

FALCONBRIDGE NICKEL MINES LIMITED

INTER-OFFICE MEMORANDUM

DATE: October 19, 1977

TO: W. A. Moore

COPIES TO: HTB, D. J. Emery, K. Morton, FGTP

FROM: J. F. Jackson

SUBJECT: Trip Report to Giant Yellowknife - Sept. 19-24/77

File: Roaster

Summary

On Sept. 19-24/77 I accompanied FGTP to Giant to examine the roaster operation.

The roaster system was examined and no faults in operating procedure were evident, in fact the operation is very well run.

It was apparent from examination of the records that the arsenic content of the roaster calcine increased significantly about the time that the roaster was last bricked-in during April 1974. At the same time the oxygen level in the gases from the first stage roaster increased from 0.2 to 2-4%. For good arsenic elimination it is necessary to conduct the first stage roast under reducing conditions as indicated by a low oxygen content in the gases to prevent the formation of non volatile As_2O_5 . High levels of arsenic in the roaster calcine are associated with low gold recovery and high cyanide requirements.

It was recommended that oxygen measurements on the first stage roaster gases be taken regularly and that efforts be made to change the roasting parameters to result in a low oxygen content in the off gases. Checks should be made in the roaster thermocouples to verify the readings. It was recommended that the roaster bed temperature be raised until good oxygen efficiencies are obtained.

The lowering of the oxygen content in the roaster gases and thus operating the roaster under reducing conditions should maximize the arsenic elimination. The resulting low arsenic calcine should lower the cyanide requirement for equivalent gold extraction and reduce the quantity of soluble arsenic which must eventually be treated. Increased gold extraction may result.

At the present tonnage rates the roaster cyclones are oversized for the volume of gases being handled. This has resulted in poor dust collection efficiencies which increased the load on the cottrell and carbon circuit. Means for improving the cyclone efficiencies were suggested.

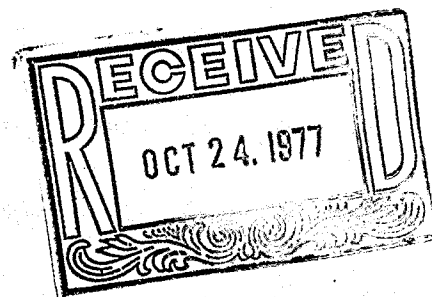


FIGURE 2

GOLD EXTRACTION FROM ROASTER CALCINE
AT VARIOUS LEVELS OF CYANIDE

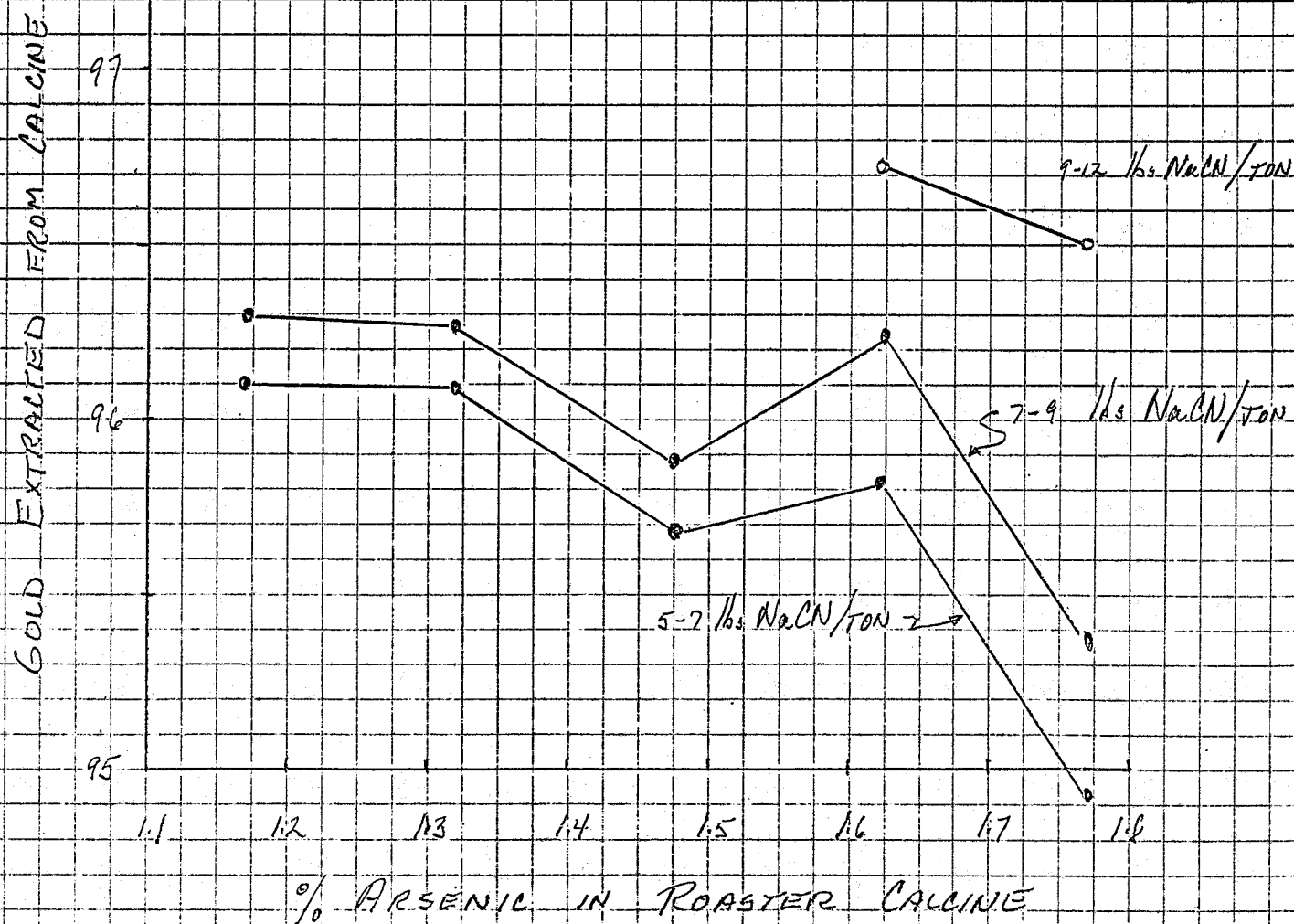
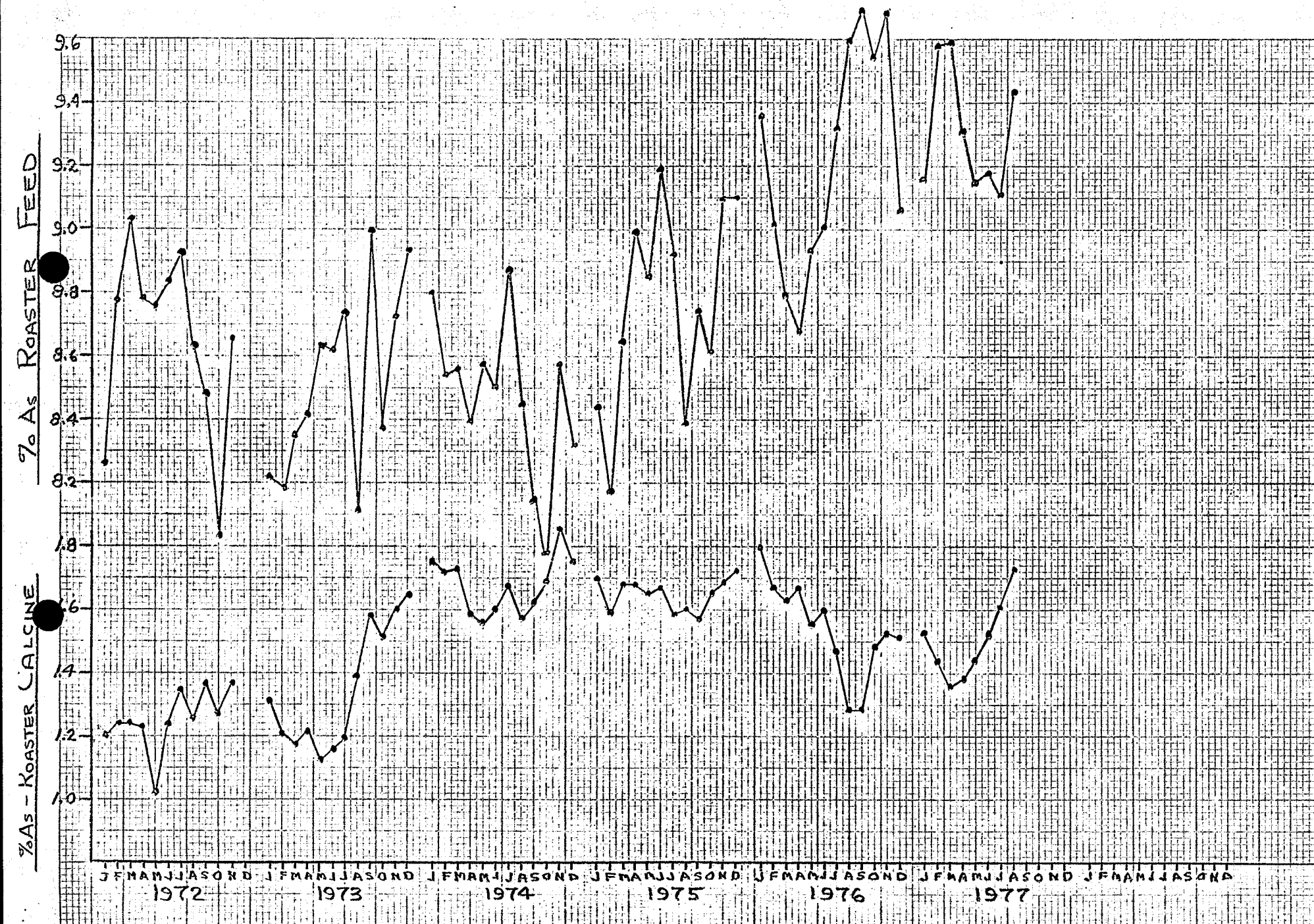


TABLE I

COMPARISON OF ROASTER OPERATING CONDITIONS

	<u>Dec, 1959</u>	<u>May 30, 1973</u>	<u>Sept.19,1972</u>
Concentrate Tons/Hr	8.2	7.28	6.0
Stage I Roaster			
Bed Diameter Ft.	16	13	11.5
Air SCFM	3350	3200	2550
Bed Temp. °F	925	925	925
Freeboard Temp. °F	800	783	805
Spray Water IGPM	2.5	1.18	0.8
% Solids	76	76.9	76.9
% O ₂ in Gas	0.2	0.2	2-4
Space Velocity FPS	1.3	1.07	1.09
Retention Time Solids Hrs.	7.4	8.2	9.1
Retention Time Gases Sec.	3.9	7.0	8.0
Bed Depth inches	60	90	105
Stage II Roaster			
Bed Diameter Ft.	14.0	11.0	9.5
Air SCFM	1450	1000	900
Bed Temp. °F	875	925	925
Freeboard Temp °F	850	870	860
Space Velocity FPS	0.6	0.48	0.56
Retention Time Solids Hrs.	5.6	5.9	6.2
Roaster Gases (Calculated			
Volume ACFM	19,900	-	14,600
N ₂ % Vol.	48.2		48.3
SO ₂ "	7.3		7.0
As ₂ O ₃ "	0.8		0.8
O ₂ "	1.5		1.0
H ₂ O	42.2		42.9
Ft ³ Gas/lb Roaster Feed	72.8		73.0
Cottrell Dust			
Tons per day	8.9 - 9.75		14.4
% of Roaster Feed	4.5 - 5.4		10.0



1. Roaster Operating Procedure

The operating procedures were examined and it was found that the roaster has been operated in an excellent manner. Roasting conditions that were established early in the roaster life have been rigidly adhered to. The temperature control, operating time, feed system, and operating records were all very good indicating a well run plant.

2. Roaster Modifications

Over the life of the plant because of reduced tonnage, it has been necessary to reduce the internal diameter of the roasters by adding courses of brick.

		<u>Hearth Diameter Ft.</u>	
	<u>TPD</u>	<u>Stage I</u>	<u>Stage II</u>
Original	196	16	14
1962	180	14.5	12.5
1967	175	13.0	11.0
1974	144	11.5	9.5

The roasting conditions have not changed very much over the years as illustrated in Table I.

3. Arsenic Elimination

The arsenic content of the roaster calcine increased from 1.2 to 1.7% As towards the end of 1973 when the roaster was operated intermittently. The higher level of As in the calcine continued after the roaster was bricked-in during April 1974.

It is desirable to eliminate as much arsenic from the calcine as possible. The extraction of gold from the calcine is dependent upon the cyanide addition as shown by FGTP (July 7, 1977). The gold extraction is also dependent upon the arsenic content of the calcine as illustrated in Figure 2, which is a statistical analysis of the monthly data from April 1974 to date.

Other benefits of a low arsenic content in calcine are a lower cyanide consumption and a reduction in the amount of soluble arsenic which must eventually be precipitated.

4. Roaster Oxygen Efficiency

It was found that after the last roaster rebricking the oxygen content of the gases from the first stage roaster had increased from the normal 0.2% to 1-4%. There was no corresponding change in other roasting parameters.

To obtain high arsenic elimination in the first stage roaster it is necessary to operate the roaster under conditions where low levels of oxygen are present in the gases. This allows As_2O_3 to be formed and eliminated as a vapour. Under oxidizing conditions As_2O_5 is formed which is non volatile.

The roasting reactions for some reason are not going to completion. Possible explanations for poor oxygen efficiency are: too high a space velocity, too low a bed temperature, too low a retention time, a coarser concentrate size, and air channelling.

4.1 Roaster Space Velocity

The space velocity in the first stage roaster has remained at approximately the same level over the life of the roaster and in fact is lower than when the roaster started up.

	Dec.1959	May 1973	Sept.1977
Tons/Hr	8.2	7.28	6.0
Bed Diameter	16	13.0	11.5
Space Velocity FPS	1.3	1.07	1.09

Extensive testing in the pilot roaster at Falconbridge when partial roasting CuNi concentrate indicated that at a given bed temperature the higher the space velocity the higher the oxygen in the off gases.

4.2 Roaster Bed Temperature

The first stage roaster has been operated at 925°F since shortly after the roaster was started. At that time this was the optimum temperature for good gold extraction. The antimony content at that time was much higher.

Referring again to the Falconbridge pilot roaster, it was found that for a given space velocity the oxygen content of the gases increased with decreasing bed temperature. It should be noted that the Falconbridge system is different mineralogically, the temperatures are much higher and the retention time in the roaster much lower. Nevertheless the same trends should hold for the Giant roaster.

4.3 Retention Time

The longer the calcine particles are in contact with the roaster gases the better the chance for the roasting reactions to go to completion. The gas retention time is essentially equivalent to the space velocity and this has not changed over the years.

	Dec.1959	May 1973	Sept.1977
Solid Retention Time Hrs.			
Stage I	7.4	8.2	9.1
Stage II	5.6	5.9	6.2
Bed Depth inches	60	90	105
Space Velocity Fps	1.3	1.07	1.09
Gas Retention Time	3.9	7.0	8.0

The only way to increase the retention time is to increase the bed level in the reactor. This has actually occurred every time the roaster has been bricked-in. Each time a coarse of brick was added the bed overflow was in fact raised about 15 inches.

Deeper bed depths result in a higher back pressure at the roaster windbox. The limit of the blower may have been reached.

4.4 Concentrate Size Distribution

The concentrate size distribution also changed about the time of the last roaster bricking from 40-46% +200 mesh to 45-48% +200 mesh. It is doubtful that this small a change would cause the noticed difference in the roaster operation and that it coincided exactly with the roaster rebricking.

4.5 Air Channelling

Poor air distribution through the bed or incomplete fluidization is a possibility. There might be a dead spot in the bed. The bed depth is also getting very deep and the bed depth to diameter ratio is getting close to the range for bed slugging. The air might be going through the bed in large bubbles rather than properly fluidizing the bed. This condition would be indicated by excessive fluctuation in the windbox pressure.

5. Roaster Dust Collection System

The quantity of dust escaping the roaster cyclones has been increasing over the years.

	<u>Dec. 1959</u>	<u>1962</u>	<u>Sept. 1977</u>
Gottrell Dust TPD	8.9	9.75	14.4
% Dust on Roaster Feed	4.5	5.4	10
Gas Volume ACFM	19,900		14,600
Cyclone Pressure Drop (ins.Wg Calc)	6.7		3.7

The calculated off gas volumes have decreased by 27% since 1959 and this has reduced the pressure drop across the cyclones from 6.7 to 3.7 inches Wg. Cyclone dust collection efficiencies are dependent upon the pressure drop across the cyclones.

The cyclones now are too large for the gas volumes and they probably were a bit large in the first place.

5.1 Possible Methods for Improving Cyclone Efficiency

At the present time there are two cyclones in use in the roaster circuit. The first stage cyclone (Ducon SD 17) and the second stage cyclone (Ducon SD 16). The cyclone between the first and second stage roasters (Ducon SD 15) is currently not in use. The cyclone size increases with the manufacturers number, i.e. SD 15 is the smallest and SD 17 the largest.

The dust collection efficiency of the cyclones can be improved by increasing the pressure drop. This could be accomplished by rearranging the existing cyclones, i.e. by replacing the second stage cyclone (SD 16) with the cyclone from the first stage roaster (SD 15). This would increase the pressure drop from 3.7 to 4.6 ins. Wg. A more extensive rearrangement by replacing the first stage cyclone (SD 17) with the second stage cyclone (SD 16) and replacing the second stage cyclone with (SD 15) would increase the pressure drop to 5.1 ins. Wg.

Another possible method of increasing the cyclone pressure drop would be to install a refractory lining in the existing cyclones.

Improvement in the cyclone efficiency would lower the burden on the cottrell and the carbon plant.

6. Recommendations

6.1 Oxygen Measurements

The practice of measuring the oxygen content of the gases from the first stage roaster should be resumed on a regular basis until stable operation of the roaster at good oxygen efficiencies is demonstrated.

6.2 Roaster Bed Thermocouples

The temperature that the bed thermocouples are indicating should be checked. The thermocouples may have deteriorated and may be registering the temperature incorrectly. The location of the bed thermocouples should be checked as they may be located too near the wall refractory since the courses of brick have been added.

6.3 Roaster Bed Temperature

The temperature of the first stage roaster should be increased gradually in steps of about 10°F until the oxygen content of the gases is reduced to 0.1 to 0.2% O_2 . Some instability in control can be expected as the temperature is increased due to fluctuations in oxygen efficiency and heat generation. Once this range of instability is past, control of the roaster should stabilize.

6.4 Cyclone Rearrangement

The rearrangement of the cyclones would be more of a long term project and no immediate decision need be made.

