electricity Supply Commission. Main line input is at 80,000 volts, stepped down in Plant substation to 550 volt, 50 cycle, 3 phase. Tariff is a

maximum demand charge of 10/-per KVA plus an energy charge of 0.5 pence per unit. Power factor is 0.9.

Water. River water is normally available throughout the year sufficient for rabble cooling. A supply of approximately 1,000 gallons per hour from a bore-hole and pumping unit within Plant grounds, is used for other purposes.

Labour. Normal complement is 18 Europeans and 90 Natives, the latter used but slightly on even semi-skilled work. Of the 18 Europeans, chemical and assay work require four. Two men are engaged in Tavener operations. A mill-foreman and three operators form the roasting and cyaniding staff, and a mechanical staff of two men are necessary for general maintenance and varied construction, as is one builder.

Purchases

Concentrate tonnages per lot will vary from 1 to 50, and contain from 1 to 20 or more ounces Au. per ton. Gold (and silver in slag) are alone purchased. No premiums are paid for arsenic or sulphur, but penalties are imposed for certain base metals in concentrates, as shown later.

At this time the Plant is not equipped to treat concentrates containing high copper or antimony, but can accept high lead-gold material and treat in Tavener furnaces.

Weighing, Sampling, Assaying. Purchase is made on dry weight. Seller or representative may be present at weighing and sampling. Weights are accurately determined, and suppliers are provided with a "Weight Certificate" which gives details of gross, moisture, net, etc.

Dusting, in dry lots, and excessive moisture in the other extreme, limit automatic sampling, and for the most part tube or augur cutting is resorted to.

Samples for assaying and moisture are taken simultaneously, immediately following weighing and opening of containers. The bulk sample secured by cutting is coned and quartered on a steel plate, and the final sample reduced in the Assay Office to four equal portions.

The sample secured for moisture determination is dried in an electrically heated water drying oven. Of the four portions taken for assay, and/or, analysis, one portion is held by the Plant, the second portion is sent to the supplier's designated assay office for check. The third is held for umpire, if necessary, and the fourth held against emergency or dispute. Disagreement of gold assays exceeding 5% between Plant and outside assay, result in umpire.

Payment

Payment is made on the average of agreed assay values, or if umpire assay has been resorted to, on the average of the umpire assay and the one nearest to it. 85% of the agreed total gold content of a consignment is paid for at the ruling local price of gold (172/3d per ounce Rhodesian currency).

Treatment Charge. Concentrates purchased treated at 45/- per ton.

Realization. All gold produced in the Colony sold to banks. Total bank charges against the s exceed 2/- per fine ounce.

Electrolytically refined gold assaying 999.5 produced at the Plant, met bank charges of 2 pence to 27.27 pence per fine ounce.

Resultingly it is necessary for the buyer to a "realization charge" against suppliers, and at pr ent a charge of 1/11d per fine ounce is levied aga the Seller.

Penalties. In the case of concentrates, table sh acceptance limits, free from penalty, and penalt limit is exceeded.

Impurity	Limit	Penalty
Copper, Nickel, Cobalt	0.5%	24/- per unit
Lead	0.1%	5× % deduction
Antimony, Bismuth	1.0%	of Au. plus basic 15%

By-Products

Weighing, sampling, etc., is substantially same as for concentrates. For clean slag, payme is up to 96% of the agreed gold content of a co signment and 75% of the silver. Treatment char is £5 per ton with a minimum of £2.10.0. for l than one ton lots.

In the case of purchases of other products, agre ment of charges, per cent payment, etc., is arran between Seller and Plant Manager.

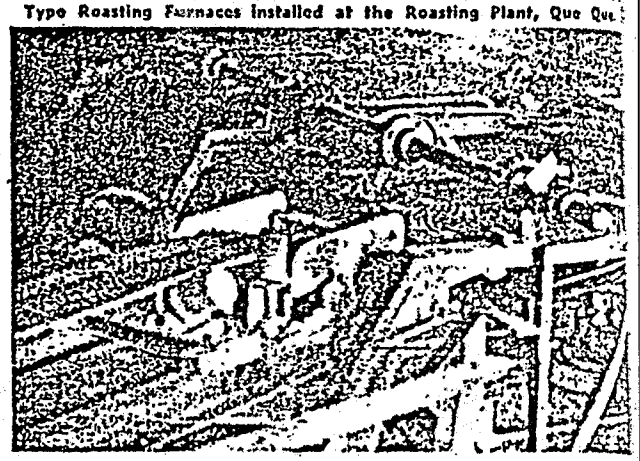
Plant and Treatment Processes

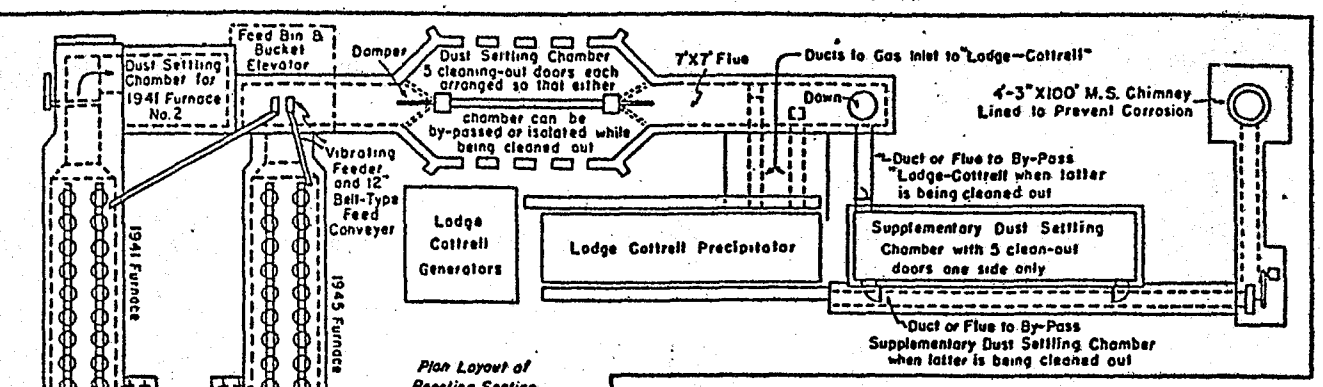
Concentrates, Stockpiling. Following purcha identity of material is lost, as, knowing within lim the Au. As. S., contents, the newly sampled lot stockpiled, and the procedure permits a more or l standard roasting condition becoming applicable a given stockpile, which is normally prepared for ensuing month's operation.

On a drawing from the stockpile, the mix passed through a stationary screen with ⅜" ope ings, the oversize returned and crushed throu 15"x10" crushing rolls, and the product re-screene

Elevation of the screened feed to storage b

This flat belt conveyor and chute feeds one of the 36-rabble Edw Type Roasting Furnaces installed at the Roasting Plant, Que Que





ove the furnaces is by bucket elevator which is wered by a 5 h.p. motor, belt speed at 160' p. m.

rnace Feed, from storage bins is controlled by 2A ffrey vibrator feeders to flat belts, which convey e vibrating feeder discharge to the furnace feed ppers. The hoppers in service terminate within a clearance of the rabbles, at the mid point between . 1 and No. 2 sets of rabbles.

asting, is performed in two, 56 rabble, Duplex wards type furnaces. Hearth area is 115' long x wide. Slope is ¼" per foot.

ive. A 20 h.p. 1,000 r.p.m. slip-ring motor, con-mption @ 12-14 amps, drives the standard mech-sms of each furnace. Two-stage speed reduction, h Croft variable speed gears, gives choice of rab-speeds, ranging from 1 revolution in 45 seconds 1 revolution in 135 seconds.

Stems, rabbles, and shoes or tynes, are of cast n. locally made. Shoe renewal frequency is one per 500 tons concentrates roasted.

el, at present is indigenous timber. Consumption rages 90 cords per month per furnace. Moisture tent of wood is 25-30% (in dry season). Thermal ue (estimated) 4,000 B.T.U. per dry lb. Costs, at nt, £1 per cord. Coal as fuel, with automatic king, is planned, in order to conserve timber.

Fire Boxes. Each furnace has five fire boxes built in and staggered, as illustrated, with final box being situated at the discharge end. This last is very seldom used. Firebox hearth area is 5'x3'. Inlet cross section from firebox to hearth, 4'x1'.

Roasting Temperature. Normally maintained at a maximum of 650° C. and very seldom exceeding 700° C.

Temperature Recording is effected from a 2-leg pyrometer in each furnace with automatic recording by use of Cambridge Recorders.

Rabble Cooling is performed with unfiltered river water, the discharge temperature of which is 40-45° C. The volume of water through this system is 40-50 g.p.m., per furnace.

Roasting of Concentrates. With varying tonnages and variable grades of materials treated, variations in this circuit and in the ensuing cyanide section are the rule. Average roasting time is 12 hours travel in hearth.

Tonnages, roasted, per furnace, over a period of several years, averages 485 tons per month. This does not include the return addition of 40-50 tons per month of flue dust from the settling chambers. Table I below gives casual screening analyses of furnace feed, furnace discharge, and residues, and Table II gives typical monthly averages of day by day feed, and corresponding discharge date:

View through a furnace inspection door shows rabble arms turning the roasting concentrate.

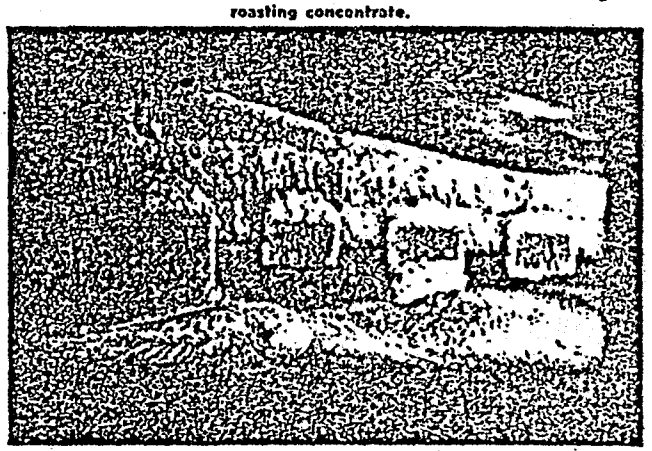


TABLE I

GRADING ANALYSES OF COMPOSITE SAMPLES FOR FEBRUARY 1946

ROASTER FEED

Tyler series	% by weight	Au. dwts/ton	% of total gold content
+ 65	21.3	71.0	14.4
— 65+100	8.4	64.6	5.2
—100+200	24.4	79.9	18.6
—200+325	12.0	146.4	16.8
—325	33.9	139.7	45.0
	100.0	104.9	100.0

ROASTER DISCHARGE

Tyler series	% by weight	Au. dwts/ton	% of total gold content
+ 65	12.6	75.0	6.9
— 65+100	10.5	76.1	5.9
—100+200	29.4	107.6	23.2
—200+325	15.2	195.9	21.9
—325	32.3	177.5	42.1
	100.0	136.2	100.0

FINAL RESIDUE

Tyler series	% by weight	Au. dwts/ton	% of total gold content
+200	0.4	9.3	0.5
—200+325	4.0	5.6	3.1
—325	95.6	7.3	96.4
	100.0	7.2	100.0

COMPOSITION OF GRADING FRACTIONS
COMPOSITE ROASTER FEED, FEBRUARY 1946

Tyler series	% by Weight	% Fe.	% As.	% S.	% SiO_2 & insoluble
+ 65	21.3	32.4	14.4	23.5	21.9
— 65+100	8.4	28.5	11.7	20.8	28.9
—100+200	24.4	29.5	10.1	21.1	30.4
—200+325	12.0	31.2	14.3	24.3	22.5
—325	33.9	23.4	23.1	16.5	25.1
Original	100.0	28.0	15.1	19.9	25.1

PERCENTAGES IN THE GRADING FRACTIONS

Tyler Series	% Fe.	% As.	% S.	% SiO_2 & Insoluble
+ 65	24.5	20.4	24.5	18.1
— 65+100	8.5	6.6	8.6	9.4
—100+200	25.6	17.2	25.2	28.9
—200+325	13.3	12.6	14.3	10.5
—325	28.1	43.2	27.4	33.1

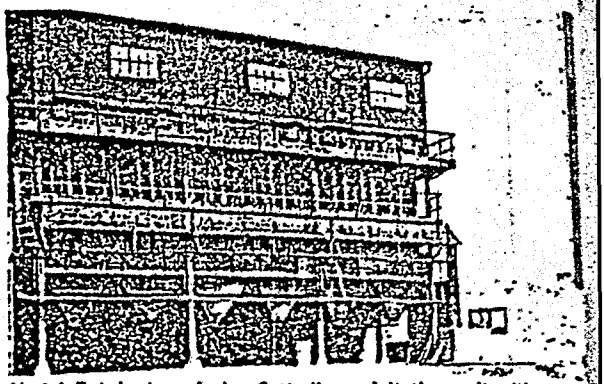
TABLE II

TYPICAL ANALYSIS—ROASTER FEED

Feed	"A"	"B"	"C"
Au.	47.49 dwts.	68.91 dwts.	79.45 dwts.
As.	8.20%	6.98%	10.53%
S.	17.06%	24.05%	17.44%
Fe.	25.76%	29.40%	23.31%
H_2O	6.13%	4.18%	4.54%

ROASTER DISCHARGE

Feed	"A"	"B"	"C"
Au.	64.02 dwts.	85.91 dwts.	91.729 dwts.
Ag.	10.12 dwts.	13.27 dwts.	9.66 dwts.
As.	0.71%	0.38%	0.58%
S.	1.50%	0.77%	0.68%
SO_4	2.72%	1.53%	1.74%
Fe.	30.32%	47.05%	30.78%



Model 7 twin type Lodge-Cottrell precipitation unit with a part the auxiliary settling chamber and stack on the right.

Specific gravity of the discharge, roasted solid i

Furnace discharge of roasted product is via t 18" diameter hoppers, to push, or scraper conve one conveyor to each furnace, and each drive 3 h.p. motors. Conveyor flights are at 1' inte and 20" wide.

Quenching of the roast is performed by spraying with a protecting cover box 36" which is constructed and built into the fur walls, and forming a dust seal over the convey

Temperature reduction, avoidance of dust lo and primary washing is thereby performed. P uct is then concentrated and cyanided.

Flue system. Butterfly controls are located at throats of each furnace. Dust collected in the du settling chambers is returned to the furnace Tonnage collected and so returned is between 1 2 tons per day, and averages 5-6 dwts Au. 25-40% AS_{200}. Cross section of each half of cha is 9'x12' and length of chamber is 30' exclu the tapered ends. Floors are sloped, enabling clean-out to cars, through five cast-iron doo each side of the chamber.

As shown in layout a flue from the set chamber to the electrified auxiliary chambe available, and if necessary, by-pass fumes norm treated in the Cottrell.

Lodge Cottrell precipitator. This machine Model 7 twin type standard unit, capacity b 400,000 cu. ft. of gases per hour at N.T.P. operated at as high an H.T. potential as poss close to 85,000 volts with lead current at 50-60 m amps.

Manual rapping of the electrode tubes re in deposition of the precipitated arsenical dust 12 hoppers, which are hand cleaned daily.

Arsenic production. Cottrell hopper product, until recently, averaged 50 tons per month, b now reduced being necessarily dependent upon As. content of treated concentrates. Product a ages 80-85% As_{200} and from 3 to 3.3 dwts. Au.

Wartime conditions, import restrictions, etc. sulted in this arsenic being one of the few s sources of South African supply, and contract are made to the African Explosives and Che Industries, Ltd., who, after sublimation of this

uct at their Salisbury plant, manufacture cattle dip, and return their residues to this Plant where it is added to normal roasting furnace feed.

Contents of this residual sludge are +10% As. in the form of an iron arsenide, and 20-30 dwts. Au. per ton. Sulphur at present escapes to waste.

Concentration, Amalgamation, Grinding

Solids, expelled by the push conveyors from the furnaces, enter a feed box and with additional water, are pumped to an oversized concentrating table.

The high grade table product, 600-1,000 lbs. per 24 hours, is amalgamated, after grinding, without reagents, in a 4'x3' barrel. The barrel tails are run into a mechanical Batea with 44" bowl, and thence over an amalgam plate.

In two years operation, 45% of the total recovered gold was secured by amalgamation, with a mercury loss of 0.17 ounces, per recovered ounce of gold. Procedure is standard and normal. Amalgam tails join the table middlings and tails, and are pumped to the classification and grinding circuit.

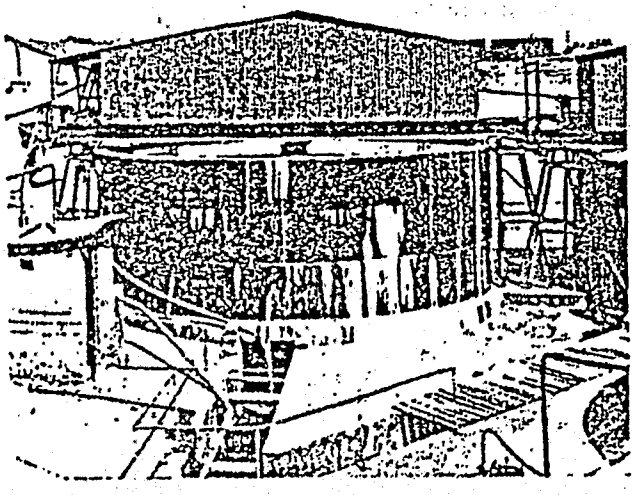
Classification and Grinding Circuit. Separation is made in a 14'8"x4' rake type simplex classifier, overflowing at 8-10% solids, grind at 99% —200 mesh Tyler series. Classifier sands gravitate to a 4'x3' Ball Mill, driven by a 20 h.p. motor at 29 r.p.m.

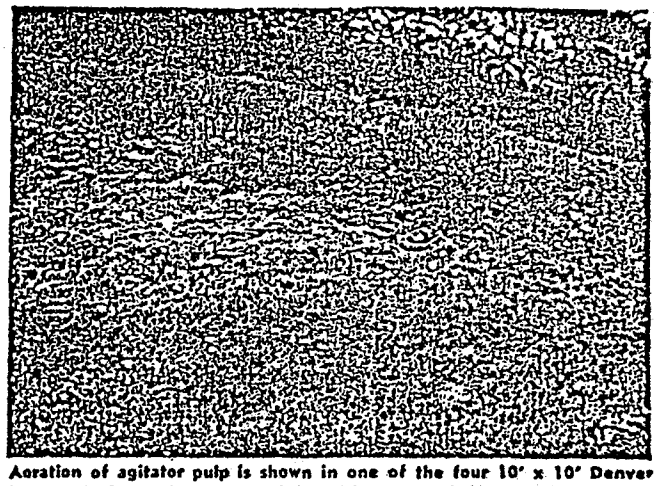
Ball load is maintained at 4,000 lbs. by daily make up of 2½" locally made cast-steel grinding balls. Consumption is 2.75 lbs./ton. Liner wear is 1½ lbs. per ton. Liners are locally made cast steel. Mill discharge at 75% solids is pumped to the concentrating table, thus closing this circuit.

Washing Thickeners receive the classifier overflow, grind as above, with S. content of solids under 2%, and SO_4 in liquid varying from 10 to 20 g.p.l. Units operate in 20'x10' concrete tanks with 9" walls.

Rake speed is 1/5 r.p.m. 3 h.p. motors, and drives through V belts with flat belt drive to diaphragm pumps, are employed. Pumps are one 2" Denver Simplex and one 3" Geco.

One of four 28' x 10' Denver Standard Lowhead Thickeners, mounted in concrete, form the counter-current decantation circuit. 50% solids are pumped from thickener to thickener by 2" Denver Diaphragm Pumps.





Aeration of agitator pulp is shown in one of the four 10' x 10' Denver (Patented) Super Agitators and Conditioners used for preagitation and cyanidation. Metal impeller replacement is one per 5000 tons treated. Rubber covered impellers exceed 12,000 tons without sign of wear.

Underflow of each unit is at 50-55% solids. 50% of wash water is run to waste, assaying trace to 0.02 dwts. Au.

Cyanidation

Agitation. Agitation is conducted in four 10'x10' Denver (patented) Super Agitators and Conditioners, each equipped with 7½ h.p. motor and operated in concrete tanks with 8" walls. Inter-connecting pipe lines readily permit by-passing each or any agitator. Provision is made for the rapid and easy discharge of tank contents.

Preagitation is performed in the first agitator at 50% solids. Lime and cyanide are added, as is barren solution to No. 2 agitator. Dilution of pulp is reduced to 30-33⅓% solids in this agitator, and 16 hours agitation in cyanide solution is approximately the contact time. KCN is maintained by regular addition, at about 0.12%, and CaO at 0.02%.

Cyanide consumption, variable, is between 5 and 6 pounds per ton. Lime consumption (itself a variable) is between 15 and 20 pounds per ton.

Impellor replacement in the case of metal impellors is one per 5,000 tons treated. One rubber covered impellor, after 12,000 tons of solids have passed through the agitator, shows no sign of wear.

Counter-Current Decantation. Four 28'x10' Denver Standard Lowhead Thickener mechanisms, also mounted in concrete tanks, form the counter-current decantation circuit.

Pulp at 30% solids, leaving No. 4 agitator, gravitates to No. 1 thickener feedwell. Solids at +50% are pumped by 2" Denver Simplex Diaphragm pump to No. 2 thickener, and so on.

Barren solution from the precipitation unit is pumped at the rate of 240-250 tons per 24 hours to No. 4 thickener, overflowing as pregnant solution from No. 1.

The underflow of No. 4, unfiltered and pumped at 50-55% solids, forms the final tailing pumped by

a 2" C.A.C. rubber lined pump to the tailings dam.

The ratio of solution to solids in this circuit averages 22:1. Rake speed of mechanisms is 1/7 r.p.m. Tanks are fitted with discharge piping in the walls such that emergency dumping of contents may be rapidly performed.

In three years service no mechanical or operational defects in either agitators or thickeners have arisen, and metallurgical results gained have been good. As noted in Table III below, solution feed of the counter-current decantation circuit, less solution discharge to waste is consistently +99%.

TABLE III

AVERAGES OF PLANT DAILY ASSAYS

FEBRUARY 1946

Roaster Feed	= 93.495	dwts.—ton (diluted)
True Head	=101.384	dwts.—ton (on basis of purchased value)
Roaster Discharge	=135.528	dwts.—ton (on basis of purchased value)
Classifier O'Flow	=108.193	dwts.—solid & 0.017 dwts. solution.
No. 1 Agitator Feed	=104.479	dwts.—solid & 0.014 dwts. solution.
*No. 4 Agitator Disc:	= 21.750	dwts.—solid & 44.474 dwts. solution.
**No. 4 Thickener Disc:	= 7.050	dwts.—solid & 0.051 dwts. solution.
True Head—Tail	= 93%	

*Counter-Current Decantation Circuit Head.

**Final Tails.

EXTRACTION—SOLIDS

Roaster Feed—Tails	=92.46%
Roaster Discharge—Tails	=94.79%
Classifier Overflow—Tails	=93.48%
No. 1 Agitator Feed—Tails	=93.34%

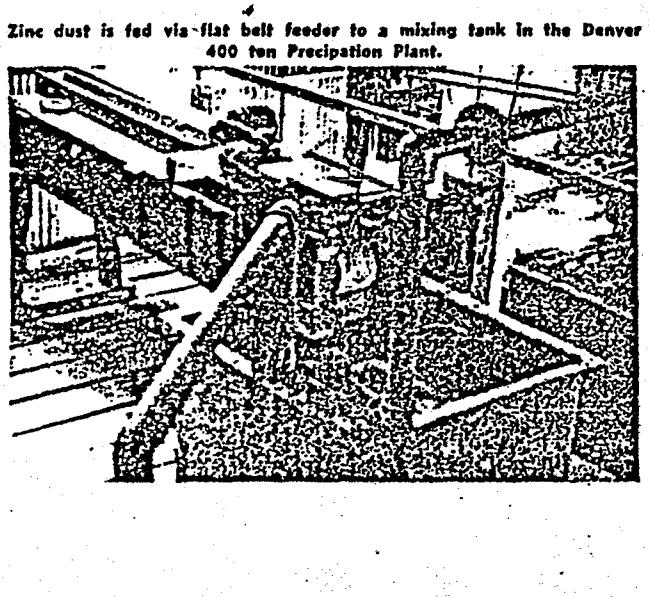
EXTRACTION—SOLUTIONS

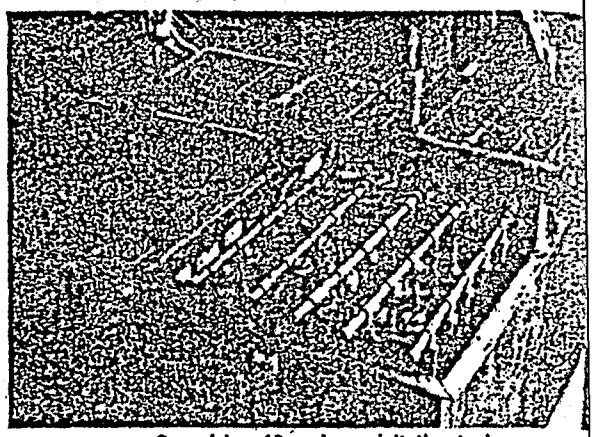
No. 1 Thickener Feed—No. 4 Thickener Disc.=99.88%

Precipitation. The overflow of No. 1 Thickener is primarily clarified in one of two sand clarifier tanks and is then pumped to a Denver Equipment Co. 400 tons per 24 hours capacity Precipitation Plant.

This is a standard unit containing a 30 leaf clarifier; 2'x7' vacuum receiver; zinc dust feeder, etc., and is utilized with two precipitation tanks each of which accommodates 60 socks. A Lea Recorder registers and charts solution tonnage passing

Zinc dust is fed via flat belt feeder to a mixing tank in the Denver 400 ton Precipation Plant.





One of two 60 sock precipitation tanks.

through the circuit, and the barren solution pumped from storage tanks to No. 4 thickener well. No solution is discarded except the 45- content of the final tailings.

Continued drip sampling is maintained from pregnant and barren solution streams. Operation the unit is normal and trouble-free. Gold recovery is normally at 99%.

Average pregnant solution (12 months)	=1.6923
Average barren solution (12 months)	=0.0104

Reagent consumption is within accepted and averages:—

Zinc Dust	@ 0.05 lbs. per ton.
Lead Nitrate	@ 0.012 lbs. per ton.

Precipitate Treatment. Precipitate is washed the inner of the collecting socks, collected, treated, and water washed in a wooden mech ical agitator. The treated slime is pumped Johnson press, and on transfer for melting, is flu with borax, nitre and silica sand, or other reage depending on nature of precipitate, and melted buttons in either an oil-fired vertical furnace u pots and liners, or a Rockwell type furnace.

Gold Recovery

During the financial year of 1945, the follo distribution has been certified:—

Au. in Purchased Concts.	=13,065.4	fine ozs.=100.0
Au. Banked	=12,286.4	fine ozs.= 94.0
*Au. in Arsenic	= 106.7	fine ozs.= 0.8
**Au in Slag	= 118.5	fine ozs.= 0.9
Balance	=residues to waste.	

*Gold in arsenic is largely recovered as noted abov

**Gold in slag, the product of precipitate treatme recovered by addition of this material to Ta furnaces.

Costs

It should be noted that these costs are b against 480 tons per month concentrates tre Using two Edwards furnaces and treating tons per month, costs per ton are 60% of a Assaying costs include test work, assays and alytical determinations of samples received regular and potential suppliers.

General charges include non-operational European salaries, medical fees, bank charges, postage, telephone, advertising, transport, stationery, water, leave pay reserve, workmen's compensation, insurances, fees to board members and auditor, and traveling expenses.

Costs during the financial year 1944/45, on breakdown, include:

	Cost per ton
Receiving and Sampling	£— .4.0
Conveying	£— .1.6
Roasting	£—.11.4
Cottrell	£— .2.4
Grinding and Classification	£— .5.5
Concentration and Amalgamation	£— .4.6
Cyanidation	£—.13.5
Precipitation	£— .3.10
Refining (Smelting)	£— .2.10
Tailing disposal	£— .-.2
Research	£— .-.11
Assaying and Analytical	£— .9.1
General Charges	£—.17.6

Assay Office

The Assay Staff consists of a chemist, and three European assayers, and is equipped to conduct all normal assays and chemical determinations. Existing furnaces are being replaced by more modern equipment, i. e., Denver Fireclay Oil-burning units.

10-11,000 units are conducted monthly at a cost of 5d per unit. "Unit" table used is:

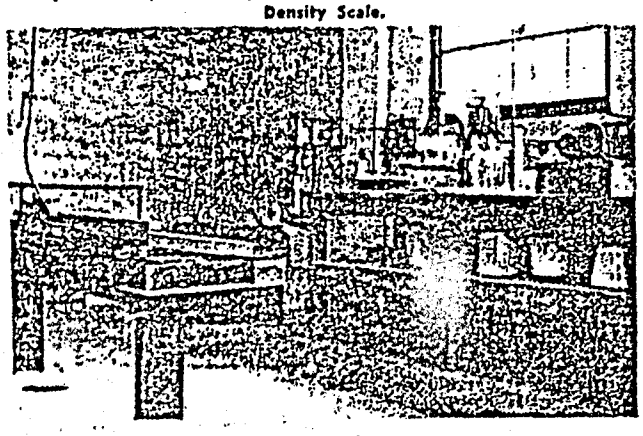
Au.= 5	Co.= 50	Ni.= 30
Ag.= 5	Cu.= 8 (Iodide)	Pb.= 4
As.= 18	Cu.= 4 (Permang.)	S.= 5
Bi.= 50	Cr.= 75	Sb.= 18
CaO.= 6	Fe.= 6	SiO_2.= 10
C.=150	Insol.= 4	WO_3.= 30

Laboratory

The laboratory is equipped with a Denver (patented) Super Agitator and Conditioner, Concentrating Table, Ball Mill, Rod Mill, Mineral Jig, Float Machine, etc. Equipment in use permits normal test-work to be performed.

Electrolytic equipment has been made up permitting production of gold and silver exceeding 999 fine, by the normal two-stage refining methods.

All normal test work can be performed in the laboratory which includes a Denver (Patented) Super Agitator and Conditioner, Concentrating Table, Ball Mill, Rod Mill, Mineral Jig, Flotation Machine and Pulp Density Scale.



Tavener Furnace

To date the small amount of 240 tons only have been purchased and treated, the lot averaging 26 ounces Au. per ton.

Procedure, following analysis of charges of about 20 tons each, is to flux with litharge, scrap iron, or other medium, melt in the Pan furnace, and collect gold and silver in a lead bath.

The lead bullion formed is tapped to bars of about 70 pounds each, and these are then cupelled in the cupel furnace. Lead is removed as PbO. and re-used, the bullion residue on the cupel is collected, melted to bars and then banked.

The slag tailings, rabbled from the Pan furnace, account for 2% of total gold, and remaining 98% is accounted for in gold banked, by-products produced, and lock-up in the Pan furnace hearth.

Special Purpose Plant

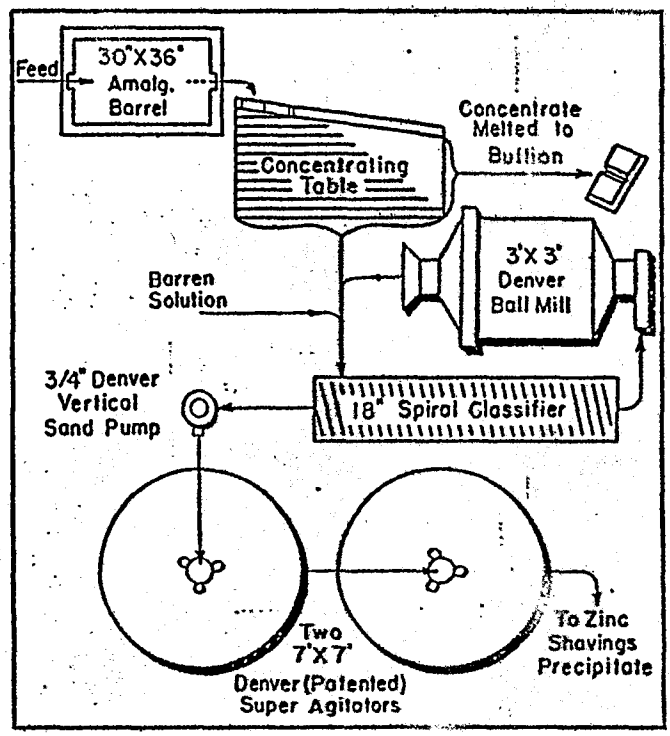
This section has been recently assembled, and is used entirely for batch treatment of high-grade consignments which may be amenable to cyaniding without roasting. Materials treated are either slag or concentrates as the case may be, and, in initial use, this self-contained unit has proved very satisfactory.

Residue Dump Retreatment Plant

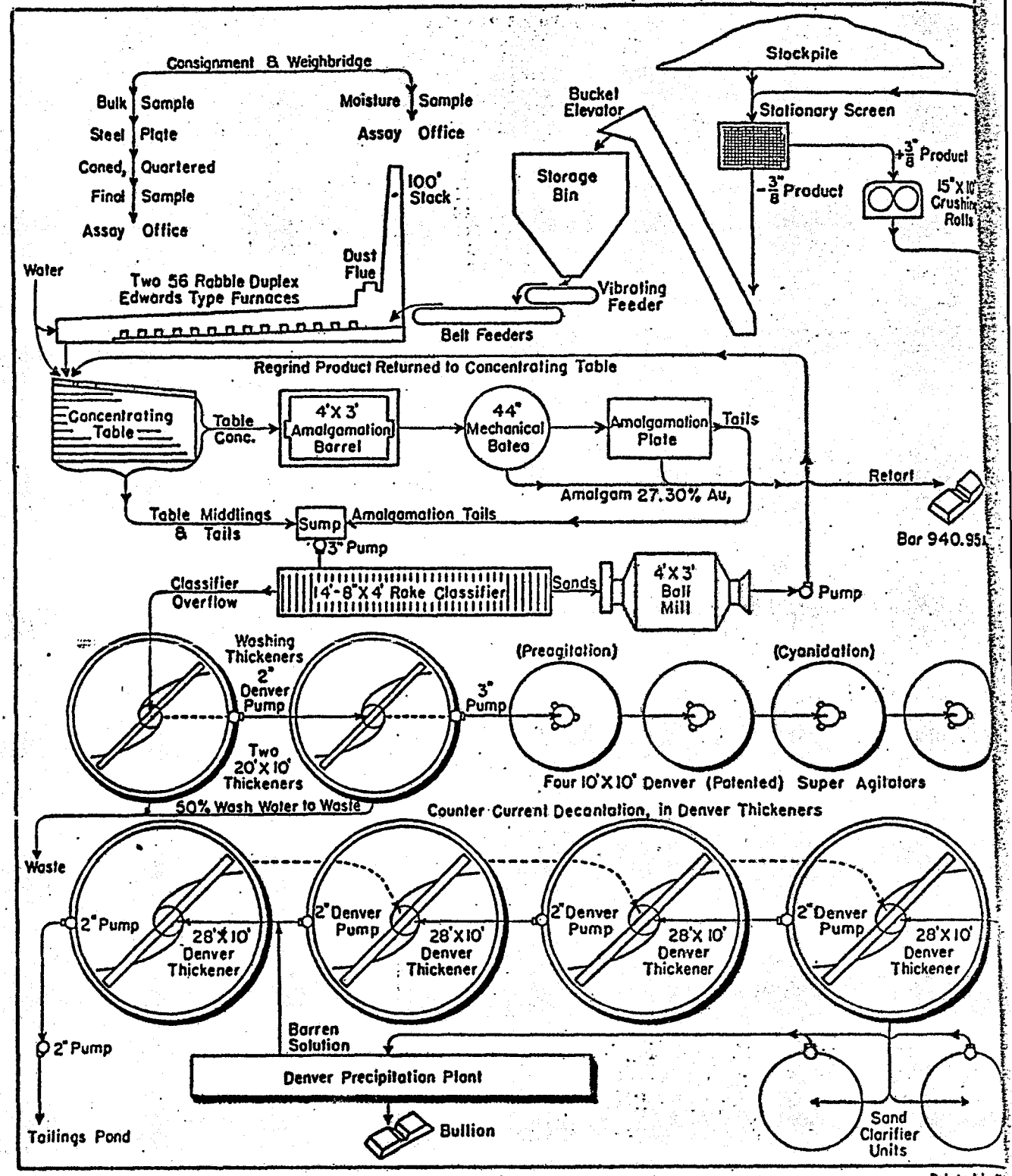
A known tonnage of accumulated high-grade tailings warrant re-treatment, and a plant is now being assembled with the object of retreating this dump.

Future plans include the possibility of installing furnaces to treat high-grade copper-gold concentrates, and antimony-gold concentrates.

FLOWSHEET...SPECIAL PURPOSE PLANT



FLOWSHEET... THE ROASTING PLANT, QUE-Q



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