60001898

Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	1991 Rosebud Project metallurgical tests
AUTHOR	Macy F; Kuhl T
DATE OF DOC(S)	1991-1992
MULTI_DIST Y / N? Additional Dist_Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Rosebud Project McClelland Laboratories, Inc Lac Minerals (USA) Inc
COMMODITY If not obvious	gold; silver
NOTES	Metallurgical test report; correspondence; assays 57p.

Keep docs at about 250 pages if no oversized maps attached
(for every 1 oversized page (>11x17) with text reduce
the amount of pages by ~25)

SS: DP 9/9/08
Initials Date

DB:
Initials Date

SCANNED:
Initials Date

Revised: 1/22/08

1991
Rosebud Project
Metallurgical Tests

McClelland Laboratories, Inc.
1991

McCLELLAND LABORATORIES, INC.

1016 Greg Street, Sparks, Nevada 89431 702 / 356-1300
FAX 702 / 356-8917

January 6, 1992

Mr. Tim Kuhl
LAC MINERALS (USA), INC.
1395 Greg Street, Suite 107
Sparks, NV 89431

Dear Tim:

Enclosed is our report concerning metallurgical results obtained from direct and CIL/cyanidation testwork conducted on the Rosebud core composites. An original of this report was sent to Mr. George Hope.

Enclosed also is our invoice (MLI Job No. 1668/1911) for the testwork.

Thank you for allowing us another opportunity to serve you on the Rosebud project.

Sincerely,

Frank

Frank A. Macy
Project Manager

FAM:aak
Enclosure

McCLELLAND LABORATORIES, INC.

1016 Greg Street, Sparks, Nevada 89431 702 / 356-1300
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Report
on
Direct and CIL/Cyanidation Testwork -
Rosebud Core Composites
MLI Job No. 1668
January 6, 1992

for

Mr. Tim Kuhl
LAC Minerals (USA), Inc.
1395 Greg Street, Suite 107
Sparks, NV 89431

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Report
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LAC Minerals (USA), Inc.
1395 Greg Street, Suite 107
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EXECUTIVE SUMMARY

Direct agitated cyanidation (bottle roll) tests were conducted on twelve Rosebud core composites at a pulverized nominal 200 mesh feed size to determine precious metal recovery, recovery rate, and reagent requirements. Metallurgical results show that the core composites were readily amenable to direct cyanidation treatment at that feed size. Gold recoveries ranged from 79.4 to 97.3 percent, and averaged 92.6 percent, in 48 hours of leaching. Silver recoveries ranged from 27.9 to 86.2 percent, and averaged 62.8 percent. Precious metal recovery rates were fairly rapid for composites 3 through 7 and composite 9, and extraction was substantially complete in from 12 to 24 hours. Gold and silver recovery rates were fairly slow for the remaining composites and extraction was progressing at a slower rate when leaching was terminated at 48 hours. Cyanide consumptions were low to moderate and averaged 0.63 pounds per ton of ore. Lime requirements were low and averaged 4.6 pounds per ton of ore.

Duplicate CIL/cyanidation tests were conducted on two Rosebud core composites (RL-100C and RL-104C) at a stage ground 80 percent minus 200 mesh feed size to determine precious metal recovery, recovery rate, reagent requirements, and the effect of pre-aeration with oxygen and $PbNO_3$ addition on overall precious metal recovery. All tests were conducted with continuous oxygen sparging to insure sufficient dissolved oxygen content for precious metal dissolution. Initial tests were conducted using standard CIL procedures at a pH of between 10.0 and 10.3. Subsequent (duplicate) tests were conducted using the same procedures, except pulps (pH 9.5 to 10.0) were pretreated with oxygen and $PbNO_3$ (0.1 kilogram per ton of ore) for four hours before adjusting pH to 10.3 and adding cyanide and carbon.

Metallurgical results showed that composites RL-100C and RL-104C were amenable to conventional CIL/cyanidation treatment at an 80 percent minus 200 mesh feed size. Gold recoveries of 84.4 and 82.1 percent, respectively, were achieved in 72 hours of leaching. Respective silver recoveries were 48.4 and 52.4 percent. Pretreatment with oxygen and $PbNO_3$ was not effective in increasing overall gold recovery. Gold recoveries by pretreatment and subsequent CIL/cyanidation decreased slightly to 81.7 and 79.1 percent for composites RL-100C and RL-104C, respectively. Silver recoveries increased to 53.2 and 60.0 percent, respectively. The increase in silver recovery was probably the result of $PbNO_3$ addition.

Gold recovery rates were fairly rapid and extraction was substantially complete in from 2 to 4 hours. Silver recovery rates were fairly rapid for the composite RL-104C feeds, but were fairly slow for the RL-100C feeds. Cyanide consumptions were high. Lime requirements were low.

COMPOSITE PREPARATION AND HEAD ASSAYS

A total of eighty-eight (4 to 5 foot) crushed Rosebud core intervals were received for compositing and subsequent direct agitated cyanidation testwork. Twelve core composites were prepared, on a weighted (footage) basis, according to instructions provided by LAC Minerals personnel. Composites were thoroughly blended and split to obtain 1 kilogram for a bottle roll test, and samples for triplicate direct head assay. Composite make-up and predicted head grades for the twelve composites are provided in Tables 1 through 12.

A total of 43 (3.7 to 7 foot) crushed Rosebud core intervals were available at MLI from a previous testing program (MLI report dated February 19, 1991). Two composites (RL-100C and RL-104C) were prepared, according to instructions provided by LAC Minerals personnel, for additional CIL/cyanidation testwork. Composite make-up was essentially the same as for the previous testing program, except that RL-100C intervals 945.5-949.5' and 996-1001.5' were consumed in preparing the initial composite. Composites were thoroughly blended and split to obtain two 1.5 kilogram samples for CIL/cyanidation tests, and samples for triplicate direct head assay. Composite make-up and predicted head grades are provided in Tables 13 through 14.

Twenty-eight Rosebud core pieces were received for bulk density measurement. Bulk densities were determined using the volume displacement method and were checked using the weight differential method. Bulk density determinations are provided in Tables 15 and 16.

Head samples were assayed directly using conventional fire assay fusion procedures to determine precious metal content. Gold and silver head assay results and head grade comparisons are provided in Tables 17 through 19.

Table 1. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 1, RL168-91

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-168	555 - 560	5	14.3	1880	500	0.510	6.19	5.6	37.9
RL-168	560 - 565	5	14.3	1040	500	0.089	0.51	1.0	3.1
RL-168	565 - 570	5	14.3	1100	500	0.579	1.25	6.3	7.6
RL-168	570 - 575	5	14.3	1420	500	2.632	2.66	28.9	16.3
RL-168	575 - 580	5	14.3	1580	500	4.928	5.25	54.0	32.1
RL-168	580 - 585	5	14.3	840	500	0.166	0.12	1.8	0.7
RL-168	585 - 590	5	14.3	1500	500	0.217	0.37	2.4	2.3
7	35	35	100.1	9360	3500	1.303	2.34	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 2. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 2, RL170-91

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-170	615 - 620	5	14.3	9220	500	0.199	0.90	19.5	17.4
RL-170	620 - 625	5	14.3	7780	500	0.140	0.47	13.7	9.1
RL-170	625 - 630	5	14.3	7000	500	0.074	0.20	7.2	7.6
RL-170	630 - 635	5	14.3	6960	500	0.203	0.48	19.8	3.9
RL-170	635 - 640	5	14.3	8200	500	0.203	1.91	19.8	36.9
RL-170	640 - 645	5	14.3	8140	500	0.074	0.80	7.2	15.5
RL-170	645 - 650	5	14.3	1260	500	0.130	0.41	12.7	7.9
7	35	35	100.1	48560	3500	0.146	0.74	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 3. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 3, RL193C-91-1

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-193C	553 - 558	5	20.0	4660	500	0.130	1.33	2.3	3.9
RL-193C	558 - 563	5	20.0	3400	500	2.384	3.63	41.4	10.6
RL-193C	563 - 568	5	20.0	3080	500	2.075	6.33	36.0	18.4
RL-193C	573 - 578	5	20.0	3780	500	0.555	12.86	9.6	37.4
RL-193C	578 - 583	5	20.0	4320	500	0.615	10.20	10.7	29.7
5	25	25	100.0	19240	2500	1.152	6.87	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 4. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 4, RL193C-91-2

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-193C	608 - 613	5	16.7	4400	500	0.343	8.61	2.1	25.1
RL-193C	613 - 618	5	16.7	4040	500	0.165	6.26	1.0	18.2
RL-193C	618 - 623	5	16.7	4520	500	12.281	14.84	75.9	43.3
RL-193C	623 - 628	5	16.7	860	500	3.122	3.97	19.3	11.6
RL-193C	628 - 633	5	16.7	4280	500	0.180	0.40	1.1	1.2
RL-193C	633 - 638	5	16.7	4340	500	0.089	0.21	0.6	0.6
6	30	30	100.2	22440	2500	2.697	5.72	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 5. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 5, RL193C-91-3

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-193C	668 - 673	5	10.4	1400	500	0.134	0.47	5.5	10.7
RL-193C	673 - 678	5	10.4	4660	500	0.156	0.25	6.5	5.7
RL-193C	678 - 683	5	10.4	4620	500	0.084	0.31	3.5	7.0
RL-193C	683 - 688	5	10.4	5320	500	0.332	0.58	13.8	13.2
RL-193C	688 - 693	5	10.4	4480	500	0.247	0.70	10.2	16.0
RL-193C	693 - 698	5	10.4	4620	500	0.599	0.59	24.8	13.4
RL-193C	698 - 703	5	10.4	4860	500	0.395	0.70	16.4	16.0
RL-193C	703 - 708	5	10.4	3820	500	0.152	0.50	6.3	11.4
RL-193C	708 - 712	4	8.4	3820	400	0.101	0.13	3.4	2.4
RL-193C	712 - 716	4	8.4	3600	400	0.287	0.23	9.6	4.2
10	48	48	100.0	41200	4800	0.251	0.46	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 6. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 6, RL195C

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-195C	608 - 613	5	12.5	4580	500	0.256	0.58	20.5	20.6
RL-195C	613 - 618	5	12.5	4380	500	0.040	0.04	3.2	1.4
RL-195C	618 - 623	5	12.5	5080	500	0.006	0.13	0.5	4.6
RL-195C	623 - 628	5	12.5	3720	500	0.307	0.63	24.6	22.3
RL-195C	628 - 633	5	12.5	5480	500	0.086	0.19	6.9	6.7
RL-195C	633 - 638	5	12.5	5060	500	0.098	0.10	7.9	3.6
RL-195C	648 - 653	5	12.5	4620	500	0.173	0.58	13.9	20.6
RL-195C	653 - 658	5	12.5	4580	500	0.281	0.57	22.5	20.2
8	40	40	100.0	37500	4000	0.156	0.35	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 7. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 7, RL123C

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-123C	542 - 547	5	16.7	2900	500	0.234	0.49	7.0	0.8
RL-123C	547 - 552	5	16.7	3020	500	1.591	6.76	47.5	11.8
RL-123C	552 - 557	5	16.7	2680	500	0.337	13.15	10.1	22.9
RL-123C	557 - 562	5	16.7	2720	500	0.584	20.72	17.4	36.1
RL-123C	562 - 567	5	16.7	2380	500	0.216	3.54	6.5	6.2
RL-123C	567 - 572	5	16.7	2840	500	0.386	12.74	11.5	22.2
6	30	30	100.2	16540	3000	0.558	9.57	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 8. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 8, RL57

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-57	550 - 555	5	20.0	7980	1000	0.281	0.89	5.8	10.3
RL-57	555 - 560	5	20.0	17460	1000	1.121	2.35	23.1	27.1
RL-57	560 - 565	5	20.0	10820	1000	1.697	3.01	34.9	34.7
RL-57	565 - 570	5	20.0	14520	1000	1.203	1.47	24.7	16.9
RL-57	570 - 575	5	20.0	10960	1000	0.557	0.96	11.5	11.0
5	25	25	100.0	61740	5000	0.972	1.74	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 9. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 9, RL130C

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-130C	572 - 577	5	14.3	2780	500	0.537	1.63	15.1	5.0
RL-130C	577 - 582	5	14.3	2180	500	0.204	0.71	5.7	2.2
RL-130C	582 - 587	5	14.3	2480	500	0.118	0.43	3.3	1.3
RL-130C	587 - 592	5	14.3	2360	500	0.806	2.17	22.7	6.6
RL-130C	592 - 597	5	14.3	2500	500	0.248	0.90	7.0	2.7
RL-130C	597 - 602	5	14.3	2560	500	1.422	22.31	40.0	68.1
RL-130C	602 - 607	5	14.3	2880	500	0.222	4.61	6.2	14.1
7	35	35	100.2	17740	3500	0.508	4.68	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 10. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 10, RL186

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-186	645 - 650	5	7.7	7370	1000	0.187	10.10	6.7	23.1
RL-186	650 - 655	5	7.7	12830	1000	0.429	26.50	15.3	60.6
RL-186	655 - 660	5	7.7	10570	1000	0.363	1.03	13.0	2.4
RL-186	660 - 665	5	7.7	10570	1000	0.096	0.59	3.4	1.3
RL-186	665 - 670	5	7.7	11000	1000	0.151	0.66	5.4	1.5
RL-186	670 - 675	5	7.7	9520	1000	0.410	0.67	14.7	1.5
RL-186	675 - 680	5	7.7	11400	1000	0.081	0.22	2.9	0.5
RL-186	680 - 685	5	7.7	13470	1000	0.469	1.03	16.8	2.4
RL-186	685 - 690	5	7.7	8800	1000	0.109	0.25	3.9	0.6
RL-186	690 - 695	5	7.7	11400	1000	0.162	0.32	5.8	0.7
RL-186	695 - 700	5	7.7	7390	1000	0.123	1.09	4.4	2.5
RL-186	700 - 705	5	7.7	11770	1000	0.119	0.82	4.3	1.9
RL-186	705 - 710	5	7.7	10520	1000	0.095	0.43	3.4	1.0
13	65	65	100.1	136610	13000	0.215	3.36	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 11. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 11 RL198C

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-198C	570 - 575	5	16.7	2700	1180	0.593	1.08	5.5	8.4
RL-198C	575 - 580	5	16.7	2860	1180	1.724	2.63	15.9	20.4
RL-198C	580 - 585	5	16.7	2090	1180	4.274	3.98	39.4	30.9
RL-198C	585 - 590	5	16.7	2270	1180	2.230	2.60	20.6	20.2
RL-198C	595 - 600	5	16.7	1180	1180	0.842	1.18	7.8	9.2
RL-198C	600 - 605	5	16.7	2580	1180	1.174	1.40	10.8	10.9
6	30	30	100.2	13680	7080	1.806	2.15	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 12. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 12, RL201C

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-201C	675 - 679.3	4.3	11.3	3970	1030	0.581	0.42	12.5	9.5
RL-201C	679.3 - 684	4.7	12.4	4440	1080	0.486	0.18	11.5	4.4
RL-201C	684 - 688	4.0	10.5	930	930	0.013	0.02	0.3	0.4
RL-201C	688 - 693	5.0	13.2	2020	1160	0.483	0.48	12.2	12.7
RL-201C	693 - 698	5.0	13.2	1720	1160	1.161	2.17	29.2	57.5
RL-201C	698 - 703	5.0	13.2	2520	1170	0.460	0.30	11.6	8.1
RL-201C	703 - 708	5.0	13.2	2430	1170	0.786	0.18	19.8	4.8
RL-201C	708 - 713	5.0	13.2	1930	1170	0.117	0.10	2.9	2.6
8	38	38.0	100.2	19960	8870	0.524	0.50	100.0	100.0

* Interval assays provided by LAC Minerals.

Table 13. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 13, RL100C

Hole No.	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* oz/ton Au	Assays,* oz/ton Ag	Contribution to Comp, pct. Au	Contribution to Comp, pct. Ag
RL-100C	930.5 - 936.5	6	6.90	540	404	0.263	0.29	9.3	0.2
RL-100C	936.5 - 940.5	4	4.60	880	269	0.350	0.65	8.2	0.2
RL-100C	940.5 - 945.5**	5	5.75	760	337	0.123	0.10	3.6	0.0
RL-100C	949.5 - 955	5.5	6.32	370	370	0.321	0.60	10.4	0.3
RL-100C	955 - 960	5	5.75	565	337	0.189	0.18	5.6	0.1
RL-100C	960 - 965	5	5.75	680	337	0.330	0.71	9.7	0.3
RL-100C	965 - 970.5	5.5	6.32	485	370	0.013	0.10	0.4	0.0
RL-100C	970.5 - 976	5.5	6.32	525	370	0.059	0.11	1.9	0.1
RL-100C	976 - 981	5	5.75	630	337	0.116	0.10	3.4	0.0
RL-100C	981 - 986	5	5.75	675	337	0.107	0.29	3.2	0.1
RL-100C	986 - 991	5	5.75	440	337	0.300	0.70	8.9	0.3
RL-100C	991 - 996**	5	5.75	665	337	0.430	2.54	12.6	1.1
RL-100C	1001.5 - 1006.5	5	5.75	825	337	0.020	1.88	0.6	0.8
RL-100C	1006.5 - 1011.5	5	5.75	740	337	0.039	5.77	1.1	2.6
RL-100C	1011.5 - 1016.5	5	5.75	590	337	0.540	73.03	15.9	32.7
RL-100C	1016.5 - 1022	5.5	6.32	885	370	0.112	117.50	3.6	57.8
RL-100C	1022 - 1027	87	5.75	835	337	0.055	7.13	1.6	3.2
17	87	87	100.03	11090	5860	0.196	12.84	100.0	99.8

* Interval assays provided by LAC Minerals.
** Next interval consumed in preparing earlier composite.

Table 14. - Composite Make-Up and Predicted Head Grade, Rosebud Core Composite 14, RL104C

Hole No	Interval, ft	Total, ft	Footage, percent	Interval Wt. Grams Avail	Interval Wt. Grams To Comp	Assays,* ozAu/ton	Au Contribution to Comp., pct.
RL-104C	742 - 747	5	3.85	2267	385	0.064	1.2
RL-104C	747 - 754	7	5.38	2145	538	0.009	0.2
RL-104C	754 - 759	5	3.85	2603	385	0.106	2.0
RL-104C	759 - 763.3	4.3	3.31	1117	331	0.994	15.8
RL-104C	763.3 - 767	3.7	2.85	1672	285	0.490	6.7
RL-104C	767 - 772	5	3.85	2193	385	0.339	6.3
RL-104C	772 - 777.2	5.2	4.00	1798	400	0.026	0.5
RL-104C	777.2 - 782	4.8	3.69	1734	369	0.174	3.3
RL-104C	782 - 787	5	3.85	1899	385	0.007	0.1
RL-104C	787 - 792	5	3.85	1702	385	0.042	0.8
RL-104C	792 - 797	5	3.85	1529	385	0.007	0.2
RL-104C	797 - 802	5	3.85	1078	385	0.001	0.0
RL-104C	802 - 807	5	3.85	1890	385	0.001	0.0
RL-104C	807 - 812	5	3.85	1650	385	0.107	2.0
RL-104C	812 - 817	5	3.85	1544	385	0.340	6.3
RL-104C	817 - 822	5	3.85	1463	385	0.189	3.5
RL-104C	822 - 827	5	3.85	1125	385	1.786	33.1
RL-104C	827 - 833.2	6.2	4.77	2888	477	0.068	1.5
RL-104C	833.2 - 837	3.8	2.92	1261	292	0.212	3.0
RL-104C	837 - 842	5	3.85	2481	385	0.144	2.6
RL-104C	842 - 847	5	3.85	1932	385	0.085	1.6
RL-104C	847 - 852.6	5.6	4.31	2401	431	0.105	0.8
RL-104C	852.6 - 857	4.4	3.38	1462	338	0.215	3.5
RL-104C	857 - 862	5	3.85	2307	385	0.045	0.8
RL-104C	862 - 867	5	3.85	1992	385	0.174	3.2
RL-104C	867 - 872	5	3.85	1440	385	0.046	0.9
26	130	130	100.06	47573	10006	0.208	99.9

* Interval assays provided by LAC Minerals. Silver values not reported because a number of intervals were below detection levels.

Table 15. - Bulk Density Results, East Zone Core Samples, Volume Displacement Method

Hole No.	Intercept, ft.	Specific Gravity	Bulk Density, lb/cu. ft	Bulk Density, cu.ft./ton	Ambient Moisture, Wt., pct.
RL-191C	625.4 - 625.9	2.60	162.2	12.3	0.66
RL-191C	715.9 - 716.4	2.24	139.8	14.3	0.84
RL-198C	572.55 - 573.05	2.26	141.0	14.2	1.41
RL-198C	589.95 - 590.4	2.73	170.4	11.7	0.40
RL-198C	596.9 - 597.35	2.09	130.4	15.3	0.92
RL-201C	590.2 - 590.625	2.23	139.2	14.4	1.01
RL-201C	678.12 - 678.6	2.67	166.6	12.0	0.34
RL-201C	690.9 - 691.3	2.44	152.3	13.1	0.61
RL-206C	696.8 - 697.3	2.25	140.4	14.2	0.76
RL-206C	698.5 - 699	2.32	144.8	13.8	0.82
RL-206C	781.25 - 781.7	2.65	165.4	12.1	0.75
RL-207C	665.3 - 665.73	2.12	132.3	15.1	1.37
RL-207C	774.6 - 775	2.40	149.8	13.4	0.76
RL-243C	716.7 - 717.1	2.21	137.9	14.5	1.74
RL-243C	748.3 - 748.75	2.40	149.8	13.4	1.06

Table 16. - Bulk Density Results, South Zone Core Samples, Volume Displacement Method

Hole No.	Intercept, ft.	Specific Gravity	Bulk Density, lb/cu. ft	Bulk Density, cu.ft./ton	Ambient Moisture, Wt., pct.
RL-101C	1026.6 - 1027	2.67	166.6	12.0	0.94
RL-123C	547.3 - 547.8	2.38	148.5	13.5	0.46
RL-192C	488.4 - 488.75	2.45	152.9	13.1	0.46
RL-193C	563.1 - 563.5	2.10	131.0	15.3	1.06
RL-195C	629.35 - 629.7	2.29	142.9	14.0	0.70
RL-196C	474 - 474.45	2.03	126.7	15.8	1.23
RL-197C	860.15 - 860.5	2.14	133.5	15.0	1.58
RL-197C	862.5 - 863	2.34	146.0	13.7	1.00
RL-208C	528 - 528.4	2.36	147.3	13.6	1.04
RL-209C	461 - 461.4	2.34	146.0	13.7	0.59
RL-209C	550 - 550.3	2.31	144.1	13.9	0.68
RL-210C	415 - 415.4	1.86	116.1	17.2	2.09
RL-210C	425.5 - 425.95	2.48	154.8	12.9	0.62

Table 17. - Gold Head Assay Results and Head Grade Comparisons, Rosebud Core Composites

	Head Grade, ozAu/ton											
	Composite Number											
Determination Method	1	2	3	4	5	6	7	8	9	10	11	12
Predicted[1]	1.303	0.146	1.152	2.697	0.251	0.156	0.558	0.972	0.508	0.215	1.806	0.524
Direct Assay, Init.	1.131	0.186	1.030	2.650	0.294	0.172	0.523	1.347[2]	0.467	0.208	1.726	0.524
Direct Assay, Dup.	1.101	0.152	0.978[2]	2.879	0.276[2]	0.145	0.705[2]	0.757	0.375[2]	0.225	1.910[2]	0.512
Direct Assay, Trip.	0.944[2]	0.142[2]	1.006	3.102	0.306	0.134[2]	0.560	0.711	0.478	0.267	1.540	0.533
Calc'd, Bottle Test	1.166	0.179	1.065	3.461[2]	0.297	0.163	0.598	1.064	0.460	0.194[2]	1.681	0.482[2]
Arithmetic Average	1.086	0.165	1.020	3.023	0.293	0.154	0.597	0.970	0.445	0.224	1.714	0.513
Max. Dev. from Avg.	0.142	0.023	0.045	0.438	0.017	0.020	0.108	0.377	0.070	0.030	0.196	0.031
Precision, percent	86.9	86.1	95.9	87.3	94.2	87.0	84.7	72.0	84.3	86.6	89.7	94.0

1) Predicted grade based on weighted average interval assays provided by LAC Minerals (not included in average).
2) Maximum deviation from average occurred with this head grade determination.

Table 18. - Silver Head Assay Results and Head Grade Comparisons, Rosebud Core Composites

	Head Grade, ozAg/ton											
	Composite Number											
Determination Method	1	2	3	4	5	6	7	8	9	10	11	12
Predicted[1]	2.34	0.74	6.87	5.72	0.46	0.35	9.57	1.74	4.68	3.36	2.15	0.50
Direct Assay, Init.	1.97	0.70	7.37	4.95	0.32	0.20	8.72	1.44[2]	3.84[2]	6.03	3.62	0.77[2]
Direct Assay, Dup.	1.95	0.61	7.44	5.39	0.30[2]	0.13[2]	12.60[2]	0.93	4.11	6.46	2.55	0.49
Direct Assay, Trip.	1.69[2]	0.55[2]	7.11	5.75	0.38	0.29	9.04	0.91	3.90	7.25[2]	3.96	0.33
Calc'd, Bottle Test	1.87	0.65	8.75[2]	6.22[2]	0.40	0.35	8.40	1.27	4.08	5.67	2.17[2]	0.55
Arithmetic Average	1.87	0.63	7.67	5.58	0.35	0.24	9.69	1.14	3.98	6.35	3.08	0.54
Max. Dev. from Avg.	0.18	0.08	1.08	0.64	0.05	0.11	2.91	0.30	0.14	0.90	0.91	0.23
Precision, percent	90.4	87.3	87.7	89.7	85.7	54.2	76.9	79.2	96.5	87.6	70.5	70.1

1) Predicted grade based on weighted average interval assays provided by LAC Minerals (not included in average).
2) Maximum deviation from average occurred with this head grade determination.

Table 19. - Head Assay Results and Head Grade Comparisons, Rosebud Core Composites

	Head Grade, oz/ton			
	RL-100C		RL-104C	
Determination Method	Au	Ag	Au	Ag
Predicted[1)]	0.196	12.84	0.208	N/A
Direct Assay, Initial	0.227[2)]	14.22[2)]	0.215	0.23
Duplicate	0.160	9.41	0.144	0.17[2)]
Triplicate	0.194	10.31	0.127[2)]	0.21
Calculated, Standard CIL/CN^- Test	0.205	11.39	0.184	0.21
Calculated, CIL/CN^- Test (w/$PbNO_3$)	0.153	11.16	0.196	0.20
Arithmetic Average	0.188	11.30	0.173	0.20
Maximum Deviation from Average	0.039	2.92	0.046	0.03
Precision, percent	82.8	79.5	73.4	85.0

1) Predicted grade based on weighted average interval assays provided by LAC Minerals (not included in average).
2) Maximum deviation from average occurred with this head grade determination.

Head grades determined by the various methods, in general, agreed fairly closely. Gold occurrence was somewhat "spotty", especially for composites 8 and RL-104C. "Spottiness" could be caused by visible gold particles contained in the feeds, or by enrichment of values in sulfide mineral particles.

DIRECT AGITATED CYANIDATION TEST PROCEDURES AND RESULTS

Direct agitated cyanidation (bottle roll) tests were conducted on twelve Rosebud core composites at a pulverized nominal 200 mesh feed size to determine precious metal recovery, recovery rate, reagent requirements, and metallurgical similarities between composites. Ore charges were mixed with water to achieve 40 weight percent solids. Natural pulp pHs were measured. Lime was added to adjust the pH of the pulps to 10.3 before adding the cyanide. Sodium cyanide, equivalent to 2.0 pounds per ton of solution, was added to the alkaline pulps.

Leaching was conducted by rolling the pulps in bottles on the laboratory rolls for 48 hours. Rolling was suspended briefly after 2, 6, 12, and 24 hours to allow the pulps to settle so samples of pregnant solution could be taken for gold and silver analysis using conventional A.A. methods. Pregnant solution volumes were measured and sampled. Cyanide concentration, dissolved oxygen, and pH were determined for each pregnant solution. Make-up water, equivalent to that withdrawn, was added to the pulps. Cyanide concentrations were restored to initial levels. Lime was added, if necessary, to maintain the leaching pH at between 10.0 and 10.5. Rolling was then resumed.

After 48 hours, pulps were filtered to separate liquids and solids. Final pregnant solution volumes were measured and sampled for analysis. Final pH and cyanide concentrations were determined. Leached residues were washed, dried, weighed, and assayed in triplicate to determine residual precious metal content.

Overall metallurgical results from the bottle roll tests are provided in Tables 20 through 24. Gold and silver leach rate profiles are shown graphically in Figures 1 through 10. Tail assay results are provided in Table 25. A summary of bottle roll test results is provided in Table 26. Leach solution data for all twelve tests are provided in Tables 27 through 38.

Table 20. - Overall Metallurgical Results, Bottle Roll Tests, Rosebud Core Composites, Nominal 200 Mesh Feeds

Metallurgical Results	Composite 1		Composite 2	
Extraction: pct. of total	Au	Ag	Au	Ag
in 2 hours	5.2	7.5	12.5	12.6
in 6 hours	15.3	18.0	28.2	23.2
in 12 hours	32.8	32.0	46.1	33.2
in 24 hours	67.2	56.3	75.8	44.6
in 48 hours	93.1	70.1	87.7	53.8
Extracted, oz/ton ore	1.085	1.31	0.157	0.35
Tail Assay, oz/ton[1)]	0.081	0.56	0.022	0.30
Calculated Head, oz/ton ore	1.166	1.87	0.160	0.62
Head Assay, oz/ton ore[2)]	1.059	1.87	0.179	0.65
Predicted Grade, oz/ton ore[3)]	1.303	2.34	0.146	0.74
Cyanide Consumed, lb/ton ore	0.88		0.10	
Lime Added, lb/ton ore	3.2		3.8	
Final Solution pH	10.1		10.1	
Natural pH (40% solids)	7.7		7.7	

1) Average of three tail assays.
2) Average of three head assays.
3) Provided by LAC Minerals personnel.

Figure 1. – Gold Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

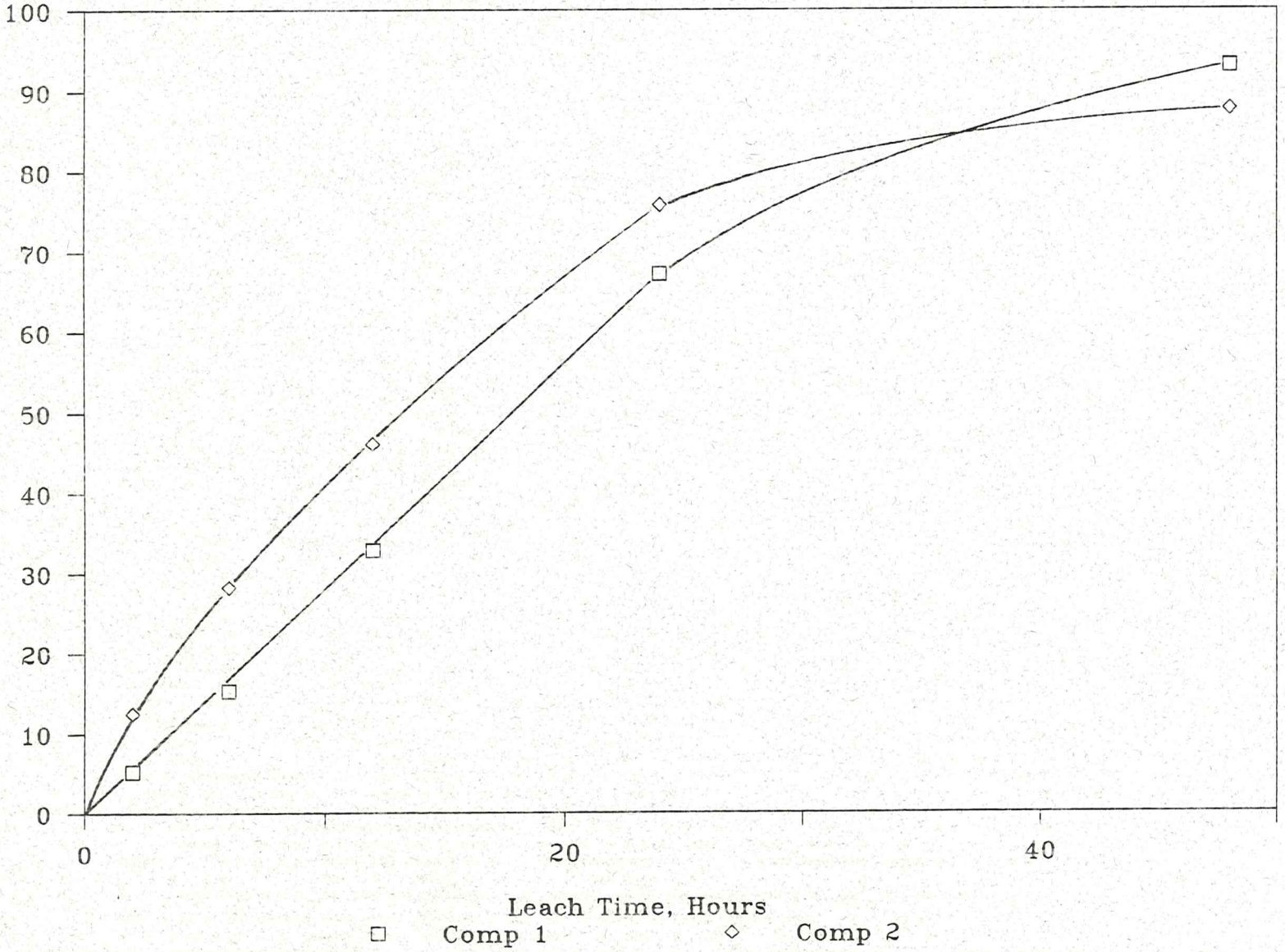


Figure 2. – Silver Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

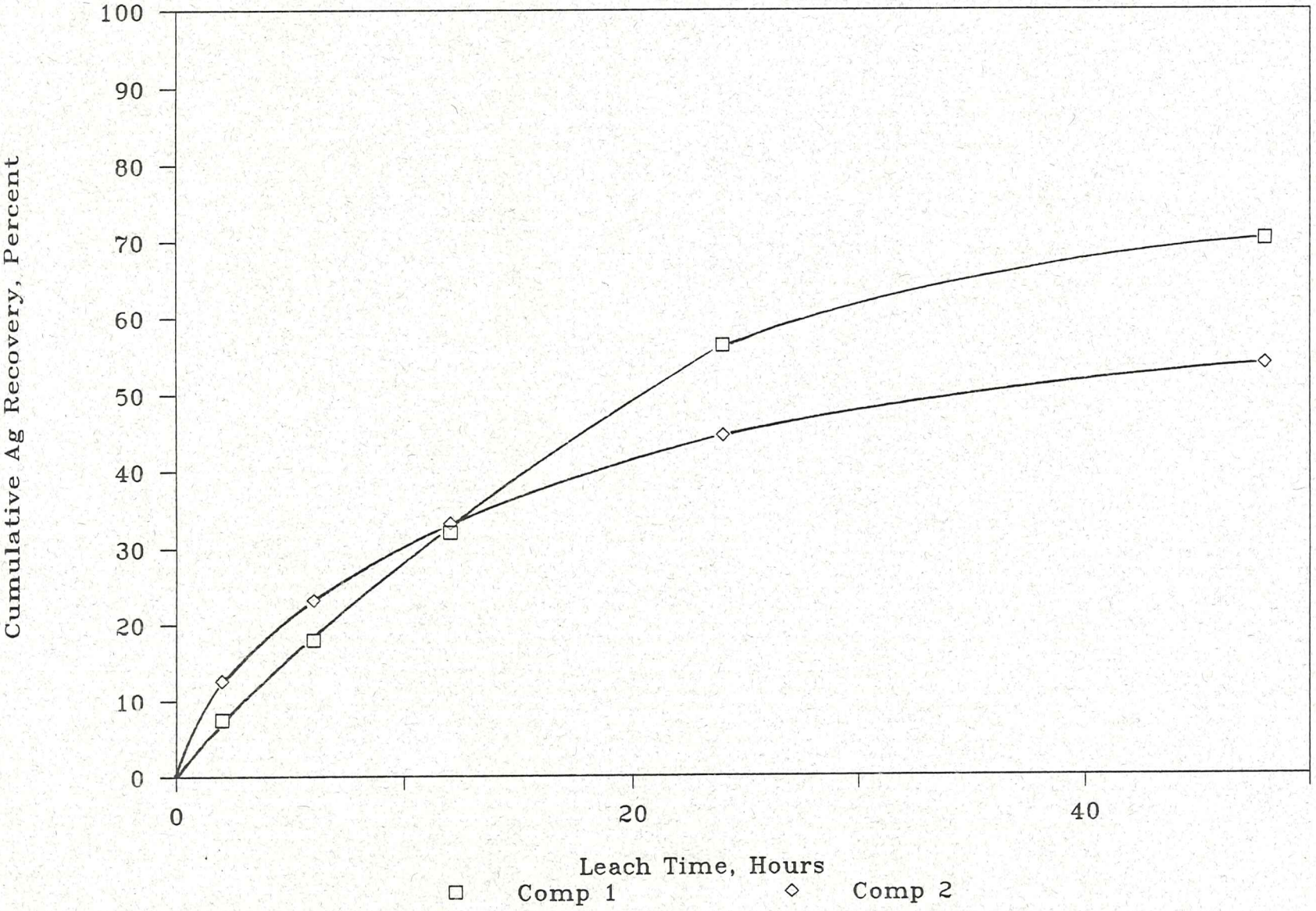


Table 21. - Overall Metallurgical Results, Bottle Roll Test, Rosebud Core Composites, Nominal 200 Mesh Feeds

	Composite					
Metallurgical Results	3		4		5	
Extraction: pct. of total	Au	Ag	Au	Ag	Au	Ag
in 2 hours	41.1	12.5	35.4	21.8	36.8	32.3
in 6 hours	73.1	21.2	63.8	39.8	59.5	53.5
in 12 hours	90.0	26.6	80.4	48.7	88.0	70.7
in 24 hours	96.7	33.2	91.6	58.6	93.3	75.0
in 48 hours	97.3	41.1	93.1	61.3	95.6	80.0
Extracted, oz/ton ore	1.036	3.60	3.221	3.81	0.284	0.32
Tail Assay, oz/ton[1)]	0.029	5.15	0.240	2.41	0.013	0.08
Calculated Head, oz/ton ore	1.065	8.75	3.461	6.22	0.297	0.40
Head Assay, oz/to ore[2)]	1.005	7.31	2.877	5.36	0.292	0.33
Predicted Grade, oz/ton ore[3)]	1.152	6.87	2.697	5.72	0.251	0.46
Cyanide Consumed, lb/ton ore	0.60		0.59		0.43	
Lime Added, lb/ton ore	5.9		3.7		5.0	
Final Solution pH	10.2		10.0		10.2	
Natural pH (40% solids)	7.5		7.8		7.6	

1) Average of three tail assays.
2) Average of three head assays.
3) Provided by LAC Minerals personnel.

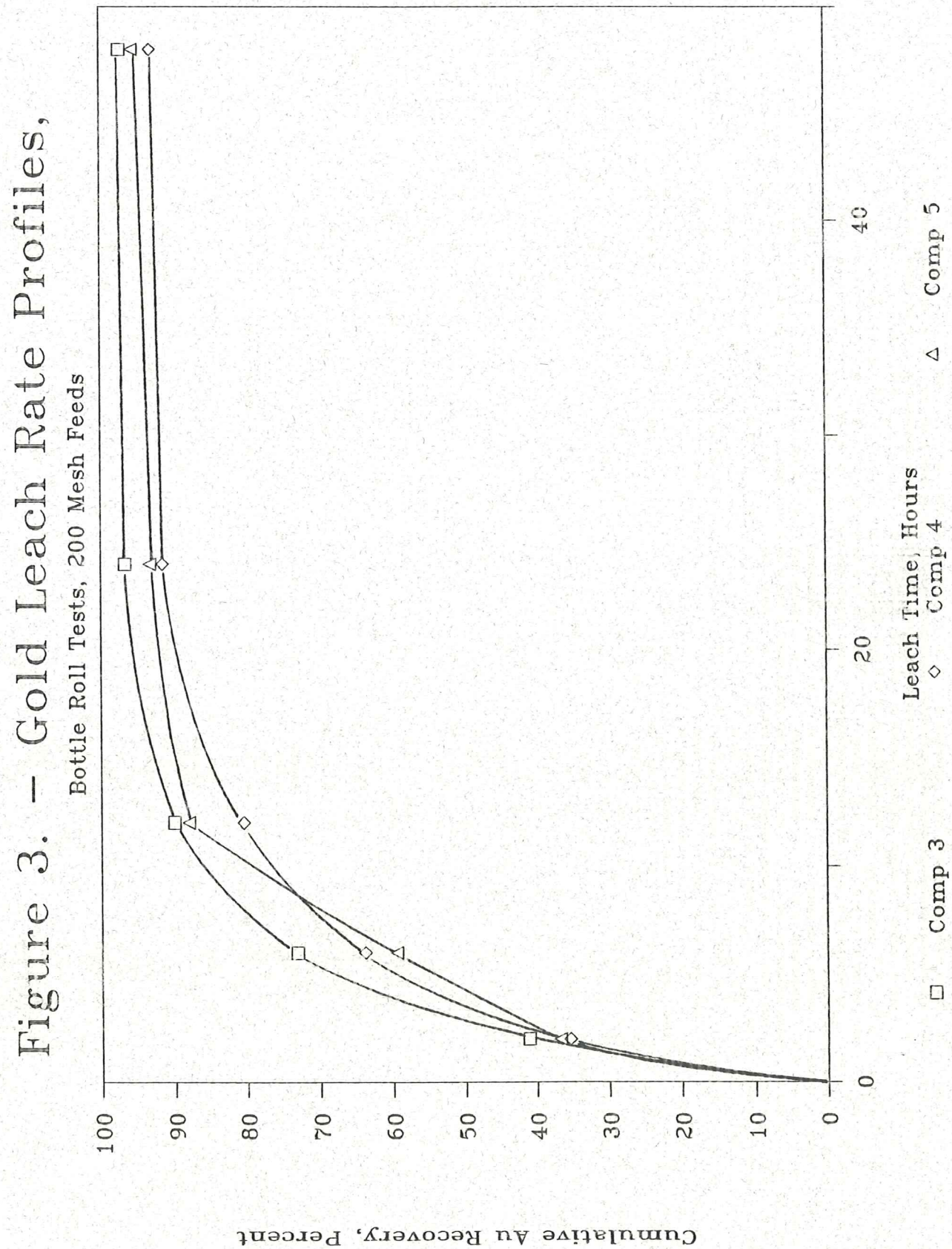


Figure 3. - Gold Leach Rate Profiles,
Bottle Roll Tests, 200 Mesh Feeds
Cumulative Au Recovery, Percent
100
90
80
70
60
50
40
30
20
10
0
0
20
40
Leach Time, Hours
□ Comp 3
◇ Comp 4
△ Comp 5

Figure 4. – Silver Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

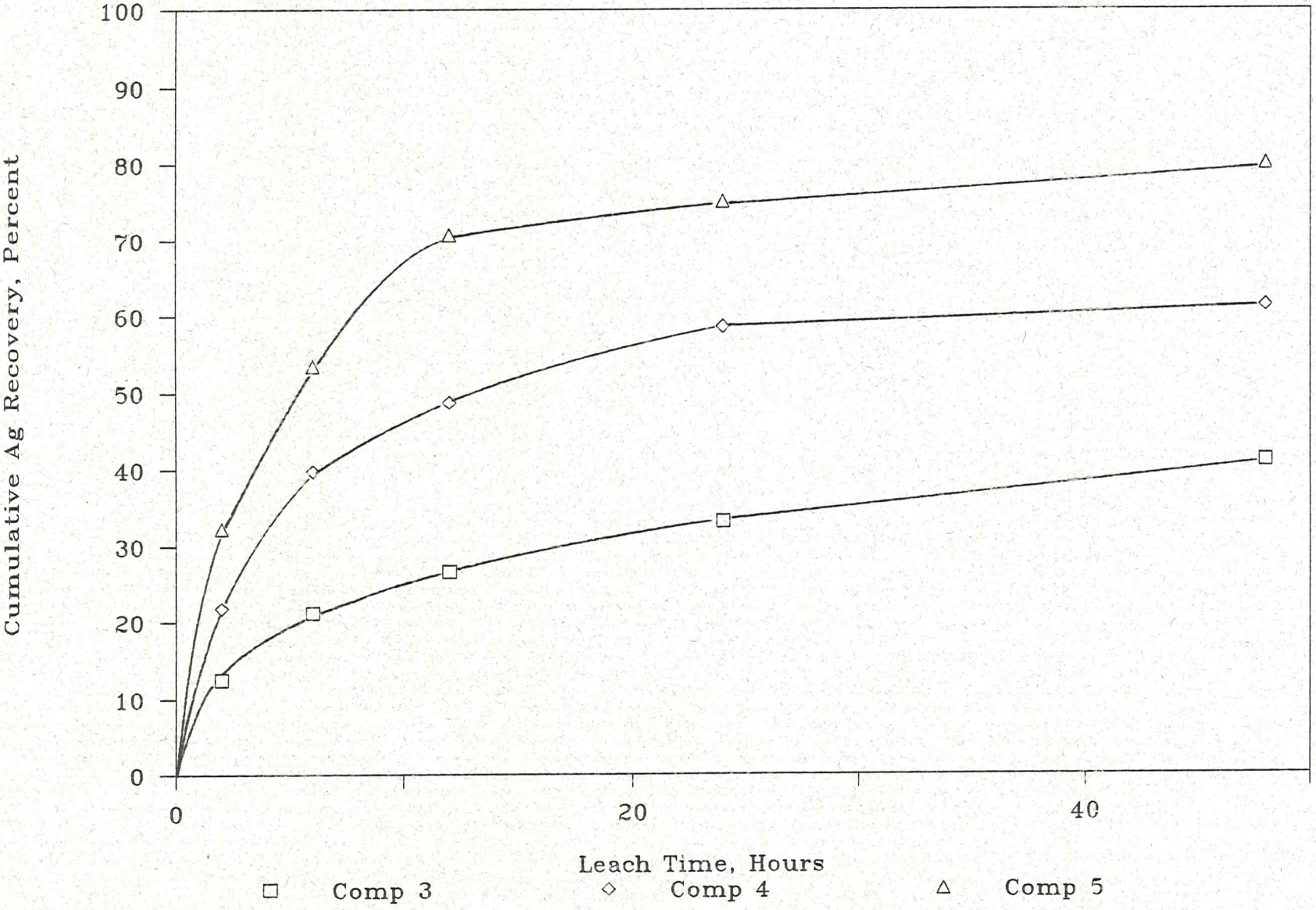


Table 22. - Overall Metallurgical Results, Bottle Roll Tests, Rosebud Core Composites, Nominal 200 Mesh Feeds

Metallurgical Results	Composite 6		Composite 7	
Extraction: pct. of total	Au	Ag	Au	Ag
in 2 hours	30.6	23.1	40.9	14.3
in 6 hours	57.3	39.1	68.6	24.7
in 12 hours	75.5	50.3	87.6	31.2
in 24 hours	90.4	61.4	95.2	38.3
in 48 hours	95.7	68.6	95.7	47.9
Extracted, oz/ton ore	0.156	0.24	0.572	4.02
Tail Assay, oz/ton[1)]	0.007	0.11	0.026	4.38
Calculated Head, oz/ton ore	0.163	0.35	0.598	8.40
Head Assay, oz/ton ore[2)]	0.150	0.21	0.596	10.12
Predicted Grade, oz/ton ore[3)]	0.156	0.35	0.558	9.57
Cyanide Consumed, lb/ton ore	0.59		0.74	
Lime Added, lb/ton ore	4.9		4.2	
Final Solution pH	10.1		10.2	
Natural pH (40% solids)	7.4		7.0	

1) Average of three tail assays.
2) Average of three head assays.
3) Provided by LAC Minerals personnel.

Figure 5. – Gold Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

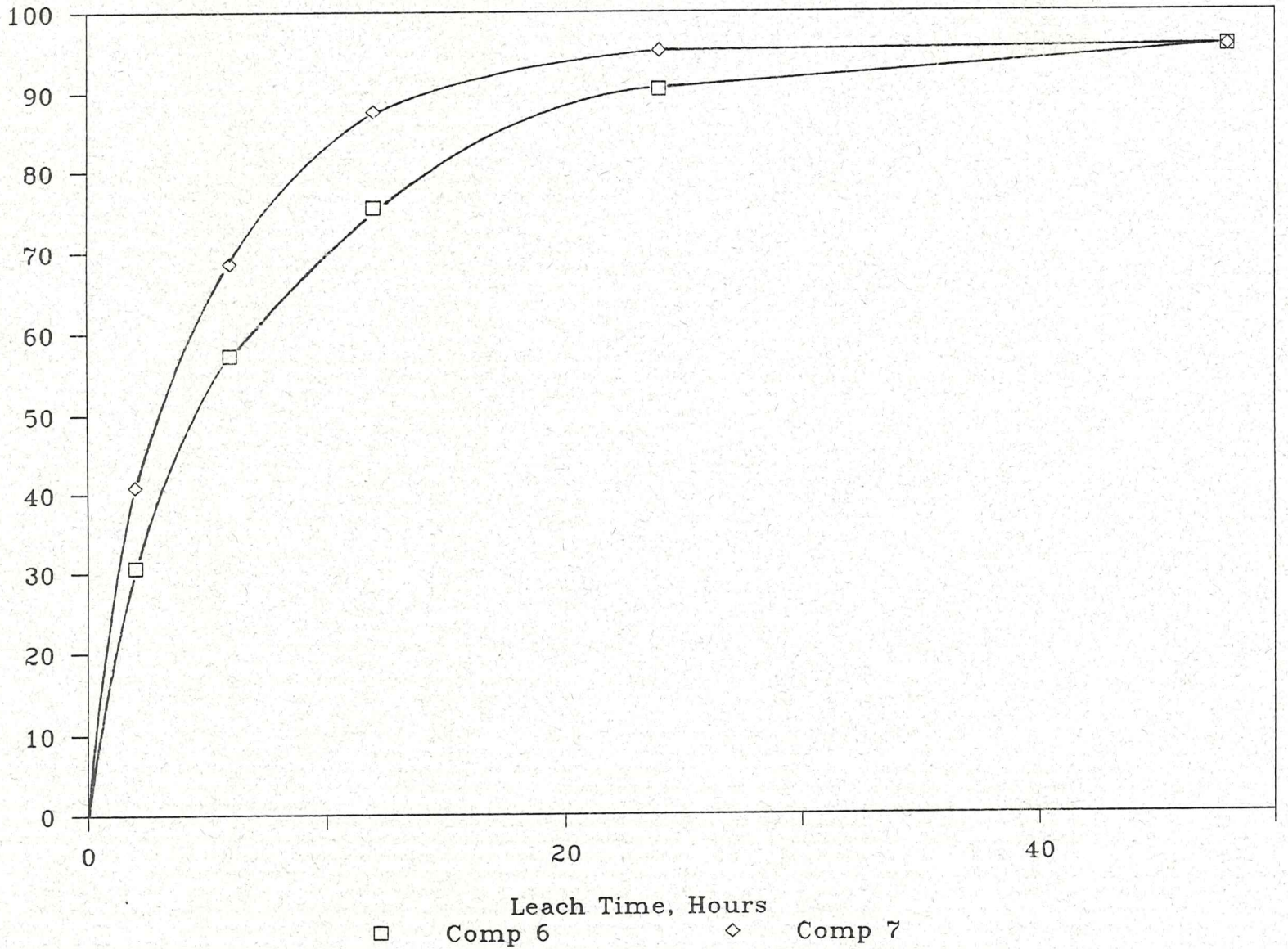


Figure 6. – Silver Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

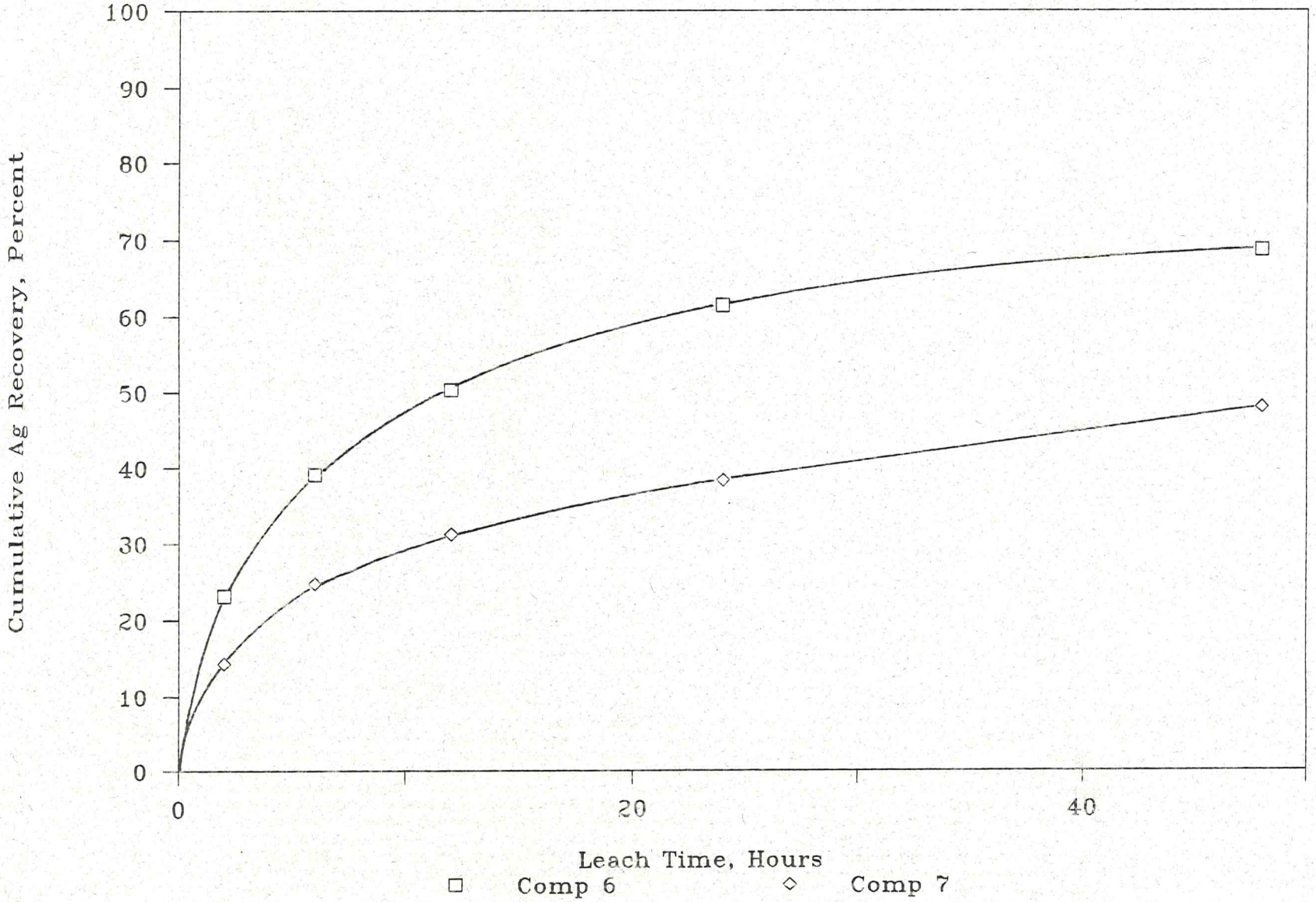


Table 23. - Overall Metallurgical Results, Bottle Roll Tests, Rosebud Core Composites, Nominal 200 Mesh Feeds

	Composite			
Metallurgical Results	8		9	
Extraction: pct. of total	Au	Ag	Au	Ag
in 2 hours	16.3	16.9	47.6	13.9
in 6 hours	35.6	33.9	69.6	24.0
in 12 hours	59.4	55.0	86.5	31.4
in 24 hours	77.9	70.6	91.7	39.2
in 48 hours	91.4	81.9	94.1	50.7
Extracted, oz/ton ore	0.972	1.04	0.433	2.07
Tail Assay, oz/ton[1)]	0.092	0.23	0.027	2.01
Calculated Head, oz/ton ore	1.064	1.27	0.460	4.08
Head Assay, oz/ton ore[2)]	0.938	1.09	0.440	3.95
Predicted Grade, oz/ton ore[3)]	0.972	1.74	0.508	4.68
Cyanide Consumed, lb/ton ore	0.58		0.75	
Lime Added, lb/ton ore	3.5		5.3	
Final Solution pH	10.0		10.3	
Natural pH (40% solids)	7.0		7.4	

1) Average of three tail assays.
2) Average of three head assays.
3) Provided by LAC Minerals personnel.

Figure 7. – Gold Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

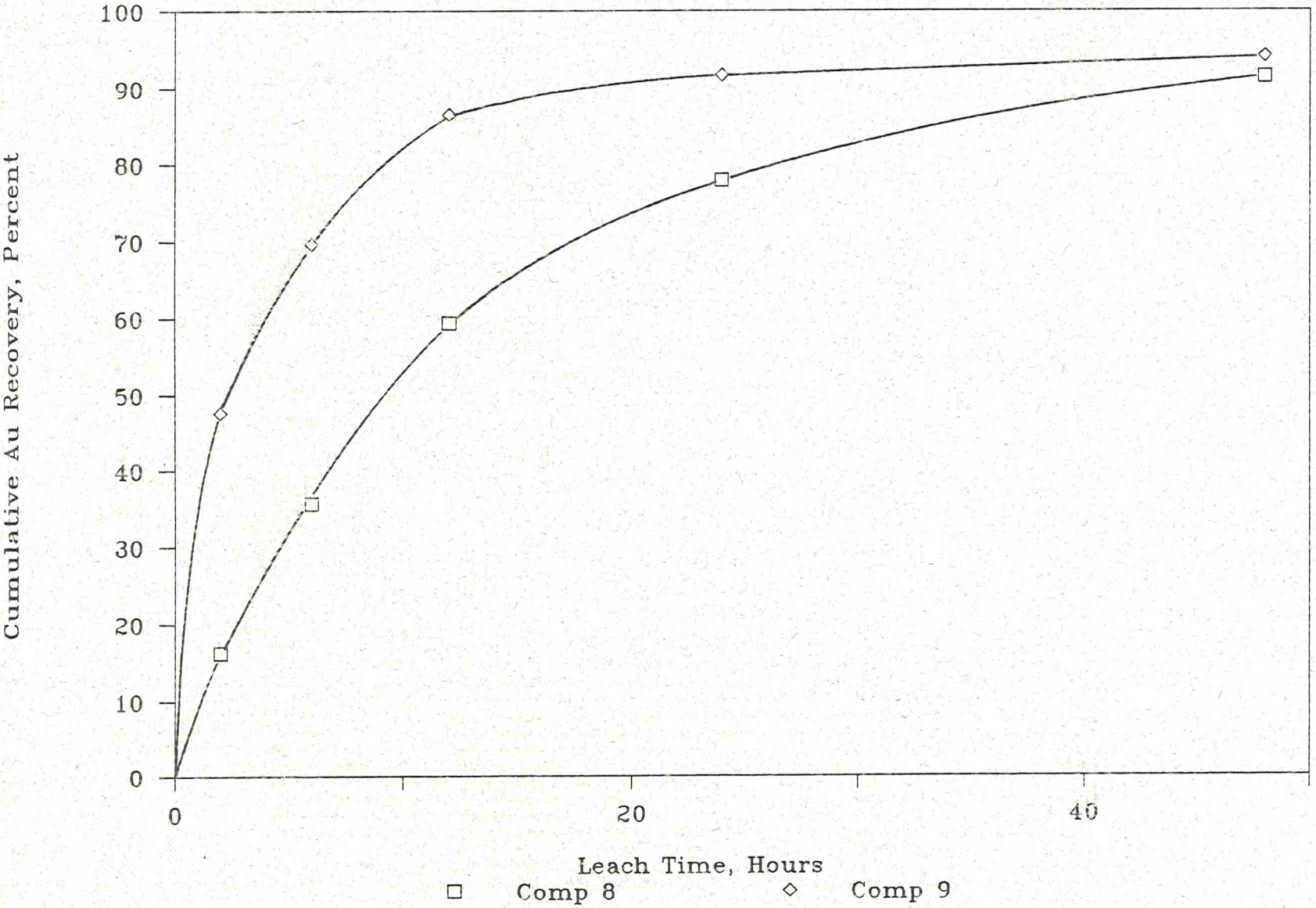


Figure 8. – Silver Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

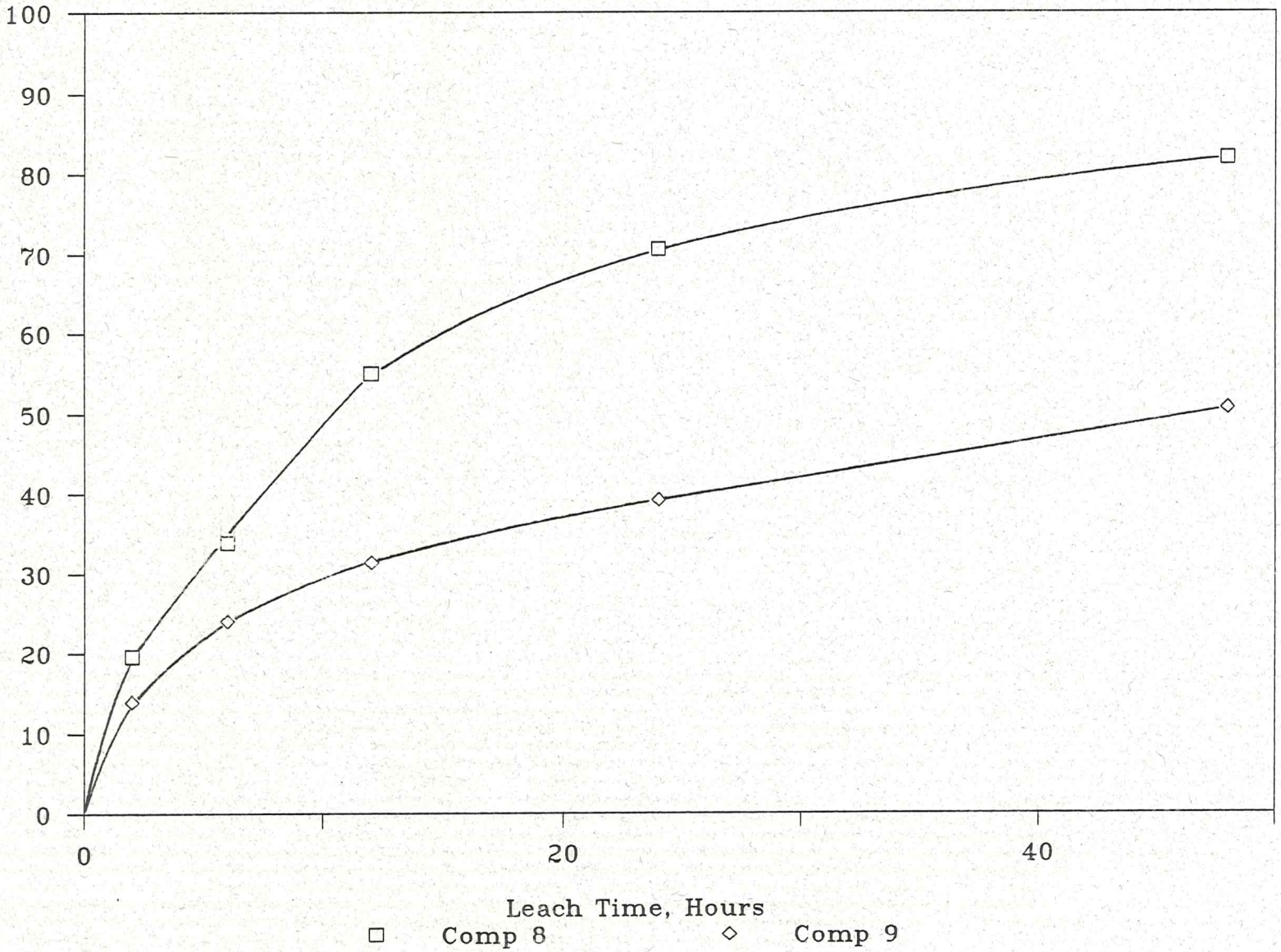


Table 24. - Overall Metallurgical Results, Bottle Roll Tests, Rosebud Core Composites, Nominal 200 Mesh Feeds

	Composite					
Metallurgical Results	10		11		12	
Extraction: pct. of total	Au	Ag	Au	Ag	Au	Ag
in 2 hours	9.5	6.7	20.8	11.1	12.6	11.3
in 6 hours	18.7	11.2	27.4	27.0	35.5	28.7
in 12 hours	29.0	14.2	49.9	44.8	66.5	50.5
in 24 hours	53.3	20.4	79.0	69.7	88.7	71.8
in 48 hours	79.4	27.9	94.2	86.2	94.0	83.6
Extracted, oz/ton ore	0.154	1.58	1.583	1.87	0.453	0.46
Tail Assay, oz/ton[1)]	0.040	4.09	0.098	0.30	0.029	0.09
Calculated Head, oz/ton ore	0.194	5.67	1.681	2.17	0.482	0.55
Head Assay, oz/ton ore[2)]	0.233	6.58	1.725	3.38	0.523	0.53
Predicted Grade, oz/ton ore[3)]	0.215	3.36	1.806	2.15	0.523	0.50
Cyanide Consumed, lb/ton ore	0.62		1.04		0.60	
Lime Added, lb/ton ore	5.7		5.0		5.0	
Final Solution pH	10.1		10.2		10.2	
Natural pH (40% solids)	6.3		6.5		6.5	

1) Average of three tail assays.
2) Average of three head assays.
3) Provided by LAC Minerals personnel.

Figure 9. – Gold Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

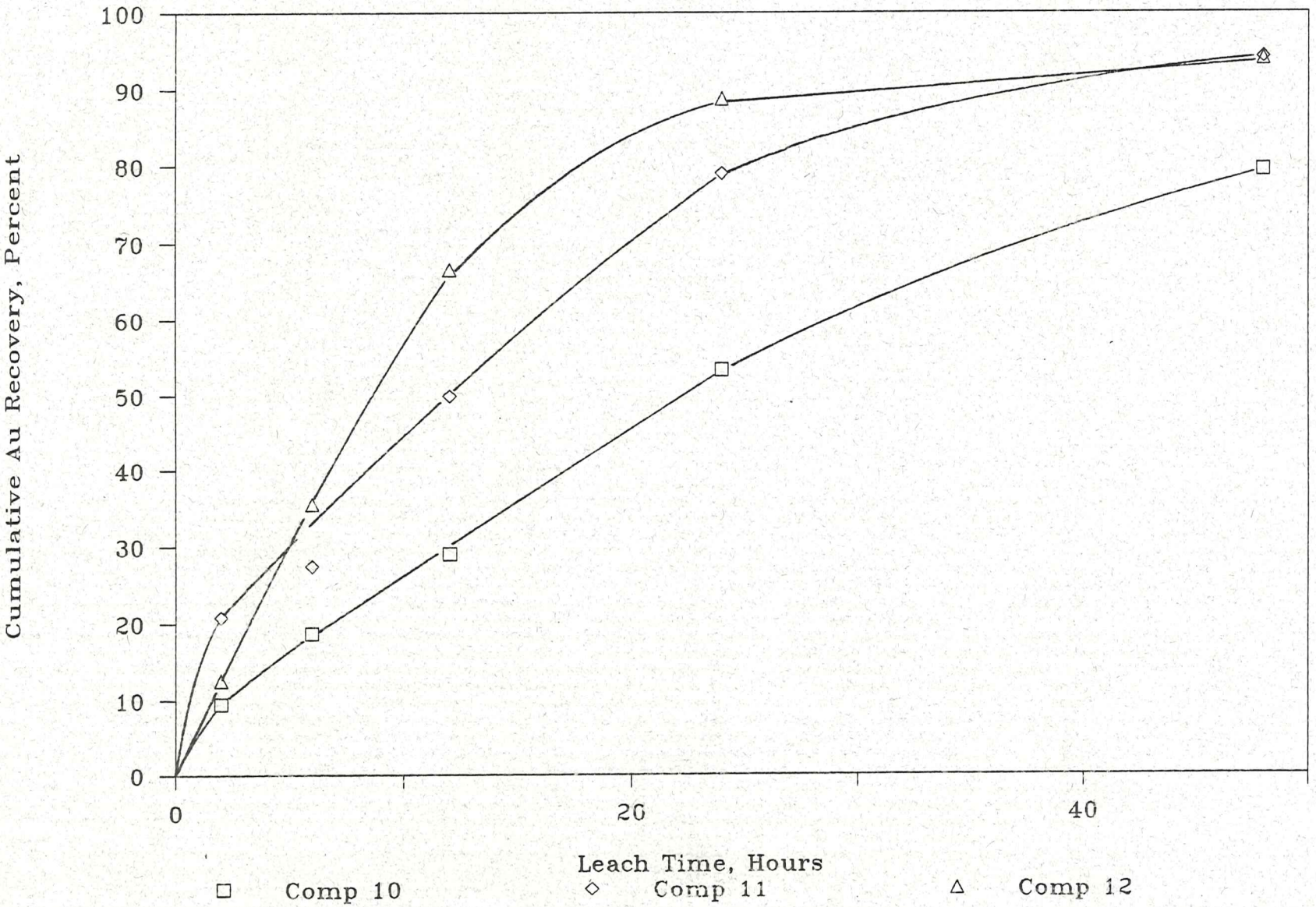


Figure 10 – Silver Leach Rate Profiles,

Bottle Roll Tests, 200 Mesh Feeds

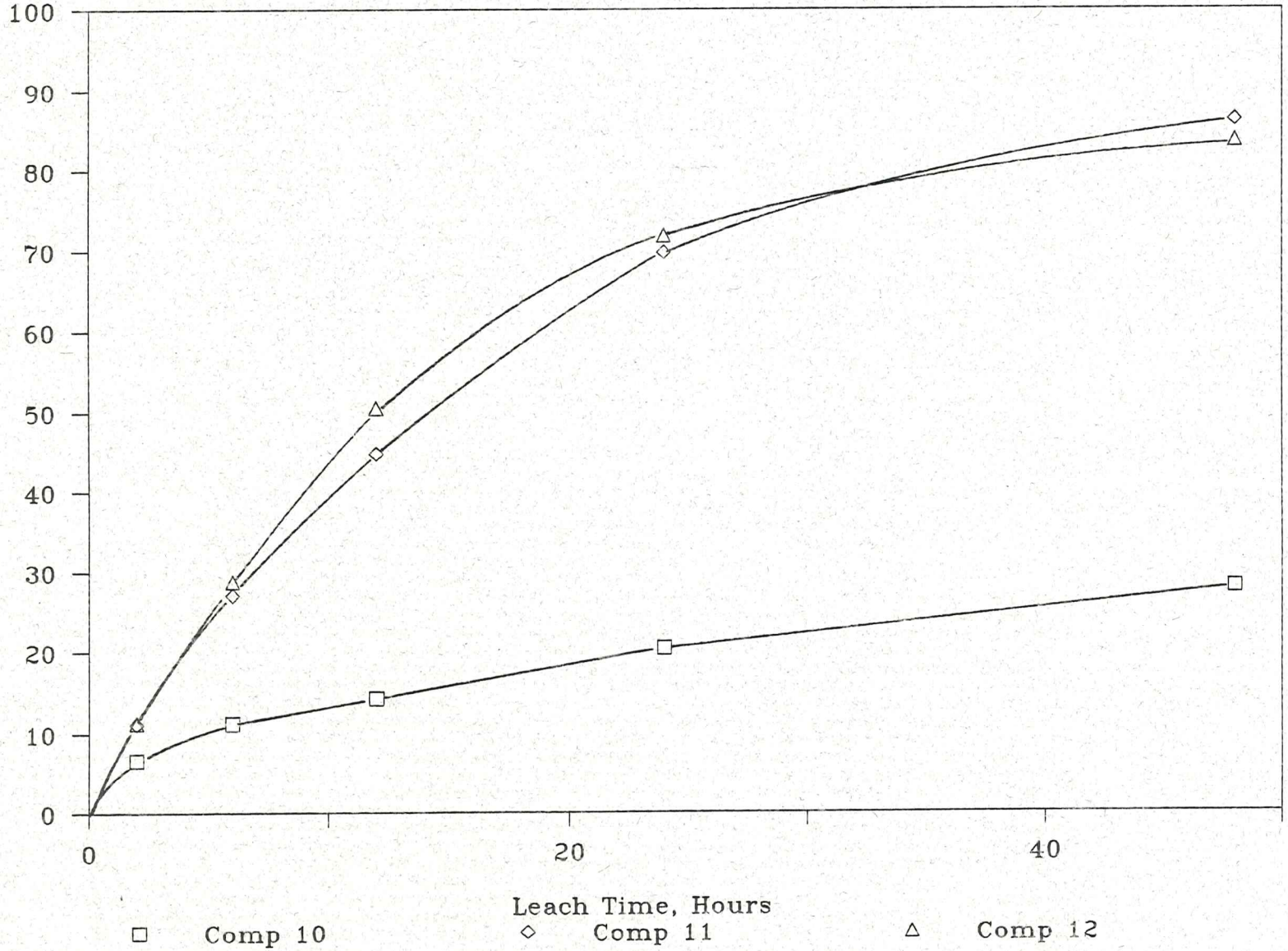


Table 25. - Tail Assay Results, Bottle Leached Residues, Rosebud Core Composites, Nominal 200 Mesh Feeds

Composite No.	Tail Assays, oz/ton							
	Initial		Duplicate		Triplicate		Average	
	Au	Ag	Au	Ag	Au	Ag	Au	Ag
1	0.081	0.50	0.077	0.62	0.084	0.57	0.081	0.56
2	0.019	0.27	0.023	0.32	0.025	0.30	0.022	0.30
3	0.032	5.01	0.025	5.11	0.030	5.33	0.029	5.15
4	0.236	2.40	0.243	2.44	0.240	2.40	0.240	2.41
5	0.011	0.07	0.015	0.07	0.012	0.09	0.013	0.08
6	0.007	0.10	0.007	0.10	0.007	0.12	0.007	0.11
7	0.026	4.56	0.027	4.35	0.026	4.24	0.026	4.38
8	0.081	0.25	0.072	0.19	0.123	0.25	0.092	0.23
9	0.047	2.00	0.017	1.96	0.016	2.06	0.027	2.01
10	0.041	3.95	0.017	4.30	0.063	4.01	0.040	4.09
11	0.080	0.28	0.119	0.30	0.096	0.32	0.098	0.30
12	0.020	0.09	0.039	0.09	0.029	0.10	0.029	0.09

Table 26. - Summary of Bottle Roll Test Results, Rosebud Core Composites, Nominal 200 Mesh Feeds

Composite No.	Extracted, oz/ton		Calculated Head, oz/ton		Recovery, percent		Cyanide Cons., lb/ton	Lime Added, lb/ton
	Au	Ag	Au	Ag	Au	Ag		
1	1.085	1.31	1.166	1.87	93.1	70.1	0.88	3.2
2	0.157	0.35	0.179	0.65	87.7	53.8	0.10	3.8
3	1.036	3.60	1.065	8.75	97.3	41.1	0.60	5.9
4	3.221	3.81	3.461	6.22	93.1	61.3	0.59	3.7
5	0.284	0.32	0.297	0.40	95.6	80.0	0.43	5.0
6	0.156	0.24	0.163	0.35	95.7	68.6	0.59	4.9
7	0.572	4.02	0.598	8.40	95.7	47.9	0.74	4.2
8	0.972	1.04	1.064	1.27	91.4	81.9	0.58	3.5
9	0.433	2.07	0.460	4.08	94.1	50.7	0.75	5.3
10	0.154	1.58	0.194	5.67	79.4	27.9	0.62	5.7
11	1.583	1.87	1.681	2.17	94.2	86.2	1.04	5.0
12	0.453	0.46	0.482	0.55	94.0	83.6	0.60	5.0

Overall metallurgical results show that the Rosebud core composites were readily amenable to direct agitated cyanidation treatment at the nominal 200 mesh feed size. Gold recoveries ranged from 79.4 to 97.3 percent, and averaged 92.6 percent in 48 hours of leaching. Silver recoveries ranged from 27.9 to 86.2 percent, and averaged 62.8 percent. The lowest gold and silver recoveries were achieved from composite 10 (RL-186, 645-710'). Gold and silver recovery rates for composites 3 through 7, and 9 were fairly rapid and extraction was substantially complete in from 12 to 24 hours. Precious metal recovery rates were fairly slow for the remaining composites and extraction was progressing at a slower rate when leaching was terminated at 48 hours. Additional precious metal values would be extracted with leaching cycles longer than 48 hours, but at a very slow rate.

Cyanide consumptions were low to moderate and ranged from 0.10 (comp 2) to 1.04 (comp 11) pounds per ton of ore, and averaged 0.63 pounds per ton of ore. Consumption rates, in general, were more rapid the first 12 hours of leaching. Lime requirements were low for all twelve composites and ranged from 3.2 (comp 1) to 5.9 (comp 3) pounds per ton of ore, and averaged 4.6 pounds per ton of ore. Controlling pH was not a problem even though lime addition was required at various sampling intervals to maintain the leaching pH at between 10.0 and 10.5. An average of 73.8 percent of the total lime required was added during the initial pH adjustment procedures. The remaining 26.2 percent was added during leaching.

The core composites were, in general, metallurgically similar with respect to gold recovery, recovery rate, and reagent requirements. Composite 10 was dissimilar with respect to precious metal recovery. Composites 2 and 11 were dissimilar with respect to cyanide consumption. Composites 1, 2, 8, 10, 11, and 12 leach substantially more slowly than the other six composites. Leach rate could be a function of coarse gold in the feeds. Recovery rate was not a function of grade. Gold recovery was not grade dependent. Silver recovery was quite variable.

Table 27. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 1, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.2	1.6	6.0	1.38	3.23
6	10.4	1.8	6.8	3.98	7.50
12	10.4	2.0	3.6	8.40	13.00
24	10.3	2.0	4.8	17.00	22.50
48	10.1	2.0	4.6	22.80	27.00

Table 28. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 2, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.1	1.9	5.3	0.51	1.88
6	10.1	2.0	5.9	1.12	3.33
12	10.4	2.1	3.3	1.78	4.60
24	10.0	1.9	4.5	2.88	6.00
48	10.1	2.0	4.2	3.19	7.00

Table 29. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 3, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.0	1.9	5.0	10.00	25.00
6	10.0	1.9	5.7	17.20	41.00
12	10.1	2.0	3.2	20.20	49.00
24	10.0	1.9	3.5	20.50	59.00
48	10.2	1.9	5.6	19.30	71.00

Table 30. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 4, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.4	2.0	5.5	28.00	31.00
6	10.0	1.8	5.3	49.00	55.00
12	9.9	2.0	3.7	59.00	64.00
24	10.4	2.0	3.9	64.00	74.00
48	10.0	1.8	4.6	61.00	73.00

Table 31. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 5, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.0	1.9	5.5	2.50	2.94
6	9.9	1.8	5.5	3.91	4.74
12	10.0	2.0	3.6	5.59	6.00
24	10.0	2.0	4.7	5.59	6.00
48	10.2	2.0	4.6	5.38	6.00

Table 32. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 6, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.1	1.9	4.6	1.14	1.86
6	9.9	2.0	3.7	2.06	3.00
12	10.3	2.0	3.5	2.60	3.70
24	9.8	1.3	4.0	2.98	4.35
48	10.1	2.0	3.1	2.98	4.60

Table 33. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 7, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.1	1.9	4.4	5.59	27.50
6	10.1	1.9	3.2	9.00	45.50
12	10.4	1.9	3.5	11.00	55.00
24	9.9	1.8	3.5	11.30	65.00
48	10.2	2.0	3.6	10.60	79.00

Table 34. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 8, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.4	1.9	4.6	3.97	4.90
6	10.0	1.9	3.6	8.40	9.50
12	10.4	1.8	4.0	13.60	15.00
24	10.1	2.0	4.0	17.20	18.50
48	10.0	2.0	3.4	19.30	20.50

Table 35. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 9, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.0	1.8	4.3	5.00	13.00
6	10.1	2.0	3.8	6.99	21.50
12	10.1	2.0	4.4	8.30	27.00
24	10.0	2.0	4.8	8.30	32.50
48	10.3	1.7	3.2	8.00	41.00

Table 36. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 10, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.2	1.7	4.7	0.42	8.70
6	9.9	2.0	6.7	0.80	14.00
12	10.2	2.0	4.3	1.21	17.00
24	10.6	2.0	3.7	2.21	24.00
48	10.1	1.9	4.8	3.22	32.00

Table 37. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 11, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.3	1.9	4.5	8.00	5.50
6	10.1	1.9	5.3	10.00	13.00
12	10.2	1.9	4.6	18.00	21.00
24	10.3	1.9	4.0	28.00	32.00
48	10.2	1.7	4.8	32.00	38.00

Table 38. - Leach Solution Data, Bottle Roll Test, Rosebud Core Composite 12, Nominal 200 Mesh Feed Size

Sample Time, Hrs.	pH	NaCN, lb/ton sol.	Solution Analyses, ppm D.O.	Au	Ag
2	10.0	1.8	4.8	1.39	1.41
6	10.0	1.9	4.5	3.98	3.53
12	10.3	1.9	4.1	7.40	6.03
24	10.2	2.0	3.6	9.00	8.33
48	10.2	2.0	4.6	9.80	9.23

Leach solution data from the twelve bottle roll tests show that dissolved oxygen concentrations were fairly constant the first 6 hours of leaching. In general, dissolved oxygen concentrations decreased after 6 hours. Sufficient dissolved oxygen was present for precious metal dissolution throughout the leaching cycles.

CIL/CYANIDATION TEST PROCEDURES AND RESULTS

CIL/cyanidation tests were conducted on two Rosebud core composites (RL-100C and RL-104C) at an 80 percent minus 200 mesh feed size to determine precious metal recovery, recovery rate, and reagent requirements. The tests were conducted also to determine the effect of leaching at lower pH (pH 10.3) on antimony dissolution. Initial CIL/cyanidation tests on these composites were conducted at pH 11.0 (MLI report dated February 19, 1991), and antimony dissolution was considered high.

Ore charges were stage ground in a laboratory steel ball mill to the 200 mesh feed size. Ground solids were settled in grinding water to achieve 25 weight percent solids pulp density. Natural pulp pH's were measured. Lime was added to adjust the pH of the pulps to 10.3 before adding the cyanide. Sodium cyanide, equivalent to 2.0 pounds per ton of solution, was added to the alkaline pulps. A total of 20 grams of PICA G210 R 6x16 mesh coconut shell activated carbon per liter of pulp was added with the cyanide.

CIL/cyanidation tests were conducted by mechanically agitating the pulps in baffled leaching vessels for 72 hours. Continuous oxygen sparging was employed during initial pH adjustment procedures (approximately 2 hours) and throughout the leaching cycles. Interim pulp samples were taken at 1, 2, 4, 8, 12, 24, and 48 hours. Pulps were filtered to separate liquids and solids. Barren solution volumes were measured and sampled for gold, silver, antimony, and selenium analysis using conventional A.A. methods. Interim tails were assayed directly to establish precious metal extraction rates. Carbon was returned immediately to leaching during interim sampling procedures. Cyanide concentration, dissolved oxygen content, and pH were determined for each barren solution. Cyanide concentrations were restored to initial levels. Lime was added, if necessary, to maintain the leaching pH at between 10.0 and 10.5.

An additional CIL/cyanidation test was conducted on each composite to determine the effect of pre-aeration with oxygen and $PbNO_3$ addition on overall precious metal recovery. Procedures were essentially the same as described above, except that the pulps were sparged with oxygen as the pH of the pulps was adjusted to 9.5 with lime. Lead nitrate (0.1 kilograms per ton of ore) was added and agitation continued for 4 hours before adding cyanide, carbon, and additional lime (pH 10.0 to 10.3).

After 72 hours, pulps were filtered to separate liquids and solids. Final barren solution volumes were measured and sampled for analysis. Final pH, dissolved oxygen content, and cyanide concentrations were determined. Leached residues were washed, dried, weighed, and assayed directly to determine residual gold, silver, antimony, and selenium content. Final loaded carbons were assayed, in entirety, to determine total extracted gold and silver values.

Overall gold metallurgical results for CIL/cyanidation tests are provided in Table 39. Silver results are provided in Table 40. Gold and silver leach rate profiles are shown graphically in Figures 11 through 14. Leach solution data are provided in Tables 41 through 44. Antimony and selenium analysis results are provided, along with antimony analysis results from previous testwork, in Table 45.

Table 39. - Overall Gold Metallurgical Results, CIL/Cyanidation Tests, Rosebud Core Composites, 80 Percent Minus 200 Mesh Feeds

	Composite			
	RL-100C		RL-104C	
Metallurgical Results	Standard CIL/CN^-	CIL/CN^- w/$PbNO_3$	Standard CIL/CN^-	CIL/CN^- w/$PbNO_3$
Extraction: pct. total Au				
in 1 hour	65.8	37.3	79.9	76.5
in 2 hours	67.3	73.2	81.5	78.1
in 4 hours	70.2	79.1	82.1	79.1
in 8 hours	71.7	80.4	82.1	79.1
in 12 hours	73.7	81.7	82.1	79.1
in 24 hours	78.5	81.7	82.1	79.1
in 48 hours	84.4	81.7	82.1	79.1
in 72 hours	84.4	81.7	82.1	79.1
Extracted, ozAu/ton ore	0.173	0.125	0.151	0.155
Tail Assay, ozAu/ton	0.032	0.028	0.033	0.041
Calculated Head, ozAu/ton ore	0.205	0.153	0.184	0.196
Head Grade, ozAu/ton ore[1)]	0.188	0.188	0.173	0.173
Cyanide Consumed, lb/ton ore	17.16	16.13	8.58	8.69
Lime Added, lb/ton ore	5.4	4.8	4.8	4.8
Final Solution pH	9.7	9.9	9.8	10.2
Natural pH (25% solids)	6.6	6.6	7.2	7.2

1) Average of all head grade determinations.

Figure 11. – Gold Leach Rate Profiles,

CIL/CN- Tests, RL-100C, 200 Mesh Feeds

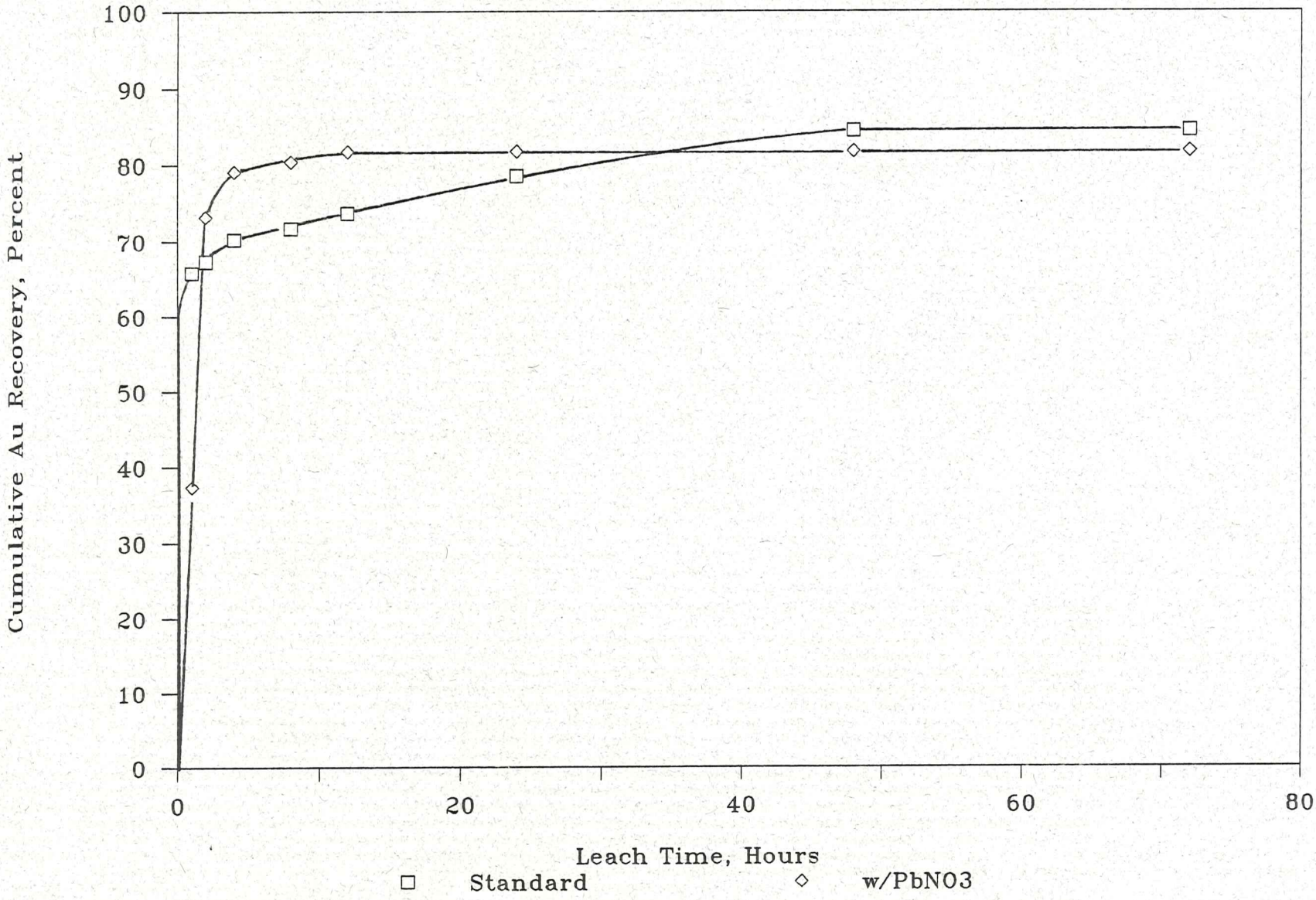


Figure 12. – Gold Leach Rate Profiles,

CIL/CN– Tests, RL–104C, 200 Mesh Feeds

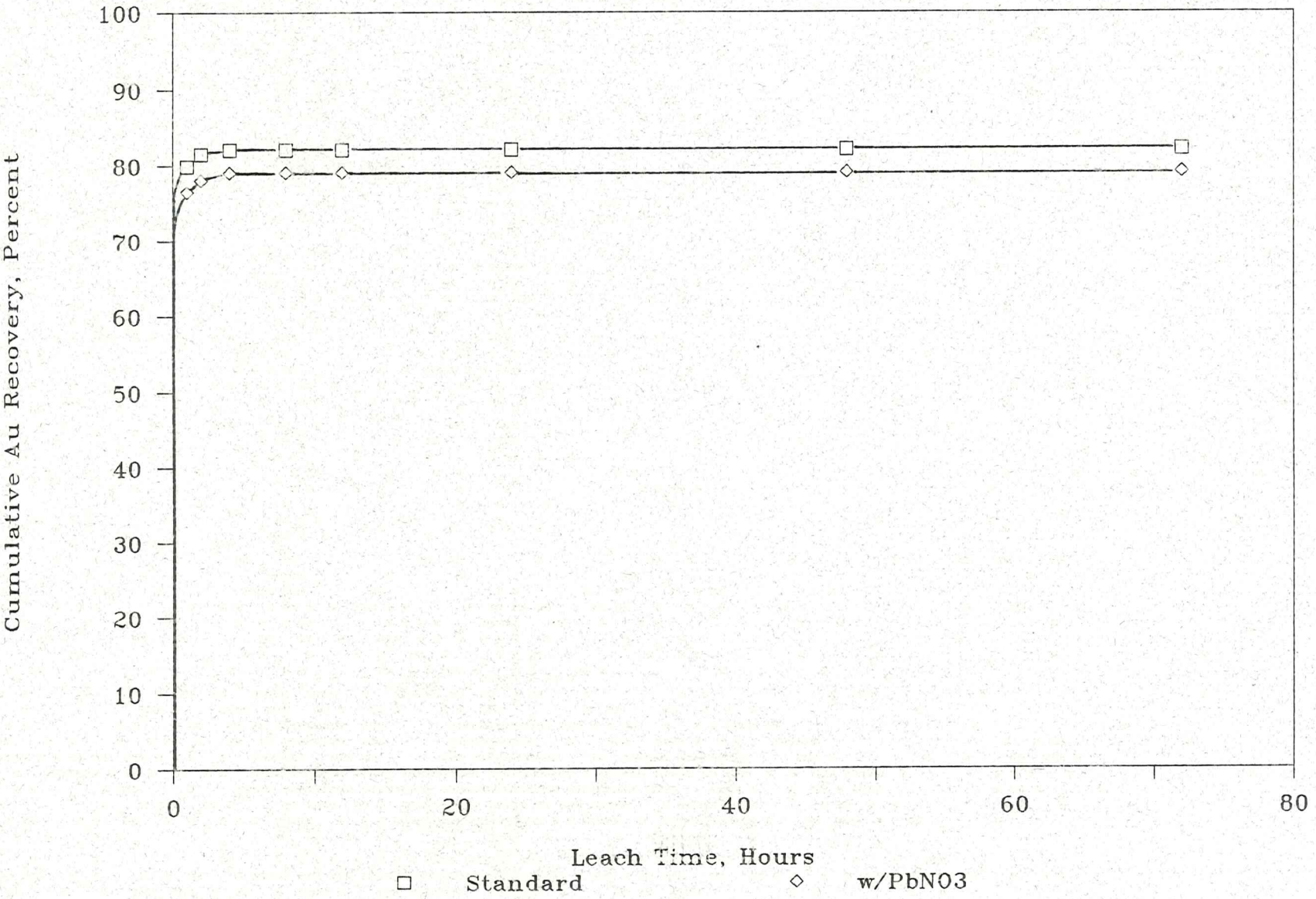


Table 40. - Overall Silver Metallurgical Results, CIL/Cyanidation Tests, Rosebud Core Composites, 80 Percent Minus 200 Mesh Feeds

	Composite			
	RL-100C		RL-104C	
Metallurgical Results	Standard CIL/CN^-	CIL/CN^- w/$PbNO_3$	Standard CIL/CN^-	CIL/CN^- w/$PbNO_3$
Extraction: pct. total Ag				
in 1 hour	2.5	12.0	52.4	35.0
in 2 hours	7.2	19.6	52.4	55.0
in 4 hours	8.7	32.1	52.4	60.0
in 8 hours	14.4	36.4	52.4	60.0
in 12 hours	22.9	40.5	52.4	60.0
in 24 hours	32.3	45.9	52.4	60.0
in 48 hours	42.1	49.1	52.4	60.0
in 72 hours	48.4	53.2	52.4	60.0
Extracted, ozAg/ton ore	5.51	5.94	0.11	0.12
Tail Assay, ozAg/ton	5.88	5.22	0.10	0.08
Calculated Head, ozAg/ton ore	11.39	11.16	0.21	0.20
Head Grade, ozAg/ton ore[1)]	11.30	11.30	0.21	0.21

1) Average of all head grade determinations.

Figure 13 – Silver Leach Rate Profiles,

CIL/CN– Tests, RL–100C, 200 Mesh Feeds

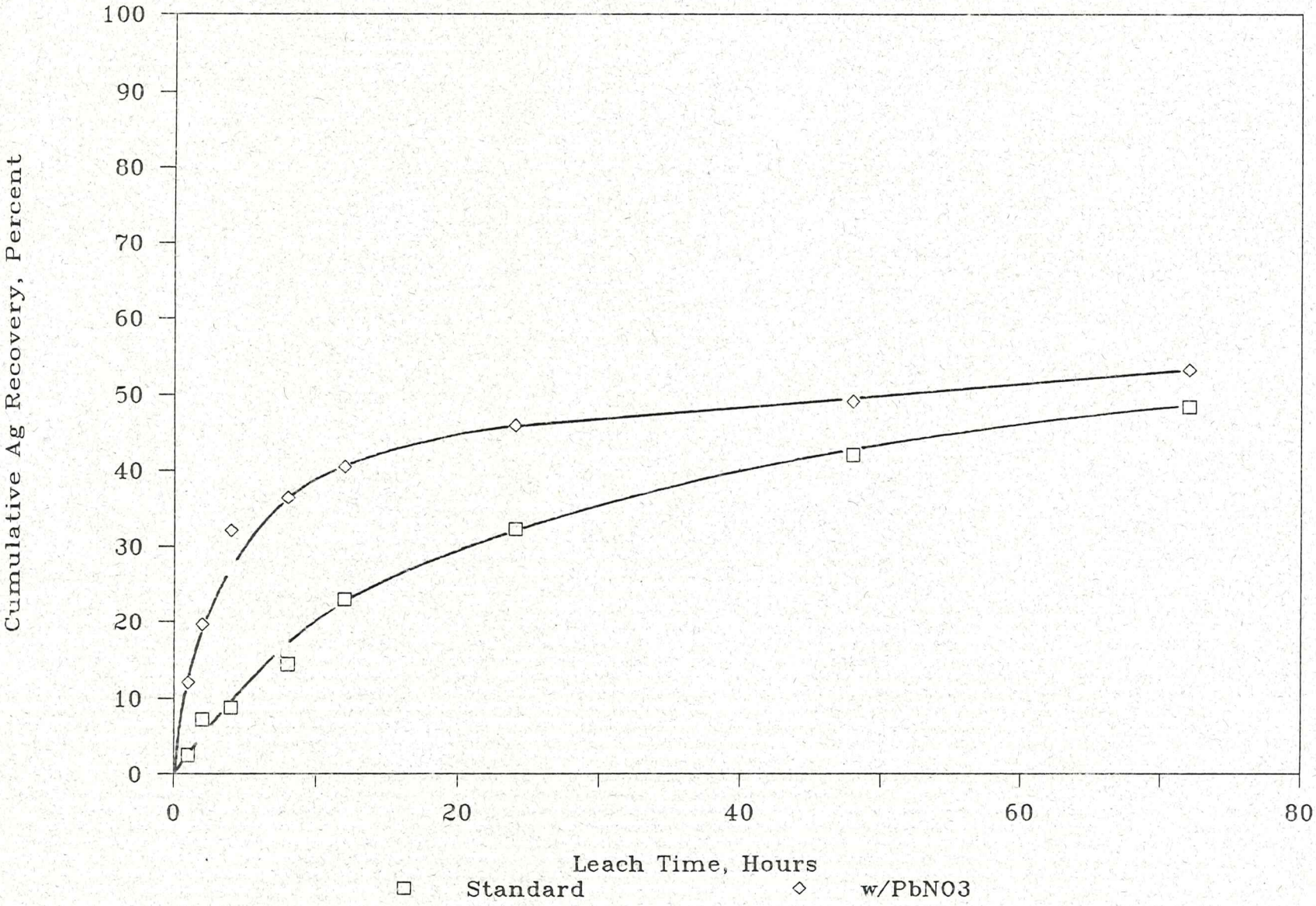
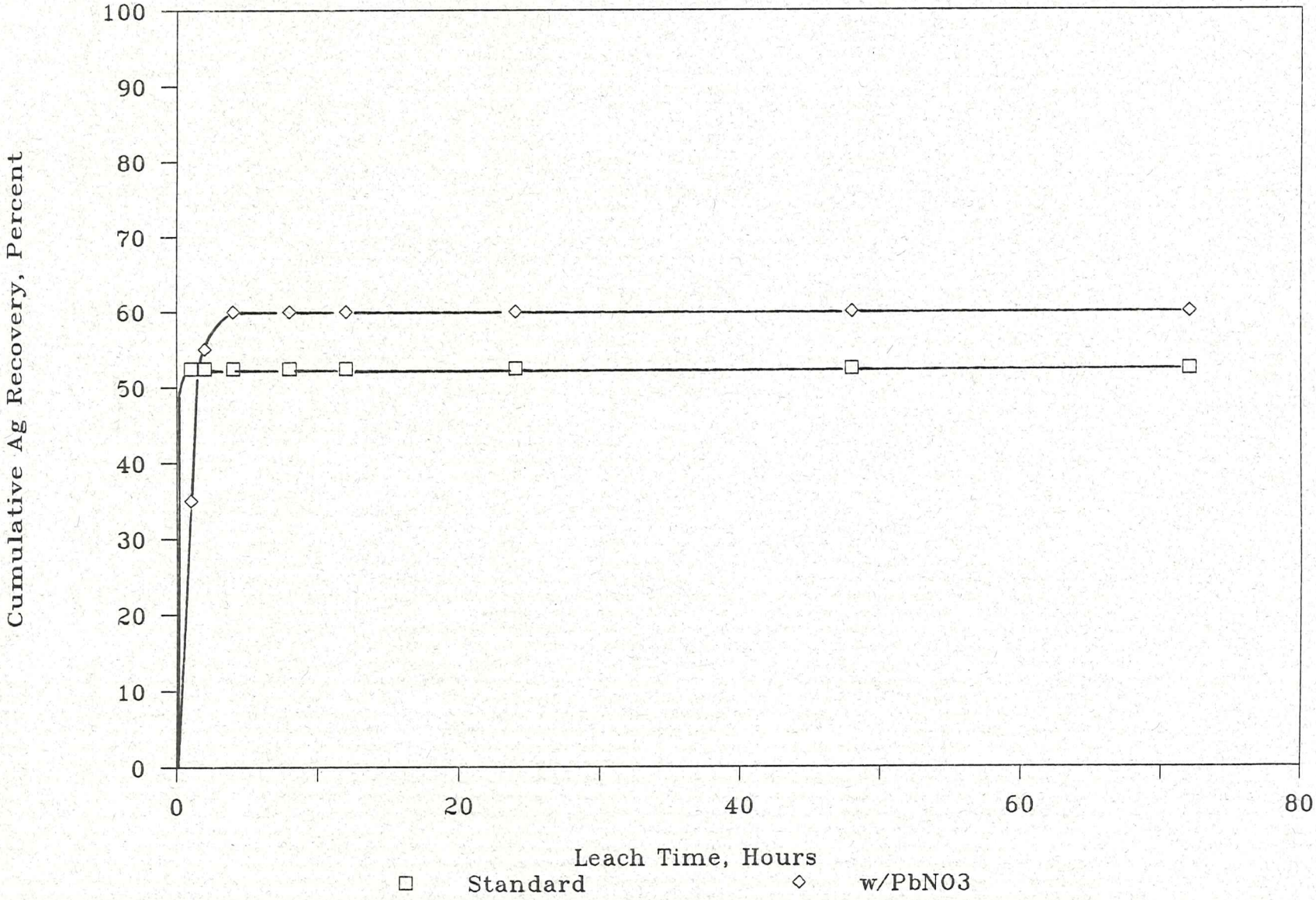


Figure 14 – Silver Leach Rate Profiles,

CIL/CN– Tests, RL–104C, 200 Mesh Feeds



Metallurgical results show that composites RL-100C and RL-104C were amenable to conventional CIL/cyanidation treatment at an 80 percent minus 200 mesh feed size. Gold recoveries of 84.4 and 82.1 percent, respectively, were achieved in 72 hours of leaching. Respective silver recoveries were 48.4 and 52.4 percent.

Pre-aeration with oxygen and addition of $PbNO_3$ was not effective in increasing overall gold recovery. Gold recoveries achieved by pretreatment and subsequent CIL/cyanidation decreased slightly to 81.7 and 79.1 percent for composites RL-100C and RL-104C, respectively. The cause of decreased gold recovery was not determined. Silver recoveries increased with pretreatment to 53.2 and 60.0 percent, respectively. Lead nitrate addition probably enhanced silver recovery.

Gold recovery rates were fairly rapid and extraction was substantially complete in from 2 to 4 hours. Silver recovery rates were fairly rapid for the composite RL-104C feeds, but were fairly slow for the RL-100C feeds.

Cyanide consumptions were high for both composites, and averaged 16.65 (RL-100C) and 8.64 (RL-104C) pounds per ton of ore. Consumption rates were more rapid late in the leaching cycles. High cyanide consumption and increase in consumption rate were caused by low pulp pH during leaching. Excessive cyanide consumption occurred when leaching pH fell below pH 10.0. Cyanide consumptions were substantially lower for previous tests conducted at pH 11.0. Lime requirements were low and averaged 5.1 and 4.8 pounds per ton of ore, respectively. Controlling pH was not a major problem even though lime addition was required late in the leaching cycles to readjust the leaching pH to above 10.0. An average of 85.2 percent of the total lime required was added during the initial pH adjustment procedures. The remaining 14.8 percent was added between 24 and 72 hours of leaching.

Controlling pH late in the leaching cycles was most difficult for composite RL-100C. Leaching pH remained stable, without lime addition, the first 24 hours of leaching (see Tables 41 and 42). Dissolved oxygen content decreased after 8 hours, and at that time, antimony dissolution rate increased. The increase in antimony dissolution rate was most substantial after 24 hours, which corresponds with the decrease in pulp pH. These data would indicate that cyanicides and oxygen consumers were released late in the leaching cycles. The decrease in leaching pH was probably caused by acid forming constituents released during that period.

Table 41. - Leach Solution Data, CIL/Cyanidation Test, Rosebud Core Composite RL-100C, 80 Percent Minus 200 Mesh Feed

Sample		NaCN	Barren Solution Analyses, mg/l				
Time, Hrs.	pH	lb/ton sol.	D.O.	Au	Ag	Sb	Se
1	10.1	1.7	5.5	<0.04	0.55	3.1	0.4
2	10.1	1.7	5.1	<0.04	0.53	4.7	0.8
4	10.3	1.8	4.4	0.04	0.52	7.6	1.2
8	10.2	1.7	4.5	<0.04	0.63	16.9	2.7
12	10.1	1.7	2.9	<0.04	0.56	27.1	4.2
24	9.8	1.0	2.7	<0.04	0.39	45.8	4.6
48	9.5	0.3	2.6	<0.04	0.33	64.1	2.7
72	9.7	0.1	3.4	<0.04	0.35	78.9	0.2

Table 42. - Leach Solution Data, CIL/Cyanidation Test with $PbNO_3$ Addition, Rosebud Core Composite RL-100C, 80 Percent Minus 200 Mesh Feed

Sample		NaCN	Barren Solution Analyses, mg/l				
Time, Hrs.	pH	lb/ton sol.	D.O.	Au	Ag	Sb	Se
1	10.0	1.7	5.5	<0.04	0.48	2.3	0.2
2	10.2	1.7	4.5	<0.04	0.45	3.4	0.4
4	10.2	1.8	4.2	<0.04	0.46	7.6	0.7
8	10.4	1.8	3.7	<0.04	0.64	16.3	1.7
12	10.3	1.7	2.9	<0.04	0.67	31.5	3.6
24	10.1	1.3	2.8	<0.04	0.78	52.7	5.5
48	9.6	0.2	2.5	<0.04	0.31	76.2	4.3
72	9.9	0.1	3.3	<0.04	0.45	97.6	0.7

Table 43. - Leach Solution Data, CIL/Cyanidation Test, Rosebud Core Composite RL-104C, 80 Percent Minus 200 Mesh Feed

Sample		NaCN	Barren Solution Analyses, mg/l				
Time, Hrs.	pH	lb/ton sol.	D.O.	Au	Ag	Sb	Se
1	10.1	2.0	4.7	<0.04	<0.04	<0.04	<0.04
2	10.1	1.7	6.0	<0.04	<0.04	<0.04	<0.04
4	10.1	1.8	4.6	<0.04	<0.04	<0.04	<0.04
8	10.1	2.0	4.7	<0.04	<0.04	<0.04	<0.04
12	9.9	1.6	3.9	<0.04	<0.04	<0.04	<0.04
24	10.0	1.8	3.7	<0.04	<0.04	<0.04	<0.04
48	9.8	1.0	3.2	<0.04	<0.04	<0.04	<0.04
72	9.8	1.2	4.1	<0.04	<0.04	<0.04	<0.04

Table 44. - Leach Solution Data, CIL/Cyanidation Test with $PbNO_3$ Addition, Rosebud Core Composite RL-104C, 80 Percent Minus 200 Mesh Feed

Sample		NaCN	Barren Solution Analyses, mg/l				
Time, Hrs.	pH	lb/ton sol.	D.O.	Au	Ag	Sb	Se
1	10.2	2.0	5.3	<0.04	<0.04	<0.04	<0.04
2	10.2	1.7	6.6	<0.04	<0.04	<0.04	<0.04
4	10.2	1.8	6.9	<0.04	<0.04	<0.04	<0.04
8	10.1	1.8	7.2	<0.04	<0.04	<0.04	<0.04
12	10.0	1.8	5.2	<0.04	<0.04	<0.04	<0.04
24	10.2	1.6	4.2	<0.04	<0.04	<0.04	<0.04
48	10.2	1.3	3.2	<0.04	<0.04	<0.04	<0.04
72	10.2	1.4	4.1	<0.04	<0.04	<0.04	<0.04

Table 45. - Comparative Antimony and Selenium Analysis Results, Direct and CIL/Cyanidation Tests, Rosebud Core Composites, 80 Percent Minus 200 Mesh Feeds

Composite	Test	Target pH	Final Barren Sol. Analysis, mg/l		Residue Analysis, mg/kg	
			Sb	Se	Sb	Se
RL-100C	Dir CN^-*	11.0	23.0	-	515	-
RL-100C	CIL/CN^-*	11.0	46.0	-	425	-
RL-100C	CIL/CN^-	10.3	78.9	0.2	207	9.9
RL-100C	CIL/CN^-**	10.3	97.6	0.7	190	8.4
RL-104C	Dir CN^-*	11.0	0.03	-	14	-
RL-104C	CIL/CN^-*	11.0	<0.03	-	2	-
RL-104C	CIL/CN^-	10.3	<0.03	<0.1	8	5.0
RL-104C	CIL/CN^-**	10.3	<0.03	<0.1	5	5.4

* Data first presented in our report dated February 19, 1991.
** Pulp pretreated with oxygen and $PbNO_3$ before CIL/Cyanidation.

Decreasing pulp pH from 11.0 to 10.3 during CIL/cyanidation was not effective in decreasing antimony dissolution for composite RL-100C. Antimony concentration in final barren solutions increased from 46.0 (pH 11.0) to 78.9 (pH 10.3) mg/l. Residual antimony grade decreased from 425 to 207 mg/kg, respectively. These data show that decreasing leaching pH increased antimony dissolution by alkaline cyanide solution. These results contrast classical antimony dissolution chemistry. Classically, antimony dissolution should be highest at above pH 11.5, with a resultant substantial decrease in gold dissolution. At pH 10.0, antimony dissolution should be minimal and gold dissolution should not be impeded. According to DORR and BOSQUI (1950), the oxygen pretreatment procedure (at pH 9.5) used in this testing program should have resulted in lower antimony dissolution and increased gold recovery. Because an opposite effect was observed, antimony occurrence in the ore must be different than the described in literature.

The effect of pH on antimony dissolution for composite RL-104C could not be determined because antimony concentration in leach solutions were below analytical detection limits (<0.03 ppm), and residue analysis results were "spotty".

Antimony and selenium dissolution was somewhat higher (Comp RL-100C only) for pretreatment and subsequent CIL/cyanidation leaching than for direct CIL/cyanidation leaching. The increase in antimony and selenium dissolution was believed to be caused by incremental sulfide mineral oxidation which occurred during the four hours of oxygen sparging at relatively low pH (pH 9.5). The addition of $PbNO_3$ should not have had an effect on the increase in antimony and selenium dissolution. Lead nitrate addition did, however, appear to improve silver recovery, as expected.

CONCLUSIONS

- Rosebud core composites 1 through 12 were readily amenable to direct agitated cyanidation treatment at a nominal 200 mesh feed size.

- Precious metal recovery rates were fairly rapid for composites 3 through 7 and composite 9, but were fairly slow for the remaining composites.

- Cyanide consumptions were low to moderate.

- Lime requirements were low.

- Core composites RL-100C and RL-104C were amenable to CIL/cyanidation treatment at an 80 percent minus 200 mesh feed size.

- Precious metal recovery rates were fairly rapid.

- Cyanide consumptions were high.

- Lime requirements were low.

- Antimony dissolution, relative to leaching pH, was not commensurate with antimony/cyanide chemistry cited in available literature.

RECOMMENDATIONS

We recommend that empirical or mineralogical work be conducted on composite RL-100C to identify antimony occurrence. This work may help clear up the mystery of antimony dissolution observed with this testing program.

Frank A. Macy
Project Manager