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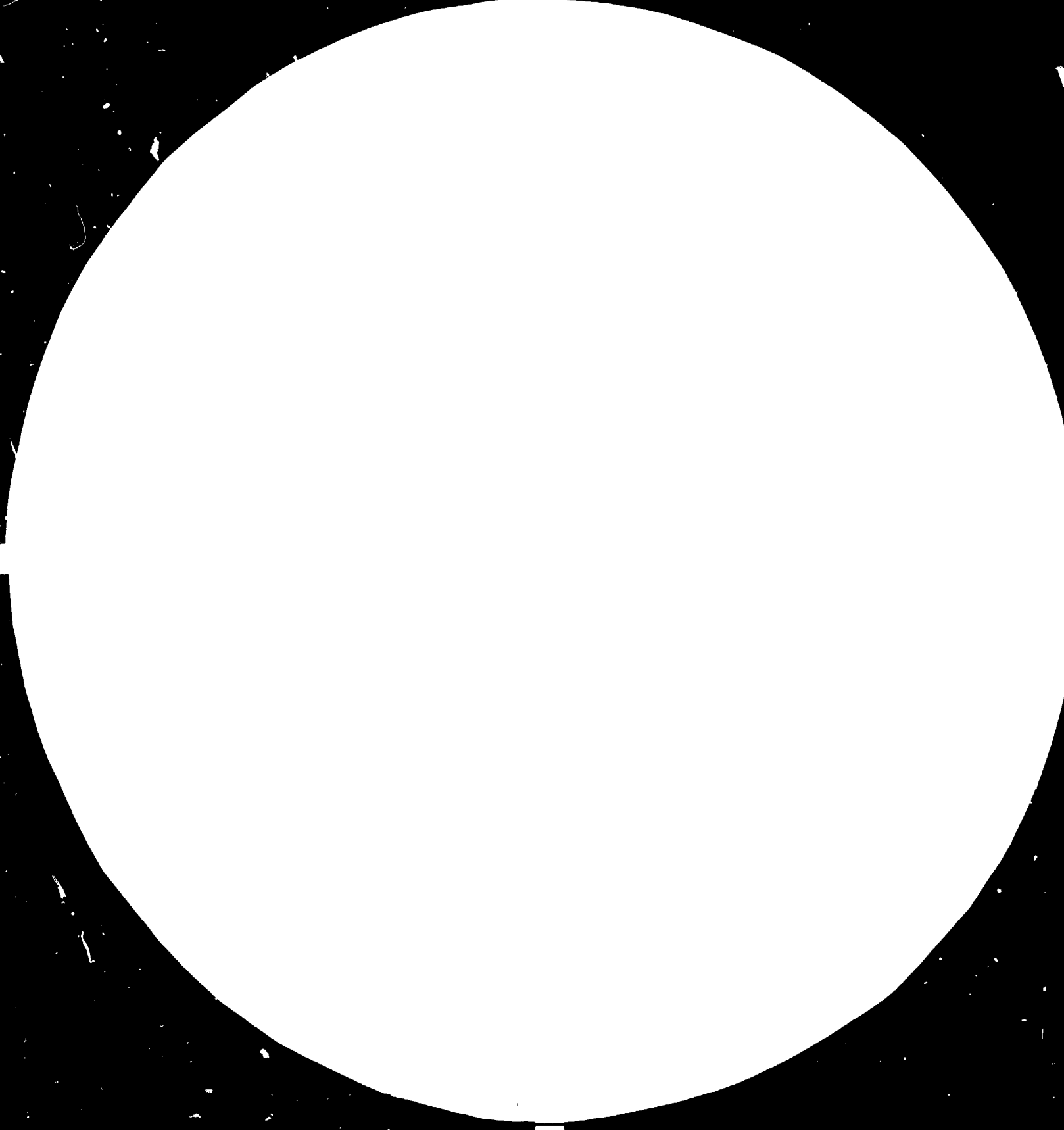
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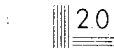
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14174

DP/ID/SER.B/486
17 December 1984
English

Brazil.

ASSISTANCE FOR ACTIVATING THE PRODUCTION OF
GOLD METAL IN THE STATE OF MINAS GERAIS.

SI/BRA/81/801

BRAZIL

Terminal Report*

Prepared for the Government of Brazil
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of F.J. Budin,
Expert in Gold Metallurgy.

United Nations Industrial Development Organization
Vienna

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V.84-94387

A B S T R A C T

The Metals of Minas Gerais S.A. (METAMIC) is engaged in expanding and upgrading the mineral production of the State of Minas Gerais. The production of gold declined in the State and the mines were abandoned due to a lack of know-how of efficient processing techniques. The Government has requested UNIDO's assistance to evaluate the viability of re-activating the production of gold in the State of Minas Gerais.

INTRODUCTION

Increasing the production of Gold in the STATE of MINAS GERAIS is to be considered very good upon the fact that approx. 240 Gold - Diamond deposits are considered to be worked profitable if newly developed technologies are applied. Some of the deposits could be worked immediately and plants put into operation within a very short period of time.

During my short assignment November/December 1982 and July 1983 with METAMIG, I concentrated on the PARACATU-Gold-Deposit, the geological investigated and most promising.

THE PARACATU DEPOSIT

A brief report has been forwarded on completion of my first assignment December 1982 giving information about geology, ore reserves and gold distribution as well as putting forward the proposals setting up a pilot plant.

Beside the huge MORRO do CURU deposit, approx. 1 bio tons of rock containing 300 tons of Gold at an average grade 0,3 g/to, the Southern and Northern Alluvial deposits justify the establishment of a plant based on gravity in the first stage and leaching of Gold in the second stage of operation.

OCCURANCE AND DISTRIBUTION OF GOLD

From samples taken in the Southern deposit granulation has been measured.

Granulation of Gold in mm:

<u>l</u>	<u>b</u>	<u>s</u>	<u>weight</u>	<u>distribution</u>
0,90	0,39	0,15	0,34mg)	50
0,36	0,30	0,06	0,07)	to
0,24	0,12	0,03	0,014)	70 %

Sizes below 100 μ have not been investigated. The distribution of sizes $\leq 100 \mu$ are estimated 30 to 50% depending on previous workings where fines have been lost during operation (see chemical analyses on different sizes).

Screen analyses and distribution of Gold in different sizes:

TEST NO. 1

<u>size</u>	<u>weight</u>	<u>Au</u>	<u>Au</u>
<u>mm</u>	<u>%</u>	<u>g/t</u>	<u>distribution</u>
+ 50	1,51	0,32	0,35 %
+ 38	1,19	0,47	0,59
+ 32	1,19	0,31	1,13
+ 19	6,41	1,15	7,75
+ 9,5	15,77	1,92	33,00
+ 4,0	19,22	0,82	17,00
+ 1,0	23,30	0,89	21,40
- 1,0	31,41	0,56	18,40 %

TEST NO. 2

size mm	weight %	Au g/t	Au distribution
+ 50	0,74	1,74	1,30 %
+ 38	1,10	0,56	0,62
+ 32	1,18	1,92	2,27
+ 19	3,38	0,91	3,64
+ 9,5	13,81	1,10	15,54
+ 4,0	22,28	0,90	20,30
+ 1,0	18,19	0,54	8,95
- 1,0	33,66	1,20	47,60 %

TEST NO. 3

size mm	weight %	Au g/t	Au distribution
+ 50	0,74	1,96	1,33 %
+ 38	1,10	0,61	0,62
+ 32	1,18	2,11	2,29
+ 19	3,98	1,00	3,65
+ 9,5	13,87	1,21	15,42
+ 4,0	22,28	0,99	20,27
+ 1,0	18,19	0,59	9,36
- 1,0	38,66	1,31	46,55 %

Overall distribution of Gold in different sized material:

size mm	Au distribution
50 - 19	3 %)
19 - 1	45 %) of this are 47%
< 1	47 %) free Gold in Sand

Gold in g/t present in different rocks (grab sample):-

Tailings from sluice	...	0,53 g/t	(worked
64 mesh	...	1,17 g/t	with
64 mesh	...	0,81 g/t	present
9 mesh	...	0,51 g/t	methods)
Tailings rubble	...	0,57 g/t	
Uncrushed rock from Corrego Rico	...	1,33 g/t	

The overall density of the rock, rubble and fines

$$\rho = 1,30 \text{ to } 1,44 \text{ to/m}^3$$

Preliminary investigations showed that 53% of the Gold is distributed in the matrix with Hematite, Magnetite, Martit, etc., the rest are fines free with the sand sized $< 1 \text{ mm}$ of which minus 100μ as greater part. Therefor applying gravity concentration is suggested and latest developments of technologies to be considered (see attached pamphlets).

Some tests have been carried out during my first (November/December 1982) and second (July 1983) assignment. The results of the investigations using spiral concentrator and Wilfley table (of very old design) were: -

Spiral Concentrator B.S.C.I

1st run:

Spiral Concentrator B.S.C.I

1st RUN:-

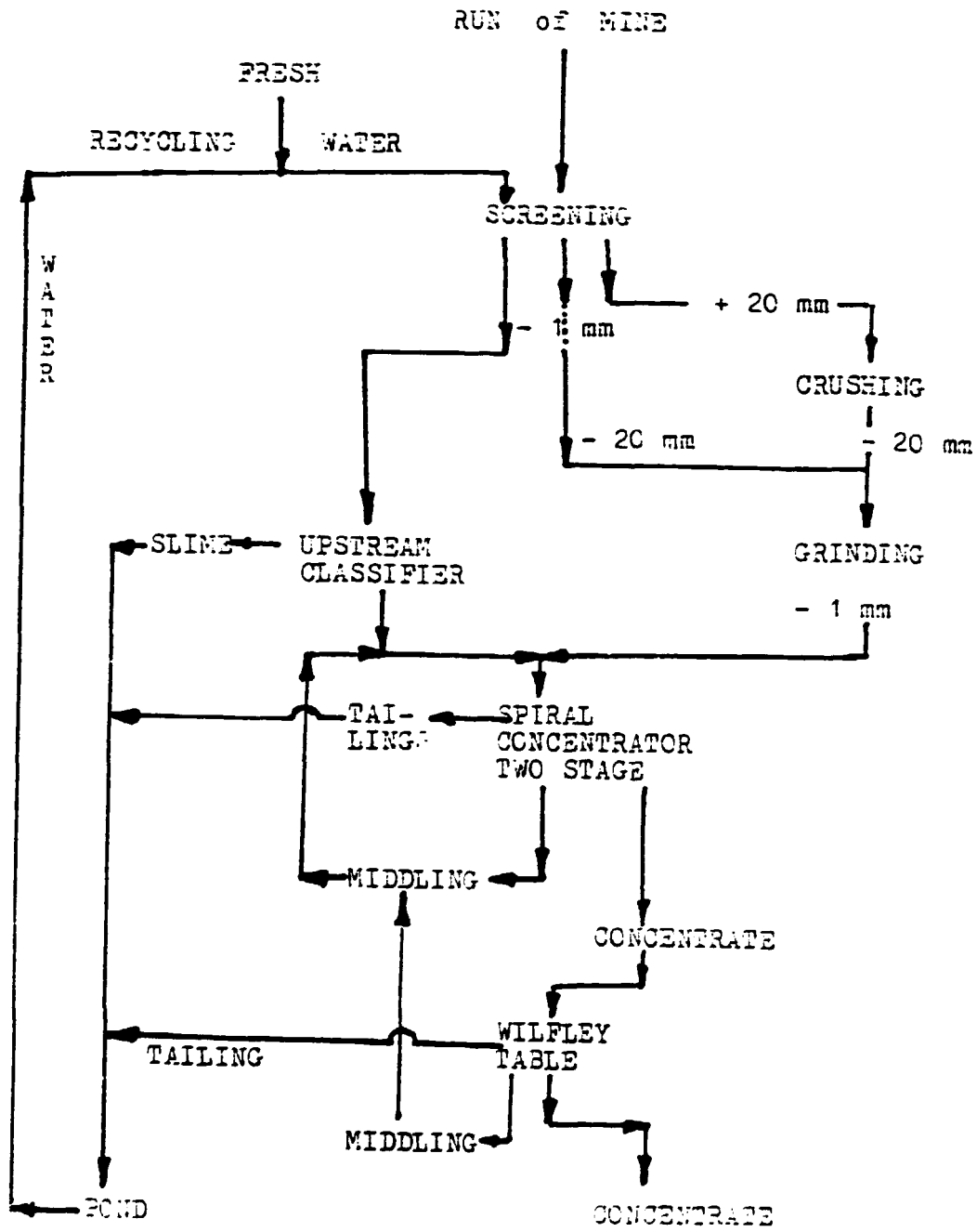
	<u>Grad g/t</u>	<u>Weight distr. %</u>
Concentrate	5,16	25
Middling	1,17	35
Tailing + Slime	0,13	40
Feed	1,95	100

2nd RUN:-

Concentrate	22,80	18
Middling	2,32	31
Tailing	0,16	51
Feed	5,16	100

The concentrate was run on an old Wilfley table, the final concentrate was a mixture of Hematite-Magnetit with free Gold, where the greater part was Gold, which can be easily be cleaned. On account of inadequate equipment the recovery can only be estimated, but must be in the order 70 to 75%.

However it would be an advantage setting up a small pilot plant capacity 5 to 10 tons per hour based on gravity concentration applying latest technologies. The crude ore above 19 mm resp. 50 mm has to be included in this set up, e.g.



The machinery for the pilot plant can be manufactured in Brazil, therefore no foreign exchange will be necessary to be allotted in the first stage.

However during operation of the pilot plant based on gravity some investigations should be made on

Cyanid leaching (C i F)

and Thiourea leaching techniques.

The first one is applied on nearly all Gold mines the world over, the second one in some places of low grade deposits < 1,0 g/t and complex ores (As, Cu, Zn, etc.). In the state of Minas Gerais many deposits (I visited) are of complex ores containing Sulphides and Arsenopyrit. The Gold in this ores is mostly lost in tailings up to 2 g/t. Recovering the Gold from complex ores encounters no difficulties applying the Roast-Reduction-Thiourea technology (see Fig.1 and Fig.2). The Thiourea-leaching process has several advantages over the conventional leaching techniques, such as: -

- good recovery rate,
- short leaching time,
- low investment,
- simple recovery of precious metals from solution.

The final products are precious metals, elementar sulfur and cyanamide, which is a well known fertilizer.

RECOMMENDATIONS

In accordance to information I received from President and Managing Director of METAMIG, the aim of the company is beside geological exploration advising small scale miners and mining and mining companies stepping into production of Gold and other precious metals. In consideration of the present setup and equipment at hand (see Photos attached) the plans could never be realized let alone advising mining companies outside METAMIG. It must be realized, that the latest technologies and equipment must be included in such a plan.

Therefore the recommendations are: -

1) First step of operation

Purchasing portable X-ray Analyser and UV-lamps.

Further purchasing a mobile pilot plant, consisting of:

Two Spiral Concentrators BSC.I .. 1 t.p.h.

One Spiral Concentrator BSC.II . 5 t.p.h.

One Upstream Classifier

Two Sand Pumps

One Mobile Wilfley Table-No.13b

and if necessary a small Crushing and Screening equipment.

The total cost of the pilot plant without crushing and screening would be at present rate US Dollar 20.000/- CiF., valid for at least six months.

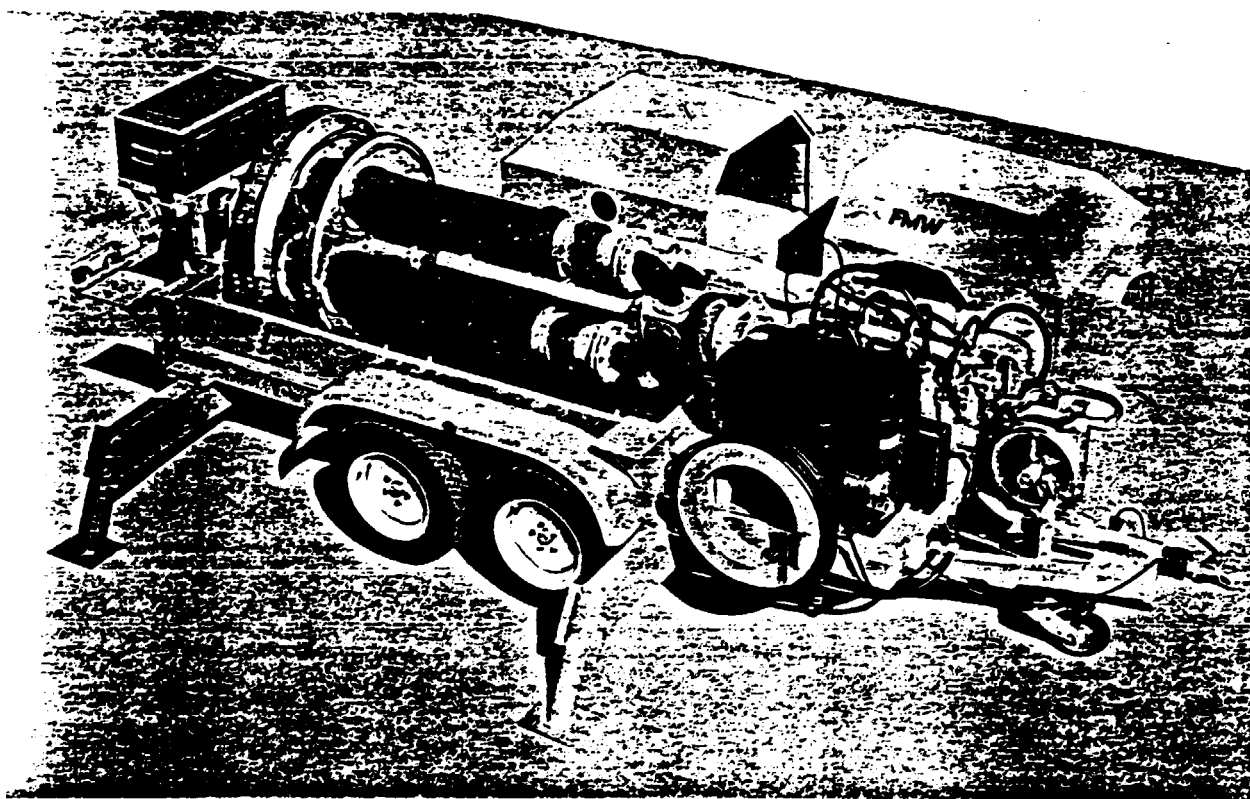
- 2) The second step could be tests on leaching of fine Gold applying about all Thiourea-technologies. The pilot plant investigations are to be carried out at well-known Research Institutes, having plants of this kind in operation.

- 3) It is also recommended doing away with obsolete technologies and equipment but switching over to latest developments. Therefor a layout for a Cyanide CiP leaching plant and photos are included in this report.

PRESENT TECHNOLOGIES.



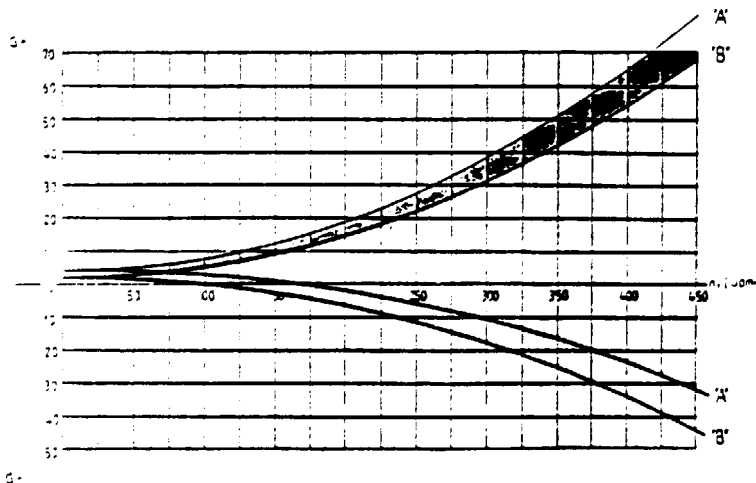
ROTATING GRAVITATIONAL CONCENTRATOR.
(R.G.C.)



The following diagram indicates the forces acting on the particles with a constant speed of the planetary separation elements of 200 rpm and a frequency of 3.3 hz and with different speeds of the central shaft

G+ = max contact pressure
G- = max lift-off-force
n₁ = speed of main axis

"A" = first part of planetary tube
"B" = final part of planetary tube

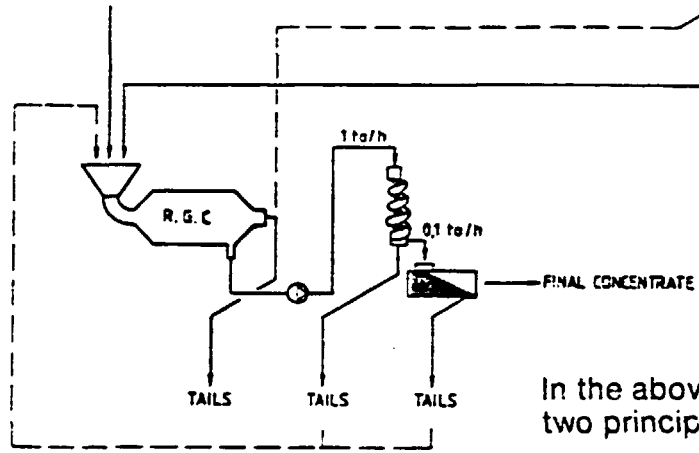


A. SINGLE UNIT

30-40 t/h

Direct feed into
Secondary Separation

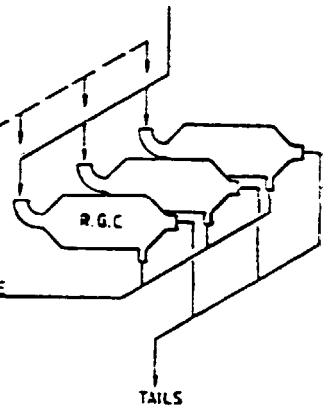
30-40 t/h solid matter - 2mm
35-45 t/h water



B. BATTERY OF PRIMERY UNITS

INTO ONE SECONDARY UNIT 900-1200 t/h

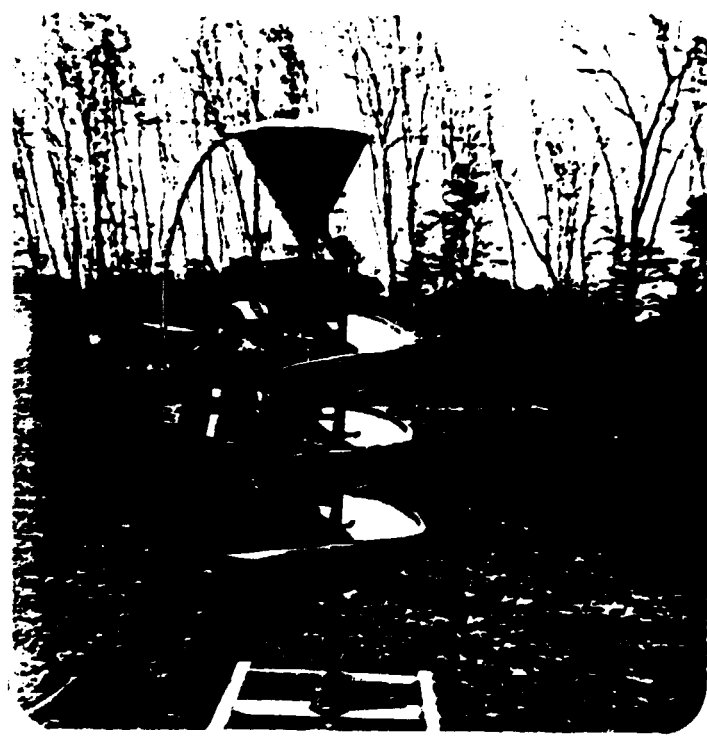
Feed into a
battery of 30
concentrators



In the above mentioned Flow Diagram
two principles are shown:

- A) One unit with a throughput of approx. 30-40 t/h.
- B) A battery of 30 units for a throughput of approx. 900-1200 t/h as primary separation and one unit for the resulting concentrate.

Due to the high performance of the R.G.C. - Rotating Gravitational Concentrator, and the recycling of middlings a very high enrichment of concentrate with a recovery of heavy metal of approx. 90% is achieved by the R.G.C. - System.



THIOUREA LEACHING of GOLD and SILVER.

