

Giant
YELLOWKNIFE MINES LIMITED

MEMO TO: G.B. Halverson

CC: M.E. Goodfellow, D. Cooper, J. Loretto

FROM: T.R. Raponi

DATE: September 8, 1987

SUBJECT: T.R.P. Pilot Plant Carbon Adsorption Testwork

Summary

Pregnant solution from No.1 CIL agitator was collected on July 24 for carbon adsorption testwork. The solution assayed 0.0097 oz/ton Au, somewhat lower than expected. The testwork performed established an equilibrium curve for the carbon loading using the procedure outlined by Hussey, Salisbury and Potter in their paper "Carbon-in-Pulp Gold Adsorption from Cyanide Leach Slurries." A maximum calculated carbon loading of 78.4 oz/ton Au was obtained with a solution to carbon ratio of 15,000:1. This was verified by the actual maximum carbon loading achieved in the T.R.P. pilot plant which was 78.5 oz/ton Au. Further testwork should be performed to expand on the data generated by this testwork and to determine plant operating parameters such as the carbon concentration, the rate of carbon advancement, etc.

Purpose

To establish adsorption equilibrium data for carbon loading for T.R.P. pilot plant pregnant solution.

Procedure

For a detailed description of the procedure used, the reader is referred to the paper by Hussey, Salisbury and Potter. Fresh Calgon GRC-22 carbon was agitated in the pregnant solution obtained from the pilot plant until equilibrium was achieved. Four tests were conducted using solution to carbon ratios of 15,000:1, 5,000:1, 150:1 and 50:1. Solution samples were taken at regular intervals to determine equilibrium and to calculate carbon loadings. The calculated carbon loading at time j during a test is:

$$Q_j = (c_0 - c_j) (W/M)$$

where Q_j = calculated carbon Au loading (oz/ton)
 c_0 = solution Au concentration at time zero
 c_j = solution Au concentration at time j
 W/M = solution to carbon weight ratio

The conditions for each test are shown in table 1.

Results


The data generated from each test are shown in tables 2 to 6. Solution Au concentration is plotted as a function of time for tests 1a and 2a in figure 1 and tests 3a and 4a in figure 1a. The equilibrium end point data for the four tests are shown in table 6 using calculated carbon loadings and in table 7 using the assayed carbon loadings. Equilibrium curves using the end point data from tables 6 and 7 are shown in figure 2. Pseudo-equilibrium curves for 4 and 12 hour contact times are shown in figure 3.

Conclusions

1. The maximum calculated carbon Au loading was 70.4 oz/ton at a solution to carbon ratio of 15,000:1. The final carbon recovered FRL 16.2 agitator in the pilot plant assayed 70.5 oz/ton.
2. The true equilibrium curve generated does not offer a practical operating isotherm for a full scale plant. Pseudo-equilibrium curves based on expected carbon retention times should be used.
3. Barren solutions assaying 0.0001 oz/ton Au were readily achieved in the testwork and should also be readily obtained in the full scale plant.

Discussion

Although the reference cited provided a good basis for this testwork, the low grade of the pregnant solutions used presented problems which could not be dealt with, in particular using the true equilibrium curve to predict carbon concentrations per stage and stage retention times. Other work done in this field by Fleming and King suggests using pseudo-equilibrium curves using retention times approximating plant conditions. Although carbon loadings of 70 oz/ton were achieved in both this testwork and the pilot plant, both used high solution to carbon ratios to achieve this. The carbon assaying 70 oz/ton represented only 4.0% of the total weight of carbon used in the pilot plant. The weighted average assay of final pilot plant carbon was only 31.2 oz/ton Au. The final assay of the carbon in test 1a was lower than calculated because of fine slimes which were filtered out with the carbon. These slimes diluted the assay since there was only 1 g of carbon. The results of this testwork and the pilot plant provide rough estimates for the operation of the full scale plant. These estimates can be optimized with further testwork and then in the full scale plant.


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1981

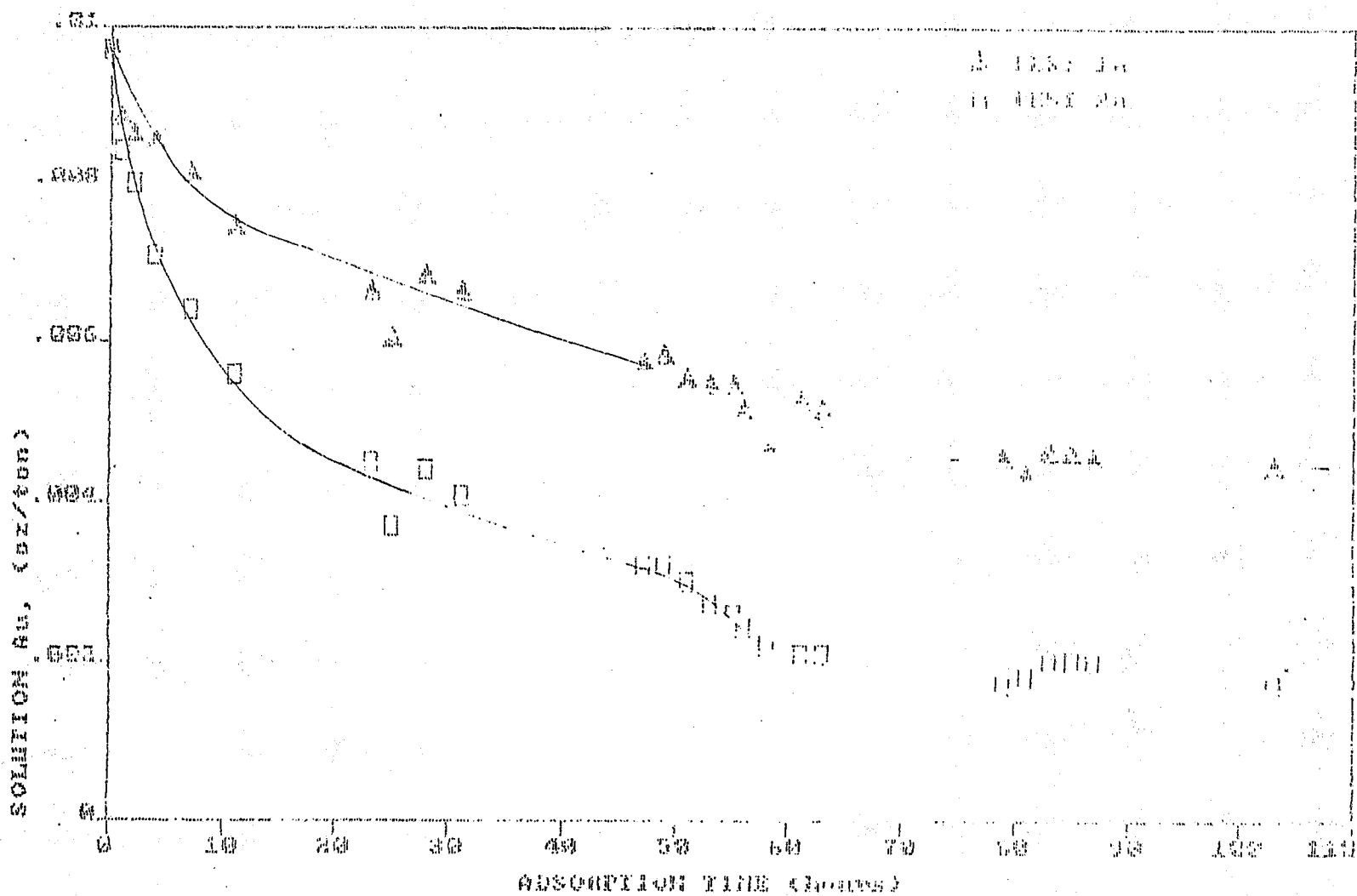


Figure 1 : Adsorption Rate Data

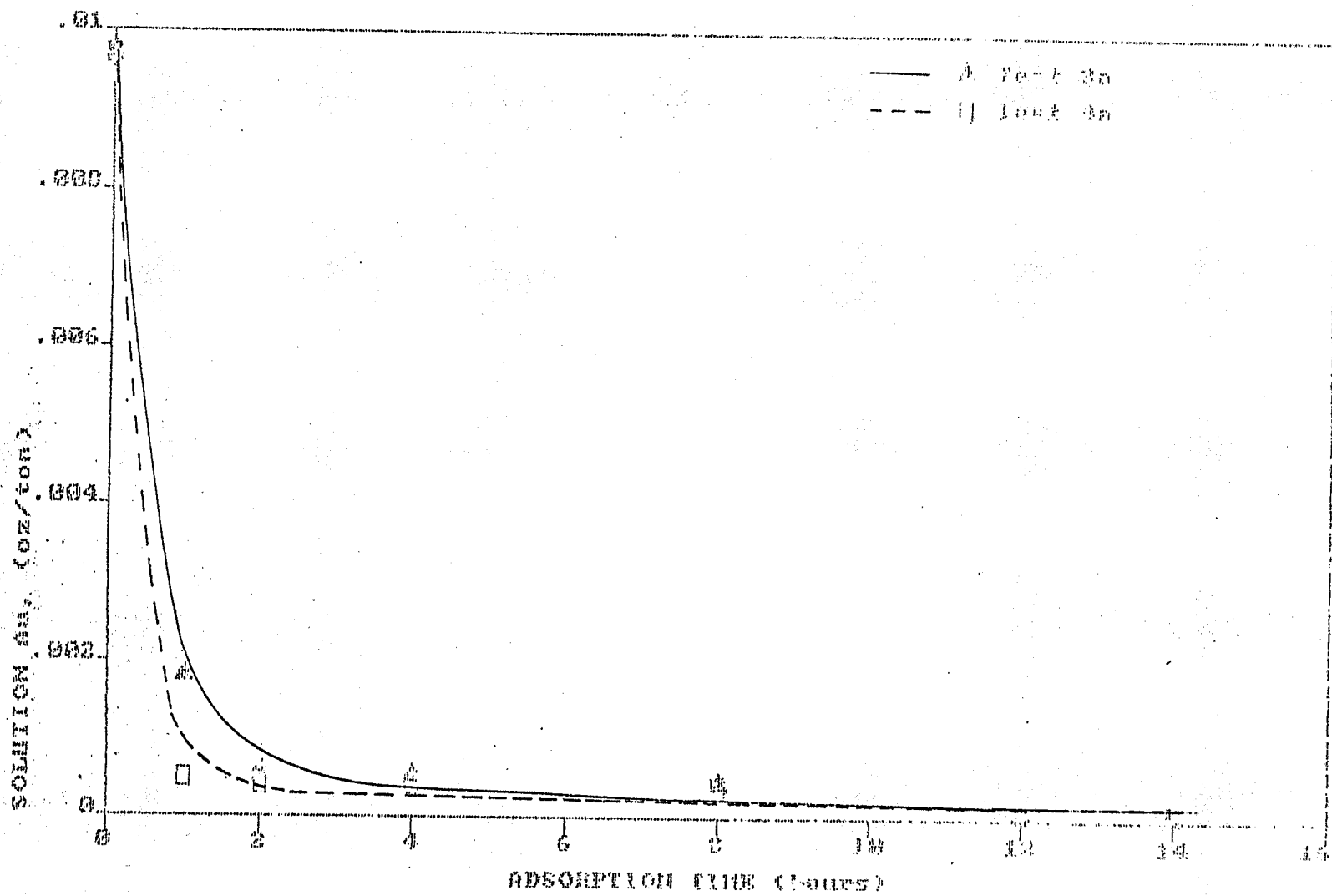


Figure 1a : Adsorption Rate Data

FIGURE 2 : EQUILIBRIUM CURVE FOR GOLD ADSORPTION

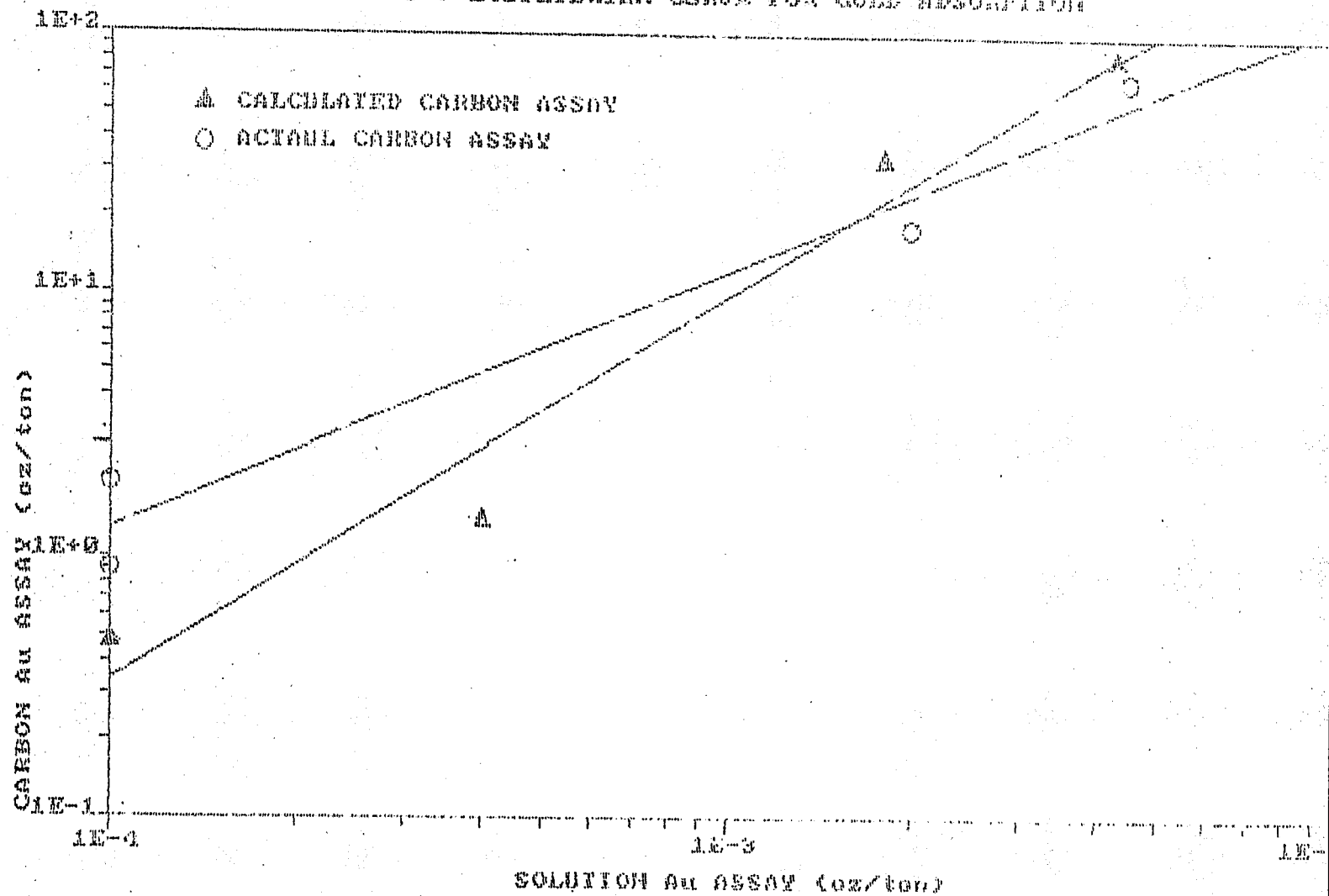


FIGURE 3 : EQUILIBRIUM CURVES FOR GOLD ADSORPTION

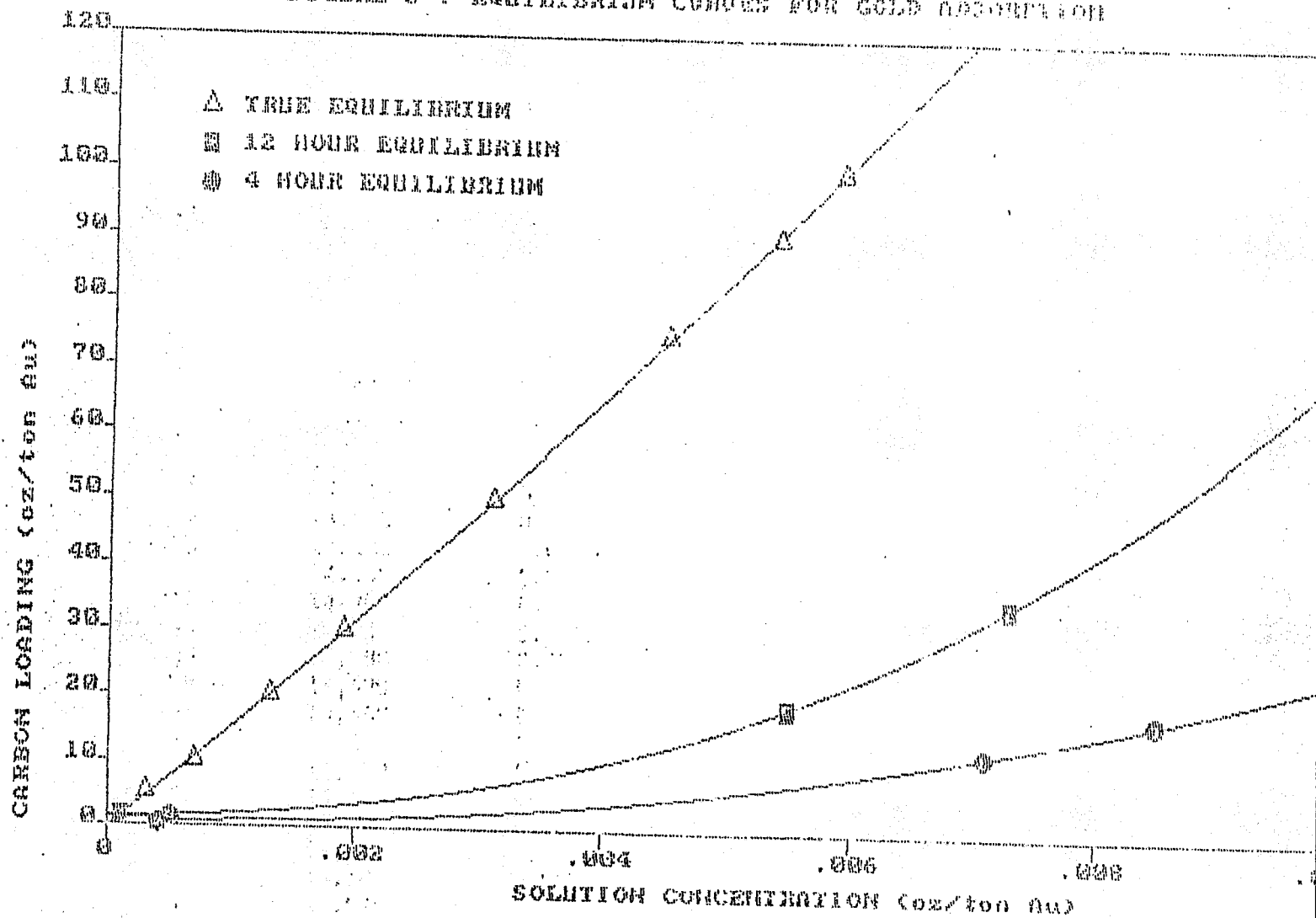


TABLE 1 - TEST CONDITIONS FOR ADSORPTION RATE BATCH TESTS

TEST #	VOLUME of SOLUTION (L)	CARBON (g)	W/M
1a	15	1	15,000
2a	2	0.4	5,000
3a	2	13.33	150
4a	2	40	50

Where W/M = weight ratio of solution to carbon.

TABLE 2 - TEST 1a : ADSORPTION RATE DATA

TIME (HR)	W/M	SOLUTION Au,oz/ton	CARBON Au,oz/ton
0	15,000	0.0097	0.000
1	14,940	0.0088	13.446
2	14,880	0.0086	16.422
4	14,820	0.0085	17.904
7	14,760	0.0081	23.808
11	14,700	0.0074	34.098
23	14,640	0.0066	45.810
25	14,580	0.0060	54.558
28	14,520	0.0068	42.942
31	14,460	0.0066	45.834
47	14,400	0.0057	58.794
49	14,340	0.0058	57.360
51	14,280	0.0055	61.644
53	14,220	0.0054	63.066
55	14,160	0.0054	63.066
56	14,100	0.0051	67.296
58	14,040	0.0047	72.912
61	13,980	0.0052	65.922
63	13,920	0.0051	67.314
79	13,860	0.0045	75.630
81	13,800	0.0043	78.390
83	13,740	0.0046	74.268
85	13,680	0.0046	74.268
87	13,620	0.0045	75.630
103	13,560	0.0044	76.986

Carbon assayed 65.70 oz/ton.

TABLE 3 - TEST 2a : ADSORPTION RATE DATA

<u>TIME</u> <u>(HR)</u>	<u>W/M</u>	<u>SOLUTION</u> <u>Au, oz/ton</u>	<u>CARBON</u> <u>Au, oz/ton</u>
0	5,000	0.0097	0.000
1	4,850	0.0084	6.305
2	4,700	0.0080	8.185
4	4,550	0.0071	12.280
7	4,400	0.0064	15.360
11	4,250	0.0056	18.760
23	4,100	0.0045	23.270
25	3,950	0.0037	26.430
28	3,800	0.0044	23.770
31	3,650	0.0041	24.865
47	3,500	0.0032	28.015
49	3,350	0.0032	28.015
51	3,200	0.0030	28.655
53	3,050	0.0027	29.570
55	2,900	0.0026	29.860
56	2,750	0.0024	30.410
58	2,600	0.0022	30.930
61	2,450	0.0021	31.175
63	2,300	0.0021	31.175
79	2,150	0.0017	32.035
81	2,000	0.0018	31.835
83	1,850	0.0020	31.465
85	1,700	0.0020	31.465
87	1,550	0.0020	31.465
103	1,400	0.0017	31.885

Carbon assayed 17.76 oz/ton Au.

TABLE 4 - TEST 3a : ADSORPTION RATE DATA

<u>TIME (HR)</u>	<u>W/M</u>	<u>SOLUTION Au,oz/ton</u>	<u>CARBON Au,oz/ton</u>
0	150.00	0.0097	0.000
1	145.54	0.0018	1.150
2	141.04	0.0006	1.319
4	136.53	0.0005	1.333
8	132.03	0.0004	1.346
12	127.53	0.0001	1.384
14	123.03	0.0001	1.384

Carbon assayed 1.9 oz/ton Au.

TABLE 5 - TEST 4a : ADSORPTION RATE DATA

<u>TIME (HR)</u>	<u>W/M</u>	<u>SOLUTION Au,oz/ton</u>	<u>CARBON Au,oz/ton</u>
0	50.00	0.0097	0.000
1	48.50	0.0005	0.446
2	47.00	0.0004	0.451
4	45.50	0.0004	0.451
8	44.00	0.0004	0.451
12	42.50	0.0001	0.464
14	41.00	0.0001	0.464

Carbon assayed 0.9 oz/ton Au.

TABLE 6- END POINT DATA OF BATCH TESTS 1a to 4a : CARBON GOLD CALCULATED

<u>TEST #</u>	<u>TIME (hours)</u>	<u>SOLUTION Au,oz/ton</u>	<u>CARBON Au,oz/ton</u>
1a	80	0.0043	78.39
2a	81	0.0018	31.47
3a	8	0.0004	1.35
4a	12	0.0001	0.46

TABLE 7 - END POINT DATA OF BATCH TESTS 1a to 4a : CARBON GOLD ASSAYED

<u>TEST #</u>	<u>TIME (hours)</u>	<u>SOLUTION Au,oz/ton</u>	<u>CARBON Au,oz/ton</u>
1a	87	0.0045	65.70
2a	83	0.0020	17.76
3a	12	0.0001	1.90
4a	12	0.0001	0.90