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Volume 8 ; Book 11

TOMBSTONE

Mining District

Cochise County

ARIZONA

1981 Discovery Process - Volume #2
May 1979 to July 1979

S. E. A. Inc. Notebook
Tombstone Heap Leaching Project
Volume II - May, 1979 to July, 1979

- 2-1. 5-6-79. Memo to JNB from WES
re: Trip to Tombstone on May 2, 1979
- 2-2. 5-10-79 - Letter to Tom Schloss from Inghelbaud Industries
re: Refining and Purchasing of gold dove bullion
- 2-3. 5-11-79 - Letter to JNB + DN from Tomco
re: Cash flow, tabulation of ore types, etc.
- 2-4. 5-11-79. - Operating agreement
- 2-5. 5-14-79 - Letter to Jay Kittle from Leo Smith
- 2-6. 5-18-79 - Letter to JNB from Jay Kittle
- 2-7. 5-22-79 - Letter to Tom Schloss from JNB
re: Amendment by mutual agreement of Letter of Agreement of March 7, 1979
- 2-7. 5-25-79 - Letter to JNB from Tom Schloss
re: Amendment by mutual agreement of Letter of Agreement of March 7, 1979
- 2-8. 5-30-79 - Letter to Dick Newlett from CMD
re: Expenses and returned checks
- 2-9. 6-4-79 - Letter to Bill Height from Tom Schloss
re: Check in the amount of \$7,500.00
- 2-10. 6-5-79 - Letter to First National from Tom Schloss
re: Check in the amount of \$3,500.00
- 2-11. 6-12-79. Phone message from WES to JNB to call Tom Schloss
- 2-12. 6-13-79. Preliminary agreement between T&I and John Dean
- 2-13. 6-18-79 Progress Report from Stevenson, Bishop + McCredie Inc
re: Limited

Volume II - May, 1979 to July, 1979
cont'd

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- 2-14 6-19-79 - Assay results on Tombstone done by Skyline Labs
- 2-15 6-20-79 - Memo to JRB from CMD
re: Prospecting Permits
- 2-16 6-22-79 - Letter to Richard Hewlett from JRB
re: Tom Schloss & Dr. John Dean visit - Evaluation
of Progress, Setting of Objectives
- 2-17 6-23-79 - JRB notes on meeting with Tom Schloss
and John Dean
- 2-18 6-23-79 - Dick Hewlett's notes
- 2-19 6-25-79 - Memo to Dick Hewlett from JRB
re: Check disbursement record
- 2-20 6-25-79 - JRB field notes on Tombstone
- 2-21 6-26-79 - Memo to Jacobs Assay Office from SEN
re: Samples delivered
- 2-22 6-26-79 - Memo to Dick Hewlett from John Dean
re: Silver Leaching and Thiosulfate + Precipitation
with zinc
- 2-23 6-27-79 - Letter to John Dean from WES
re: Transmittal of Tombstone Samples
- 2-24 6-27-79 - Memo to Dick Hewlett from John Dean
re: Silver Leaching with Thiosulfate
- 2-25 6-28-79 - Letter to JRB from John Dean
re: Handling Samples + ~~Feed~~ Feed Material
- 2-26 Notes of IC between JRB & Tom Schloss
- 2-27 6-30-79 - Bill from Jacobs Assay Office for \$208.⁰⁰
- 2-28 WES notes on additional work on Tombstone

- 2-29. 7-3-79. - Memo to JNB from JUV
re: Tombstone Payroll checks
- 2-30. Balance sheet for Tombstone Heap Leaching Project
- 2-31. 7-2-79. Memo to JNB from Tom Schloss
re: Purchase Order Policy
- 2-32. Balance sheet for Tombstone Heap Leaching Project
- 2-33. 7-7-79 - W&S map of Tombstone Heap Leaching Project
- 2-34. Balance sheet for Tombstone Heap Leaching Project
- 2-35. 7-3-79 - Memo to Dick Hewlett from John Dean
re: Comparative Thiosulfate
- 2-36. 7-30-79 - Memo to Dick Hewlett from John Dean
re: Experimental 200T Heap Leaches
- 2-37. Balance sheet for Tombstone Heap Leaching Project
- 2-38. JNB notes
- 2-39. 7-6-79 - Memo to JNB from Tom Schloss
re: 2 week program SET
- 2-40. 7-10-79 - Memo to Dick Hewlett from John Dean
re: Pretreatment of Ma-rich Emerald Mine Rock
- 2-41. 7-12-79 - Memo to JNB from John Dean
re: Selection & Evaluation of Tombstone Ore Samples
- 2-42. 7-13-79 - Memo to W&S from John Dean
re: Tombstone Ore Samples
- 2-43. 7-16-79 - Memo to Dick Hewlett from JNB
re: Assays Without P.O's
- 2-44. 7-18-79 - Memo to JNB from Dick Hewlett
re: Progress Report

Volume II - May, 1979 to July, 1979
cont'd

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- 2-45. 7-10-79 - Letter to Dick Hewlett from Janco
re: Combined Progress Report and "Pilot Test" Design
- 2-46. 7-19-79. Memo to Dick Hewlett from JAB
re: Sample Collecting Procedure
- 2-47. 7-19-79 - Memo to Dick Hewlett from JAB
re: Record Keeping
- 2-48. 7-19-79 - Report by Dick Hewlett on NaCN litigation
- 2-49. 7-17-79 - Memo to JAB from Dick Hewlett
re: Progress Report
- 2-50. 7-16-79 - Memo to JAB from John Dean
re: Mineralization & Leaching Characteristics of Tombstone Ore
- 2-51. 7-22-79 - Expense report by Dick Hewlett
- 2-52. 7-24-79 - Memo to Dwight Lee from Tom Schloss
re: Tombstone
- 2-53. 7-25-79 - Letter to Tom Schloss from Dave Rabb
re: Leaching operation
- 2-54. 7-27-79 - ~~Memorandum~~ Memo to JAB from Tom Schloss
re: Tombstone Report
- 2-55. 7-25-79 - Memo to JAB from CMD
re: Meeting with Dave Rabb & Tom Schloss
- 2-56. 7-15-79 - Tombstone Field Notes by JAB
- 2-57. Balance sheet for Tombstone
- 2-58. 7-24-79 - Memo to JAB from John Dean
re: Preliminary Tests on Heap - T&I Project
- 2-59. 7-23-79 - Memo to JAB from John Dean
re: Gold & Silver Production

Volume II - May, 1979 to July, 1979
Cont'd

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2-60. 7-31-79 - Memo to Dick Hewlett from JAB
re: Daily Reports

2-61. 7-31-79 - Memo to Dick Hewlett from JAB
re: Percy Dunning work

JULY 1979

DAY/TIMER

Time-Saver

LETTER

2-61

Southwestern Exploration Associates
4500 E. SPEEDWAY, SUITE 14
TUCSON, ARIZONA 85712

IN REFERENCE TO: *Perry Durning
Work*

FIRST CLASS MAIL INTER-OFFICE

FOR

R. F. Hewlett

HOW TO USE THIS

DAY/TIMER
Time-Saver LETTER TO SAVE TIME.

Type or write your reply in the space below. Then mail the white copy to us and keep the pink copy for your files. You'll save time and effort, and we'll have your answer much faster! Thank you.

MESSAGE

REPLY

DATE

7/31/79

DATE

FOLD

*Frick: As per my memo of 6/23/79
(xerox inclosure) I requested
a written memo explanation
of your report for Perry Durning.
I also requested a memo regarding
all other clients you've contacted
since Jan. 1, 1979 - to be on my
desk on July 1, 1979. I've received
neither of these.*

SIGNED

*See that they
are on my desk
Monday August 6, 1979
JFR*

SIGNED

DAY/TIMER
Time-Saver

REORDER FORM No. B2419L, DAY-TIMERS, Allentown, Pa. 18001

505

Southwestern Exploration Associates
4500 E. SPEEDWAY, SUITE 14
TUCSON, ARIZONA 85712

DAY/TIMER

Time-Saver

LETTER

d-60

P-418

IN REFERENCE TO:

*Daily Reports
Tombstone*

FIRST CLASS MAIL

INTER-OFFICE

FOR

Mr. R. F. Hewlett

HOW TO USE THIS

DAY/TIMER

Time-Saver

LETTER TO SAVE TIME.

Type or write your reply in the space below. Then mail the white copy to us and keep the pink copy for your files. You'll save time and effort, and we'll have your answer much faster! Thank you.

MESSAGE

REPLY

DATE

7/31/79

DATE

FOLD

Dick:

I arrived back in Tucson yesterday and found no daily reports from Tombstone on my desk.

By Friday Aug 3, 1979 I want daily reports to ~~start~~ thru 7/2/79 on my desk. By Monday 7/6/79 I want a summary weekly report for

SIGNED

the week of July 23 & July 30, 1979.

These are to be short - not more than 2 pages, concise and accurate.

JFB

SIGNED

DAY/TIMER
Time-Saver

REORDER FORM No. B2419L, DAY-TIMERS, Allentown, Pa. 18001

JUL 31 1979

By J. H. B.

July 23, 1979

Arizona Bureau of Geology & Mineral Technology

Geology Building Room 134, Univ. Arizona

Tucson, Arizona 85721

Memo of visits by

J. A. Briscoe

T. H. Schloss

J. G. Dean

David D. Rabb, Mining EngineerSubject: Gold and Silver Production, Tombstone Area

A brief visit with a tour of the metallurgical facilities was made on July 19, paving the way for a longer discussion on July 23. Mr. Rabb teaches a course on heap leaching and has become thoroughly familiar with the Tombstone area through his work for the state.

He advised that he felt cyanide leaching, especially by the heap technique with its low labor requirements, was the most promising method of treating the Tombstone ore. He appeared to be familiar with all of the older methods such as the Patio process, salt roasting, thiosulfate leaching, etc. and supplied on loan a photo copy of a book by M. Eissler, "Metallurgy of Silver", Van Nostrand 1891. He was also familiar with the work of the Bureau of Mines at Reno including the hypochlorite process, acid pretreatment, agglomeration for induced percolation, etc. and seemed to have high regard for the quality of the work there except perhaps for the economic interpretations.

Assays

Mr. Rabb stated that fire assays on samples properly prepared according to the Richard's rules were still regarded as the most reliable method of determining total gold and silver. Atomic absorption is best for determining leach solution concentrations; these data can be supplemented by fire assays on the tailings, and this combination of data permits establishment of an accurate metallurgical balance which provides a conclusive check.

Leaching Tests

Mr. Rabb confirmed that particle size was a key variable in leaching tests, first because of the critical relationship with the minimum permissible sample size, then as a factor both as to leaching rate and ultimate leachability. 200-300 pound barrel tests on samples crushed at least to minus 1" is one of the most effective leaching tests. He really prefers to crush to minus $\frac{1}{4}$ " for these tests as it speeds the extraction, facilitates comparisons between ores, and aids in the study of other key variables. Finer grinds should be used in testing smaller samples down to at least -100 mesh for bottle tests and fire assays involving 30-300 g. of ore.

Recoveries and Pretreatments

Mr. Rabb suggested that ores vary widely in their responses to leaching tests and that optimum economic results may be obtained at recoveries

of 20% or even less. The Tombstone ores contain precious metals in several forms which exhibit a wide range of responses to leaching. The manganese-rich components are typically refractory to leaching; acid pretreatments are not regarded as having practical potential in heap leaching for several reasons, such as the high quantities of acid required, e.g. 1000 lb/T ore, to react with the limestone, the formation of equally large quantities of $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ which expand and stop percolation, the dissolution of heavy metals such as zinc, copper, iron, etc. and related environmental hazards.

Heap Preparation

The preparation of an impervious pad for the heap is of great importance. The use of clays is preferred over plastic sheeting because the latter is likely to get perforated during the loading process and involve hidden leaks. Desert sands tend to be porous and are to be avoided. Old tailings can be very effective if the grind is fine enough. The pad should be tested by impounding water over specific areas and measuring the seepage loss as a function of time.

The control of particle size in setting up the heap is an important consideration, but the cost of crushing and extra handling must be more than offset by improved recoveries. Penetration of fissures in rocks by leach solutions takes time and may be only partially effective. The leach solution must penetrate to the minerals, dissolution occur and then the reverse migration take place. Dissolved values after reaching the interstices may still be lost by precipitation or adsorption as the solutions percolate down to the pad. Thus excessive fines can aggravate losses and slow percolation. A heap of minus 1" to 2" is often a good compromise, but good results may be achieved with coarser material and longer leach times.

Dissolved air in leach solutions is essential to the dissolution of gold and some silver minerals, notably sulfides. Better results are often obtained with the use of shallow lifts. New small lifts are added as extractions begin to wane. Continued recoveries at reduced rates from the lower lifts may be achieved over long periods, sometimes for years. Good heap leaching is an art but is facilitated by effective metallurgical control. Mr. Rabb suggested that Charlie and Louis Escapule have perfected a good technique for the Tombstone area.

Mining Control

Ore sampling and testing is important both for outlining economic reserves and for separating ore from barren reject material during the mining process. A trained geologist with pertinent experience can usually recognize visually suitable feed material and is essential to this part of the project. Mr. Rabb suggested that Bailey Escapule, a recent graduate in geological engineering, would be ideal for this work. He might be able to suggest other recent graduates and help in finding qualified people for other jobs in the operation.

JGDean:fm



JUL 31 1979

RECEIVED JUL 30 1979

2-58

By

JGD

July 24, 1979

Memo to: J. A. Briscoe, SEA, cc: THS, RFH

From : J. G. Dean

Subject: TEI Project. Preliminary Tests on Heap.

Dear Jim:

In accord with your suggestion for sampling the heap, we took one exploratory sample during our visit last week and carried it through an exploratory test procedure.

Dusty operated the backhoe with the objective of trenching a pit 2'x10'x10' deep. The sides tended to cave until the trench widened to 6-8', but we got a fair sample, split it with the backhoe and finally picked up about 500lb for transport in the scoop to the work area. This operation took about 30 minutes.

We then coned and quartered the sample on a plastic sheet, removing about 25% of plus 2½" pieces by handcobbing. The -2½" material contained perhaps 40% -¼" and seemed a good mixture for percolation testing.

Approximately 200lb dry basis was charged to a heavy plastic barrel and leached by recycling 2lb sodium cyanide/T plus lime for 4 hours. The leach solution remained virtually barren as judged by the sodium sulfide test. It seemed quite definite that further leaching of this particular area of the heap would yield at best very marginal results.

We then broke up the +2½" material with hand hammers until 10lb was reduced to about -1". The product did not contain many fines, perhaps 5-10% -¼"; it was leached by hand agitation in a pail. Within 30" we got positive silver dissolution estimated at 0.4Toz/T ore. This crude and preliminary test seemed to confirm the idea that there are recoverable values still present in the coarser pieces of the heap, but whether they are of any economic interest remains to be established.

We also made a 200lb barrel test on material brought down from the area of the cut where we crawled into the addit for our discussion. Within 10 minutes of leaching we got a very positive test for silver and the solution soon corresponded to greater than 5Toz/T in the feed. In contrast to the heap, there seems to be every encouragement to develop at least a conclusive test program for the Contention dike area.

A well organized sampling and test program could be quite expensive and time-consuming. It should lead to data showing realistic cyanide leaching results which can be expected from the method to be used, as well as ore reserves, mining costs, etc. My general impression is that we will have to beef up our technical capabilities by orders of magnitude to do a conclusive job and that the economic success of the program can not be taken for granted. It seems particularly important at this critical stage to project both a clear plan and a realistic budget.

John

501

23
Your copy

TOMBSTONE EXPLORATION - MAIN ACCOUNT

<u>DATE</u>	<u>PAID TO</u>	<u>PURPOSE</u>	<u>CHECK #</u>	<u>AMOUNT</u>
7/19/79	Mountain Bell	June telephone bills	2	384.86
7/20/79	Tombstone Exploration Salary Account	To cover salaries for week of 7/13/79	3	1300.00
7/20/79	Richard F. Hewlett	Expenses submitted 7/17/79	4	623.25
7/20/79		Deposit		5000.00
7/23/79	A. P. S.	Two Skyline Road June utility bills <i>— what's this</i>	5	882.88
7/23/79	Richard F. Hewlett	Expenses	6	457.25
7/24/79	Tombstone Exploration Salary Account	To cover salaries for week of 7/20/79	7	1200.00
7/24/79	McKesson Chemical (P. O. 6404)	Chemicals	1001	308.70
7/26/79	Eichenburger Nursery (P. O. 6393)	Supplies	1002	22.71
7/26/79	Postcraft Plastic Manf. (P.O. 6392)	Supplies	1003	55.33
7/27/79	Bearing, Belt & Chain (P.O. 6373)	Equipment	1004	27.19
7/27/79	Copper State Chemical (P. O. 6374)	Supplies	1005	85.44

500

2-57
REVIEWED
JUL 30 1979
By *JMB*

TOMBSTONE EXPLORATION - MAIN ACCOUNT

<u>DATE</u>	<u>PAID TO</u>	<u>PURPOSE</u>	<u>CHECK #</u>	<u>AMOUNT</u>
7/27/79	McKesson Chemical (P. O. 6375)	Supplies	1006	18.70
7/27/79	Hemco (P.O. 6376)	Supplies	1007	249.10
7/27/79	Tucson Scale & Food Equip. (P.O. 6385)	Supplies	1008	102.82
		Balance		144.64
EXPENSES:				
		July Payroll Taxes due 8/3/79 (approx)		2019.86
		Week of 7/27/79 Payroll (approx)		1300.00
		Robert Cowan - Bulldozer rental		1000.00
		Willett Transport Equip.- July & August		280.80
		Jacobs Assay Office-P.O. 6217		208.00
		Can-Am Corp. P.O. 5112		50.04
		TOTAL EXPENSES		4858.70
		TOTAL REQUIRED TO COVER EXPENSES		4714.06

667

PURPOSE IS TO CHECK SAMPLE AND LAY OUT SAMPLING PROGRAM ALONG THE CONTENTION DIKE RELATED TO TEST LEACH OF MATERIAL PICKED UP BY THE OLD EUCLID SCRAPER AT THE SOUTH END OF THE CONTENTION OPEN CUT, AND RAILROAD CUT.

TIME: 3:21 MILEAGE: DATE: JULY 15, 1979
PROJECT NO: 418 BY: JAB
FIELD NO: P-JAB-75-16, P-JAB-75-17, P-JAB-75-18, P-JAB-75-19, P-JAB-75-20

OFFICE NO:
STATE: ARIZONA COUNTY:
AREA: TOMBSTONE
T: R: SEC:

FIELD PLOT: THE SOUTH END OF THE CONTENTION OPEN CUT
COMMENTS:

PANNING LEFT TO RIGHT, LOOKING NORTHWESTWARD TOWARDS THE SOUTH END OF THE CONTENTION OPEN CUT AND ITS ENVIRONS. PHOTO 16 LOOKS APPROXIMATELY DUE WEST AND SHOWS PAD WITH CYCLONE FENCE AROUND IT AND SOME KIND OF A CRANE TOWER OR OTHER RIGGING. PANNING TO THE RIGHT, FRAME 17 SHOWS THE HEAD FRAME AT ABOUT 100 FEET SOUTH OF THE RAILROAD CUT AND THE CONTENTION OPEN STOPE. FRAME 18 IS ALMOST EXACTLY THE SAME BUT IT PANS A LITTLE FURTHER TO THE RIGHT. THIS SHOWS THE ENTIRE AREA OF BULLDOZER-SCRAPER WORKINGS THAT DICK HEWLETT SUPERVISED THE WORK ON LAST WEEK. THE CAT-B6B BULLDOZER CAN BE SEEN BEHIND THE HEAD FRAME. THE '79 BLAZER, TAN WITH WHITE TOP, CAN BE SEEN WITH THE FRONT END POINTING TOWARD THE SOUTH END OF THE CONTENTION OPEN STOPE. TO THE LEFT OF THE BLAZER IS THE RAILROAD CUT WHICH IS ABOUT 20 TO 30 FEET DEEP, AND TO THE LEFT OF THAT IS A RECENT BULLDOZER AND SCRAPER CUT, AND FURTHER TO THE LEFT OF THAT RECENT CUT IS THE HEAD FRAME WITH THE DUMP AROUND IT HAVING BEEN RECENTLY CUT BY THE BULLDOZER AND SCRAPER AND CARRIED AWAY. FOUR STAKES WITH PINK FLAGGING ARE VISIBLE IN THIS FRAME. FROM LEFT TO RIGHT THEY ARE LABELED STAKES 4, 3, 1 AND 2. THEY ARE, RESPECTIVELY, THE STAKE IN THE FOREGROUND BETWEEN THE CAMERA AND THE HEAD FRAME; THE CLOSE-UP WILL SHOW THAT IT IS ON CARBON MATERIAL CONTAINED WITHIN THE DUMP. STAKE 3 IS RIGHT AT THE BASE OF THE HEAD FRAME DUMP WHICH HAS RECENTLY BEEN CUT BY THE BULLDOZER. THESE STAKES ARE APPROXIMATELY 4 FEET LONG AND HAVE BEEN EMBEDDED APPROXIMATELY 8 INCHES TO 1 FOOT IN THE GROUND. THIS WILL GIVE SOME SCALE TO THE PHOTOS. (CONT...)

TIME: MILEAGE: DATE: JULY 15, 1979
PROJECT NO: 418 BY: JAB
FIELD NO:

REVIEWED 498
SEP 3 1979
BY: JMB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:

SEC:

FIELD PLOT:
COMMENTS:

STAKE 1 SHOWS THAT WHILE SOME SCRAPING WAS DONE ON THE RAILROAD CUT, SUBSEQUENT TO THE SCRAPING ON THAT CUT THE HILL TO THE LEFT OF STAKE 1 HAS BEEN PUSHED DOWN, BLOCKING THE SOUTHERN ENTRANCE TO THE RAILROAD CUT. STAKE 2 IS IN THE RAILROAD CUT. TO THE RIGHT IS THE BLAZER AGAIN. FRAME 19 PANS FURTHER TO THE RIGHT AND SHOWS A DUMP ON THE SIDE OF THE HILL LYING TO THE EAST OF THE CONTENTION DIKE STOPE WHICH CONSISTS OF BISBEE GROUP SEDIMENTS. I WILL NOW WALK TOWARD STAKES 4 THROUGH 2 AND TAKE ADDITIONAL VIEWS SHOWING DETAILS OF THIS SCENE.

TIME: 3:31 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-21

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:

SEC:

FIELD PLOT:
COMMENTS:

THIS FRAME LOOKS NORTH TOWARD THE CONTENTION OPEN STOPE ON THE RIGHT IN FRONT OF THE '79 BLAZER, AND THE RAILROAD CUT TO THE LEFT. THE SAME STAKES WITH PINK FLAGGING ARE VISIBLE. THEY ARE, FROM LEFT TO RIGHT, STAKE 3 NEXT TO THE EXCAVATED HEAD FRAME DUMP, STAKE 4 AROUND THE BASE OF WHICH MAY BE SEEN BLACK CARBON MATERIAL AND STAKE 1 IN THE BACKGROUND NEAR THE BLAZER WHICH IS AT THE ENTRANCE TO THE RAILROAD CUT. IN THE FOREGROUND OF THIS FRAME IS A PIECE OF PIPE STICKING OUT WHICH IS A LIKE A PIECE OF PIPE LOCATED IN THE MATERIAL HAULED TO THE TEST LEACH PAD. THE CARBON AROUND THE BASE OF STAKE 4 IS ALSO SIMILAR TO THAT VISIBLE ON THE TEST LEACH PAD.

TIME: 3:35 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-22, P-JAB-75-23

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:

SEC:

497

REVIEWED

SEP 3 1979
BY: AMB

page 3 of 10

FIELD PLOT:
COMMENTS:

LOOKING ALMOST DUE EAST WITH A CLOSE-UP VIEW OF THE PIPE, WHICH IS OF OLD MODEL A CAR BODY MATERIAL, AND MESQUITE ROOTS IN THE FRAME BEHIND THE PIPE AND IN FRONT OF THE OLD CAR METAL. THE TOMBSTONE HILLS MAY BE SEEN IN THE BACKGROUND OF THIS FRAME. FRAME 23 IS A DUPLICATE OF THE PRECEDING FRAME WITH A CHANGED EXPOSURE AND FOCUS SETTING.

TIME: 3:37 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-24

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

STAKE 4 IS WITHIN 10 FEET OF THE CAMERA, STAKE 1 IS IN THE BACKGROUND AS IS THE '79 WHITE AND TAN BLAZER. AT THE BASE OF STAKE 4 IS CARBON MATERIAL WHICH HAS BEEN PICKED UP AND TRANSPORTED TO THE TEST HEAP.

TIME: 3:39 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-25

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

LOOKING NORTHWEST WITH STAKE 4 IN THE LEFT FOREGROUND. STAKE 3, DETAILING THE CUT ON THE HEAD FRAME DUMP WHICH CAN ALSO BE SEEN IN THE MIDDLE PORTION OF THIS FRAME WITH THE CAT-B6B IN THE BACKGROUND. NOTE THE FRESHNESS OF THE CUT ON THE DUMP IN THIS FRAME.

TIME: 3:41 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-26

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA

COUNTY:

REVIEWED

SEP 3 1979

By: *[Signature]*

496

AREA: TOMBSTONE
T: R:

SEC:

FIELD PLOT:
COMMENTS:

LOOKING NORTHWEST TOWARDS STAKE 2 AND STAKE 1. AT THIS POINT I THINK I'M GOING TO HAVE TO GO BACK AND CORRECT AN ERROR WHICH I MADE. THE STAKE LABELED 2 IS AT THE ENTRANCE TO THE SOUTH END OF THE CONTENTION RAILROAD CUT WHERE STAKE 1 IS ACTUALLY WITHIN THE CUT. I THINK I HAD THESE REVERSED IN MY PREVIOUS NOTES. AT ANY RATE, THIS FRAME LOOKS NORTHWEST INTO THE SOUTH END OF THE CONTENTION RAILROAD CUT. IN THE FOREGROUND OF THIS FRAME NOTE NUMEROUS PIECES OF CHARCOAL, THE SOURCE OF WHICH APPEARS TO BE THE HEAD FRAME DUMP SCATTERED IN THE ROADWAY. ALSO NOTE IF POSSIBLE SCRAPER TRACKS INDICATING THAT A SCRAPER WAS USED TO PICK THIS MATERIAL UP.

TIME: 3:44 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-27

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

THIS FRAME LOOKS DUE WEST. IN THE LEFT-HAND PORTION OF THIS FRAME THE MINE HEAD FRAME CAN BE SEEN WITH STAKE 3 IN FRONT OF THE REMAINDER OF THE DUMP. TO THE RIGHT, STAKE 2 MAY BE SEEN IN THE SCRAPER SPOIL BELOW THE CAT-B6B BULLDOZER. THE '79 BLAZER CAN BE SEEN IN THE RIGHT-HAND PORTION OF THIS FRAME AND ITS POSITION HAS OF COURSE REMAINED CONSTANT DURING THIS PHOTOGRAPHY. NOTE GRAY COLORATION IN ROAD IN LOWER LEFT PORTION OF FRAME, INDICATING PRESENCE OF CHARCOAL SHOWN IN THE PRECEDING PHOTO.

TIME: 3:46 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-28

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:

495

REVIEWED

SEP 3 1979

BY: [Signature]

COMMENTS:

PANNING TO THE RIGHT FROM THE SAME LOCATION AS PHOTO 27.

TIME: 3:47 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-29

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

LOOKING WEST SOUTHWEST FROM THE SOUTH FLANK OF CONTENTION HILL TOWARDS THE MINE HEAD FRAME. FROM LEFT TO RIGHT I BELIEVE THAT YOU CAN SEE STAKE 3 AT THE BASE OF THE REMAINDER OF THE HEADFRAME DUMP. STAKE 2 CAN BE SEEN JUST ABOVE THE ROOF OF THE TAN AND WHITE BLAZER, INDICATING THE ENTRANCE OR SCRAPER ROAD FROM THE RAILROAD CUT HAS BEEN OBLITERATED BY MORE RECENT SCRAPER ACTIVITY ALONG THE SCRAPER TRAIL TO THE NORTH OR RIGHT-HAND SIDE IN THIS FRAME, OF THE HEAD FRAME. STAKE 1 CAN BE SEEN IN THE FAR RIGHT-HAND PORTION OF THIS FRAME.

TIME: 3:51 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-30

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

LOOKING SOUTH SOUTHEAST FROM INSIDE THE CONTENTION RAILROAD CUT TOWARDS THE SOUTHEAST. STAKE 1 CAN BE SEEN IN THE FOREGROUND WITH STAKE 2 IN THE BACKGROUND. THE TAN AND WHITE '79 BLAZER MAY BE SEEN IN THE LEFT PORTION OF THE FRAME.

TIME: 3:53 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-31

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA

COUNTY:

REVIEWED

SEP 3 1979

By *[Signature]*

494

AREA: TOMBSTONE
T: R: SEC:

FIELD PLOT:
COMMENTS:

LOOKING IN THE SAME DIRECTION, THAT IS, SOUTH SOUTHEAST, BUT FROM THE LOCATION OF STAKE 1. STAKE 2 CAN BE SEEN ON THE BERM FORMED BY THE RECENT SCRAPER SPOIL AND CUTTING OFF ACCESS TO THE RAILROAD CUT SCRAPER TRAIL. ALSO NOTE IN THE FOREGROUND OF THIS FRAME THE PRESENCE OF A BUSH WHICH HAS NOT BEEN DUG OUT, INDICATING VERY SHALLOW IF ANY SCRAPER EXCAVATION. THE '79 BLAZER MAY BE SEEN IN THE LEFT-HAND PORTION OF THIS FRAME.

TIME: 3:57 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-32

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

LOOKING NORTHWESTWARD OVER THE SAN PEDRO VALLEY FROM THE INSIDE OF THE CONTENTION RAILROAD CUT. IN THE FOREGROUND OF THIS FRAME NOTE THE 2-FOOT BERM WITHOUT TIRE TRACKS ON IT, WHICH INDICATES THE SCRAPER WAS NOT LOADED IN THIS DIRECTION. OBVIOUSLY IF ANY SCRAPER WORK WAS DONE IN THIS CUT, IT WAS DONE GOING DOWNHILL FROM NORTHWEST TO SOUTHEAST TOWARDS THE SOUTH END OF THE CUT AND THERE IS LITTLE EVIDENCE THAT ANY SUBSTANTIAL AMOUNT OF MATERIAL WAS MOVED. THE BERM SHOWS IN THIS PHOTO THERE IS NO CHANCE THAT MATERIAL WAS HAULED IN A NORTHWESTERLY DIRECTION ASIDE FROM THE INABILITY OF THE SCRAPER TO TURN ON THE ROAD RUNNING AN APPROXIMATE ACUTE ANGLE TO THE RAILROAD CUT. IN THIS FRAME WILD TOBACCO PLANTS GROW ON THE FAR SIDE OF THE ROAD AND OVERLOOKING THE CANYON WHICH LIES TO THE WEST OF THE CONTENTION OPEN CUT.

TIME: 3:59 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-33

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

493

REVIEWED

SEP 3 1979
BY: *AMB*

FIELD PLOT:
COMMENTS:

LOOKING SOUTHEAST FROM THE TOBACCO PLANTS SHOWN IN THE PREVIOUS FRAME THROUGH THE CONTENTION RAILROAD CUT TOWARDS STAKE 1 IN THE FOREGROUND AND STAKE 2 IN THE BACKGROUND. THE '79 WHITE AND TAN BLAZER IS JUST OUT OF SIGHT TO THE LEFT OF THE SOUTH ENTRANCE TO THE RAILROAD CUT.

TIME: 4:02 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-34

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

LOOKING SOUTHEAST TOWARD THE NORTHWEST END OF THE CONTENTION RAILROAD CUT. THE HEAD FRAME CAN BE SEEN IN THE BACKGROUND JUST ABOVE THE CONTENTION RAILROAD CUT, AND TO THE RIGHT OF THE HEAD FRAME MAY BE SEEN THE YELLOW TOP OF THE B6B CAT.

TIME: 4:04 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-35

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

A CLOSER VIEW OF THE CONTENTION RAILROAD CUT. THIS FRAME SHOWS THAT THE FRESH BULLDOZER-SCRAPER MARKINGS END JUST A LITTLE BIT TO THE NORTHWEST OF THE ENTRANCE TO THE RAILROAD CUT AND PROCEED UP THE HILL TO THE SOUTH TO THE PRESENT LOCATION OF THE B6B CAT SEEN IN THIS FRAME.

TIME: 4:07 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-75-36

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA

COUNTY:

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REVIEWED

SEP 3 1979

JAB

AREA: TOMBSTONE

T: R:

SEC:

FIELD PLOT:
COMMENTS:

LOOKING SOUTHWARD TO THE NORTHWEST END OF THE CONTENTION RAILROAD CUT AT THE END OF THE RECENT BULLDOZER ROAD. THIS VERIFIES THE ROAD DID NOT GO ANY FURTHER TO THE NORTHWEST AT THIS DATE. THE HEAD FRAME IS JUST OUT OF SIGHT TO THE LEFT IN THIS FRAME, ALTHOUGH YOU CAN REFERENCE THIS FRAME BY THE TOBACCO PLANTS THAT WERE VISIBLE IN THE NORTHWESTERLY POINTING VIEW LOOKING OUT AT THE CONTENTION RAILROAD CUT TO THE NORTHWEST OVER THE SAN PEDRO VALLEY.

TIME: 4:33 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-76-1

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

THIS VIEW LOOKS NORTH, NORTHEASTERLY FROM THE WEST RAMP TOWARDS THE TEST LEACH TAKEN FROM THE SOUTH END OF THE CONTENTION DIKE AREA. RFH TOLD TOM SCHLOSS THAT THIS IS READY TO START BEING LEACHED MONDAY. IT IS NOW SUNDAY AFTERNOON AT 4:35. THE STAKES WITH THE RED FLAGS ARE APPROXIMATELY 1 FOOT IN LENGTH. FROM RIGHT TO LEFT THEY ARE NUMBERED STAKE 1, 2, 3, 4 AND THEN IN THE NORTH END OF THE APPROXIMATELY TRAPEZOHEDRAL-SHAPED PILE OF DUMP MATERIAL IS STAKE 5. CLOSE-UPS WILL BE SHOWN OF THESE STAKES AND WHEN THESE ARE SEEN A LINE AT THE BOTTOM OF THE STAKES MARKS THE 1-FOOT LENGTH BETWEEN THE TOP OF THE STAKE AND THE BLACK LINE. STAKE 2 IS NEXT TO CARBON TRASH IN THE DUMP MATERIAL AS IS STAKE 3. A ROLOTAPE WILL BE USED TO MEASURE THE APPROXIMATE DIMENSIONS OF THIS MATERIAL WHICH CAN BE SEEN FROM THE LENGTHS OF THE STAKES IS GENEROUSLY 1 FOOT THICK.

TIME: 4:38 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-76-2

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE

COUNTY:

491

REVIEWED

SEP 3 1979

JAB

T: R: SEC:

FIELD PLOT:
COMMENTS:

THIS VIEW IS TAKEN FROM THE TOP OF THE MINERAL 71 HEAP ON THE NORTHWEST (???? -- STATIC). AGAIN, THE STAKES MAY BE SEEN AND USED FOR REFERENCE. IN THIS FRAME, GOING COUNTER-CLOCKWISE, ARE STAKE 1, STAKE 2, 3, 4 AND 5 IN THE FAR RIGHT-HAND PORTION OF THIS FRAME. BLACK MATERIAL BY STAKES 2 AND 3 IS CARBON TRASH PREVIOUSLY NOTED. NOTE LENGTHS OF BENT PIPE ADJACENT TO STAKE 1. IT SHOULD ALSO BE NOTED HERE THAT THERE IS NO EVIDENCE OF ANY COLLECTION SYSTEM WHICH WOULD BE USED TO COLLECT (????) ON MONDAY WHEN THE LEACHING BEGINS.

TIME: 4:46 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-76-3

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

LOOKING NORTH, AN INTERMEDIATE CLOSE-UP OF STAKE 1 SHOWING BENT PIPE SIMILAR TO THAT ON THE HEAD FRAME DUMP. SHOWN IN THIS PICTURE IS THE ROLOTAPE WHICH WILL BE USED TO MEASURE THE SIZE OF THIS DUMP. NOTICE THAT (????) BETWEEN THE TOP AND THE BLACK LINE A 1-FOOT THICKNESS IS GENEROUS FOR THIS TYPE OF MATERIAL.

TIME: 4:48 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-76-4

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:

STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

LOOKING NORTHERLY AT STAKE 2 FROM APPROXIMATELY 10 FEET, WITH STAKE 5 IN THE BACKGROUND AND THE PLANT AND SCRAPER ALSO VISIBLE. NOTE CHARCOAL AROUND THE BASE OF STAKE 2.

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REVIEWED

SEP 3 1979

JAB

page 12 of 20

TIME: 4:50 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-76-5, P-JAB-76-6

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

AT STAKE 3 LOOKING NORTH. PHOTO 5 SHOWS THE ROLOTAPE IN THE FOREGROUND WITH STAKE 3 AND THE CARBON MATERIAL IN THE BACKGROUND, WHILE PHOTO 6 SHOWS A MORE CLOSE-UP VIEW OF CARBON-RICH MATERIAL.

TIME: 4:52 MILEAGE:
PROJECT NO: 418
FIELD NO: P-JAB-76-7

DATE: JULY 15, 1979
BY: JAB

OFFICE NO:
STATE: ARIZONA
AREA: TOMBSTONE
T: R:

COUNTY:
SEC:

FIELD PLOT:
COMMENTS:

FROM THE INTERIOR PART OF THE HEAP LOOKING NORTH TOWARD STAKE 5 AND THE PLANT AND SCRAPER. IN THE FOREGROUND OF THIS FRAME IS SOME METAL TRASH ALONG WITH PLANT TRASH AND WHITE ROCK MATERIAL. THE METAL TRASH APPEARS TO COME FROM THE AREA OF THE PIPE AND THE MODEL T CAR TRASH VISIBLE IN THE DUMP SOUTH OF THE CONTENTION DIKE, WHILE THE WHITE MATERIAL IS OBVIOUSLY FROM THE SAME LOCATION. THIS IS A MEASUREMENT NOTE: I AM NOW USING THE ROLOTAPE AND GOING CLOCKWISE FROM STAKE 1 TO STAKE 4 WHICH IS 74 FEET. GOING FROM STAKE 4 TO STAKE 5 WE GO FROM 74 FEET TO 131 FEET. THEN FROM STAKE 5, TURNING ABRUPTLY AND GOING DIRECTLY TOWARD STAKE 1, THE POINT OF ORIGIN, WE GO FROM 131 FEET TO 210 FEET WHICH IS THE PERIMETER OF THE DUMP IN A ROUGH TRIANGULAR SHAPE. PLEASE REFERENCE PHOTO 2 TAKEN FROM THE TOP OF THE HEAP AT THE TEST DUMP.

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REVIEWED

SEP 5 1979

JAB

Southwestern Exploration Associates
4500 E. SPEEDWAY, SUITE 14
TUCSON, ARIZONA 85712

DAY/TIMER
Time-Saver

LETTER

2-55

IN REFERENCE TO:
David Rabb - 10:30 a.m.
Meeting, Monday, July 30

FIRST CLASS MAIL INTER-OFFICE

FOR JAB

HOW TO USE THIS

DAY/TIMER
Time-Saver LETTER TO SAVE TIME.

Type or write your reply in the space below. Then mail the white copy to us and keep the pink copy for your files. You'll save time and effort, and we'll have your answer much faster! Thank you.

MESSAGE

REPLY

DATE 7/25/79

DATE 7/29/79 FOLD

Tom Schloss asked that I set up an appointment between you and David Rabb for Monday, 7/30. That meeting is scheduled for 10:30 a.m. here at S.E.A. and is to discuss the availability of personnel. Tom & Dr. Dean met with Mr. Rabb on Monday, July 23 for breakfast. Tom is leaving on a trip on Tuesday, July 31 and would like to discuss the events of your meeting with Mr. Rabb before he (Tom) leaves.

Let me know if there's anything else I can do.

WELCOME BACK -- HOPE YOU HAD FUN!

P-418

SIGNED

Chris
Chris

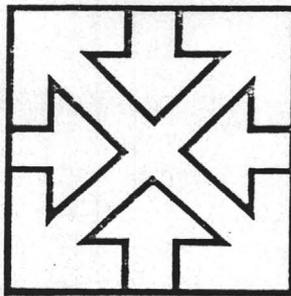
SIGNED

Thanks.
Monday's
partly full - lets
see if we can
get together on
Tuesday
[Signature]

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Consultants in:

- base & precious metals • uranium
- coal • geothermal • environment
- remote sensing • color aerial photography
- interpretation-image processing
- Worldwide Mobilization



4500 E. Speedway, Suite 14
Tucson, Arizona 85712
(602) 795-6097

James A. Briscoe, President
Registered Professional
Geologist

**Southwestern
Exploration Associates, Inc.**

July 27, 1979

Mr. Tom Schloss
FAMCO
1700 Broadway, 22nd Floor
New York, N.Y. 10019

Dear Tom,

Enclosed please find the cash disbursements for the period
of 7/19/79 to 7/27/79, for the Tombstone Exploration-Main
Account #955-16344.

Thank you,

Judy M. Urias

Judy M. Urias
Asst. Bookkeeper

JMU
P-418
Encl.

TOMBSTONE EXPLORATION - MAIN ACCOUNT

<u>DATE</u>	<u>PAID TO</u>	<u>PURPOSE</u>	<u>CHECK #</u>	<u>AMOUNT</u>
7/19/79	Mountain Bell	June telephone bills	2	384.86
7/20/79	Tombstone Exploration Salary Account	To cover salaries for week of 7/13/79	3	1300.00
7/20/79	Richard F. Hewlett	Expenses submitted 7/17/79	4	623.25
7/20/79		Deposit		5000.00
7/23/79	A. P. S.	Two Skyline Road June utility bills	5	882.88
7/23/79	Richard F. Hewlett	Expenses	6	457.25
7/24/79	Tombstone Exploration Salary Account	To cover salaries for week of 7/20/79	7	1200.00
7/24/79	McKesson Chemical (P. O. 6404)	Chemicals	1001	308.70
7/26/79	Eichenburger Nursery (P. O. 6393)	Supplies	1002	22.71
7/26/79	Postcraft Plastic Manf. (P.O. 6392)	Supplies	1003	55.33
7/27/79	Bearing, Belt & Chain (P.O. 6373)	Equipment	1004	27.19
7/27/79	Copper State Chemical (P. O. 6374)	Supplies	1005	85.44

TOMBSTONE EXPLORATION - MAIN ACCOUNT

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<u>DATE</u>	<u>PAID TO</u>	<u>PURPOSE</u>	<u>CHECK #</u>	<u>AMOUNT</u>
7/27/79	McKesson Chemical (P. O. 6375)	Supplies	1006	18.70
7/27/79	Hemco (P.O. 6376)	Supplies	1007	249.10
7/27/79	Tucson Scale & Food Equip. (P.O. 6385)	Supplies	1008	102.82
		Balance		144.64
		EXPENSES:		
		July Payroll Taxes due 8/3/79 (approx)		2019.86
		Week of 7/27/79 Payroll (approx)		1300.00
		Robert Cowan - Bulldozer rental		1000.00
		Willett Transport Equip.- July & August		280.80
		Jacobs Assay Office-P.O. 6217		208.00
		Can-Am Corp. P.O. 5112		50.04
		TOTAL EXPENSES		4858.70
		TOTAL REQUIRED TO COVER EXPENSES		4714.06

TOMBSTONE

Attn: Mr. James Briscoe:
HIGHLY CONFIDENTIAL REPORT

From: T.H. Schloss

Date: July 27, 1979

On Monday 7/23/79 John and I met for a 7:30 a.m. breakfast meeting with David Robb of the University of Arizona. Since he works for the State there was no charge.

He was familiar with Tombstone and has worked with Charlie Escapule. He knew Richard Hewlett and stated unsolicited that he felt Hewlett had run promotions before and has advised Charlie Escapule to disassociate himself from Richard Hewlett. He offered that a type of promotion used in Tombstone was to find a small high grade body of ore and raise money on that information. He was quite candid and stated he could be sued for the information he was giving us.

Other points he made are summarized below:

1. After describing our current pad, he suggested testing it by digging down and seeing if cyanide penetrated. (Implemented start of test on 7/23/79). 7/25/79 test results inconclusive and to be re-done.
2. He felt that our sampling program was an economical approach. Also, that his student, Bailey Escapole, (Charlie's son) would be an asset. (Implemented 7/23/79) 7/25/79 Baily Escapule is working half days to supervise the program.
3. Dean described to Robb some of Hewlett's chemical solutions. Robb felt the acid consumption that Hewlett indicated of 200 lbs per ton of ore was more probably 1000 lbs per ton of ore. This information has been available free of charge for the last six months in Tucson, we just needed to ask.
4. Robb teaches leaching at the University and wanted to become involved for personal career objectives in our project. He felt we should pay Charlie and Louie for helping with the plant construction, proper placement of ore on the lifts, and the chemistry. John and I implemented lifts strategy of 30 ton truck and front end loader. We will give geological information on our contention ore to Charlie and Louie, and when John and I are in Tombstone in September we will meet with them to discuss our operations.
5. Robb has available a list of people for us to use in Tombstone. Some are his students who may not be fully trained, but want to go into this field. He would like for each of us to be guest lecturers in his class - (please implement in order to augment our work force). 7/25/79 - Chris has made an appointment for you at 10:30 am to dis-

TOMBSTONE
July 27, 1979
Mr. James Briscoe
Page 2

cuss personal requirement for Tombstone.

Please supply me with a list of consultants, students, and other mines with similar operations, so that when Dwight is out in August he can interview. Then I can schedule final interviews for September.

In conclusion, David Robb confirmed what John and I had felt all along. As he was known to you, Jim, why did we not meet him before? Having to work with unqualified high priced people when alternatives are available is not only a waste of our time and money but a depleting and debilitating methodology, which in itself can destroy the potential of this project.

T.H.S.

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2-53

State of Arizona
Bureau of Geology and Mineral Technology

Mineral Technology Branch
University of Arizona
Tucson, Arizona 85721
(602) 626-1943



July 25, 1979

Mon 18:30

Mr. Thomas H. Schloss
Chairman of the Board
Famer Securities, Inc.
1700 Broadway
New York, New York 10019

Dear Tom:

Attached are rough notes pertaining to the matter we discussed Monday.

As I said, the Arizona Bureau is always ready to help in any way we can with any mining or leaching operation in this area.

I would like very much to keep in touch if I may.

Thank you for your consideration.

Sincerely,

A handwritten signature in cursive script that reads "Dave".

David D. Rabb
Mining Engineer-Metallurgist

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Richard Travis
Box 1201
Morenci, AZ

'79 graduate of UofA, Met. (good student)
Native Arizonan
Phelps-Dodge 865-3772

16-5
Robert Allgood
Cyprus Bagdad Copper Co. "
P.O. Box 1067
Bagdad, AZ 86321

'79 graduate of UofA, Met. (good student)
Native Arizonan
Home phone 633-2597
Cyprus Bagdad 633-2241 ext. 317

*Needs information
available*

Samuel Rudy
601 N. Evelyn
Tucson, AZ

BS Met. UofA, MS Met. Univ. of Nevada
Age about 30
Home phone 886-1850

Keith Crandall
Mesa, Arizona
(no mailing address)

'77 graduate of UofA, Met.
He set up Vekol
833-8670, 834-8055

Consultants

	<u>office</u>	<u>home</u>
George Roseveare	746-1451 (Tsn)	325-5790
George M. Potter	792-2800 (Tsn)	884-9609
Clem Chase	792-2800 (Tsn)	
Charles Escapule	475-3601 (Tombstone)	
E. E. Malouf	(801) 359-4005	Salt Lake City, Utah

also: Douglas J. Robinson, Ph.D. Met.
Office 626-1943
Home 886-7063

Canadian, age about 32
Metallurgist, AZ Bureau of Geology
and Mineral Technology
Hardworker, pleasing personality
Can work with people

*only school w/ BS. - \$16k
MS - \$18.5k
PhD \$32*

Saturday 6:30PM

Dear Jim,

I felt since I will be out of town in August I would send you a copy of my internal memo to Dwight.

Please give Dwight and John any help you can during this month.

My best to Lexi.

Jim

AMCO / 1700 Broadway • New York, New York 10019 • (212) 247-0420

480

TOMBSTONE:

TO: D.E.L.
FROM: T.H.S.
DATE: 7/24/79

1. Scientific Test of Metallurgy - Inconclusive in its conclusion of the silver melt, and disaster in its implementation. No proper measurements nor explanations given for inadequate techniques.
2. Pad - No test made to make sure pad was not leaking. Implementing test.
3. Heap - D.H. wanted to spray with cyanide - experimental barrel test showed no value at 18 feet down on heap. Course material broken up by hand - results - inconclusive but some potential - no further work to be done.
4. Open Pit - No ore control, no analysis of grade or crushing. Implementing sampling technique with barrell tests. Further refinement needed.
5. Personnel - willing to use for ore control a person who had absolutely no training in mining. Highered Baily Escapule - quit 7/27/79.
6. Financial - No budget for capital or personnel. Currently inadequate and needs further implementation.
7. Ore - Found high value ore but no way of currently measuring amount. I am concerned that this is a technique used by other promotors in Tombstone area.
8. Documentation - None on metalurigical test as it was progressing. Awaiting conclusion of test.
9. Cash flow - Grossly negative, - no end in sight.
10. Waste dump - No plan made until suggestions from me that it not be put on possible ore body.

./.

Page 2 contd.

11. On-sight building - No personal contact by Richard Hewlett to determine their status.

12. Tombstone Bank relations - Only bank in town will not cash our checks. Will talk to bank manager, Alan Morgan 602-457-2213. Call on Monday and transfer our account to him.

13. Leach method - After breakdown of our old scra D.H. was going to lease a new one, instead of implementing a front end loader and 30 ton truck strategy.

14. De-airization tower - Dick proposed one large de-airization tower. No standard parts, and no resale value. Implemented two standard towers which are off the shelf and can split the plant in half.

T.H.S.

THS/ijw

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Dick Hewlett

2-57

7/22/79

<u>Item</u>	<u>Aug</u>	<u>Sept.</u>
Salaries/Wages	\$ 7,000	\$ 8,000
SEA. (Geol.) - ^{\$25/yr} 25/yr	1,000	500
Exp.	200	
Lab	6,530	500
Typewriter	750	50
Back hoe	450	200
Fuel Diesel	400	400
Gas		
Jay Rental	300	300
Drilling	2,000	-
Sample Bags	200	200
Picks	100	100
Respiration Tower		\$ 3000
Truck (35 Ton)		} \$ 25,500
Dozer		
Loader		
Water Truck		
Welder/Torches		300
Air Compressor		250
Tools		200
PVC - Pipe/Fittings		\$ 3,000
Pond Liner		900
Start-up Chemicals		\$ 12,000

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RECEIVED JUL 19 1979

July 16, 1979

Memo to: J. A. Briscoe, SEA; cc: THS, RPH, WES.

From : J. G. Dean

Subject: Mineralization and Leaching Characteristics of Tombstone Ores.

Dear Jim:

With further reference to my memo to you of 7/12 and the one to Ed of 7/13, the samples from the heap recently supplied by Ed give a good crosssection of the mineralogy, except for the silver halides, and the obstacles to extraction of gold and silver by various schemes. The samples subsequently supplied by Dick do seem to contain some silver halides and are proportionately more responsive to direct leaching.

Sample 002209 representative of the Mn-rich rocks on the south end of the heap with a Jacobs fire assay of Au .01, Ag 7.30 Toz/T turned out to contain almost 3% copper present as basic carbonates directly leachable in ammonia- ammonium carbonate solution. A substantial part of the silver dissolved along with the copper as though it were present as a double carbonate instead of being associated with the manganese oxides. Material of this type could range from a cyanocide nuisance to a valuable feed in its own right.

There appears to be definite potential in selected pretreatments for specific ore fractions for liberating the values such as acid for the hydroxy sulfates and possibly for the manganese oxides, especially in association with reducing agents; and in the use of oxidizing agents such as hypochlorite for releasing silver and gold locked in base metal sulfides and carbonaceous materials. Effective combinations of these reagents might be applied with special effectiveness in a milling operation with a specific feed.

There seems to be very limited potential for applying pretreatments, especially those involving a sequence of reagents, in typical heap leaching. There seems to be no potential for applying combination leaching methods to the present heap because of the conglomeration of minerals present and excessive consumption of reagents in an unproductive way, e.g. inter-reaction between calcite and limestone with sulfuric acid before attack on the jarosite.

The ideal feed material is one with a substantial part of the silver present as halides with a well defined tendency for these halides to be exposed along fracture planes rather than being shot through the ore mass so as to be accessible only in fine grinding. The other silver minerals form a kind of spectrum of leachability which extends down from the halides to almost nil for the silver locked in silicates and some of the sulfides. The first important clues can be gotten from the mineralogy, but realistic tank and heap leaching tests are probably essential for conclusive planning. The closest possible coordination of all these factors is urgently needed to achieve production in our operation.

JGD:bm

[Handwritten signature]

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Friday 13-1933

(1)

Plant & Rain seriously diluted the preg to day, but it still runs very high for the first day (see following "plant sheets"). The preg started (6:30) at .87 Ag and .02 Au and hit a high of 1.44 Ag and .025 Au before severe rain. I can not push Charley Escapula too far on running my preg & barrens, but the barren for Hill was .05 Ag and 11 Au. Charley will run the rest of the afternoon preg & barrens tomorrow. In the mean time, we have calibrated our H_2S test for Ag and check the preg & barrens with 1 drop 5% H_2S solution producing a dark color for the preg and 10 drops produce an almost colorless barren.

Note: Plant capacity balanced with spray - 20 @ 11 3 except for severe rain showers.

July 9-1979

(2)

Harbage & Scraper broke a hydraulic hose on the power steering - have had been rubbing on engine in passed and was missed in maintenance check. Bought new hose, hydraulic fluid, etc, and the scraper was only down from 11:30 to 11:50, which was lunch and a bad rain storm. Johnny Escapule hauled 30 loads today, of from 10:30 to 1:00.

It is estimated that 250 tons of South Contention Dike lies is heaped for testing, we will haul again tomorrow.

July 10, 1940

(3)

Dozing : A small slope was broken into in the C-6 area. Gary Harrison was instructed to push some blocky Hornfels into the slope, which was done and it is stabilized.

However, I am having Gary push more ore from the bank to provide more mass under the layer of scraper to provide more stability. This whole area is now going to be approached from the west - solid ground, just soon as sampling and assaying are completed - temporary.

The area is considered safe, but we exercise all caution.

July 13, 1972

(4)

Sampling

The east wall of the contention ditch has been sampled on the south side (as length of 300 feet), and another sequence of samples were taken to give more precision (over shorter lengths). Jim Briscoe's cloth binder & stakes are being used.

Also, the west bank (which is presently being ripped with the D-6) is also being constantly sampled for grade control.

Grade control is very difficult at this time due to the necessity to push some development work into the down-hill loading ramp - or roadway. Also, the D-6 pushes faster than we can sample. However, most are vs. water in the ditch.

July 13, 1973

(5)

Arizona Bureau of Mines

David Rabb of the Arizona Bureau of Mines visited our operation today and was very interested in the various ore types in the heap, and the large extent of the open-pit on that part, also the Contention Dike, a mineralized structure for over ~~the~~ one-quarter of a mile.

July 13, 1972

(6)

Test Procedure

A. From the heap (T-5A) → 10 samples of 5th size were taken of the -1/2 inch ore. These are run without crushing or pulverizing. They are split to 100 grams and 300 gr (ml) of 1 gr/l Ca solution is added and swirled by hand for a lapse time of an hour. This produces the expected Au/Ag recovered by a cyanide leach.

The above sample locations were marked by a painted rock. After no more preg solves are detected, the above sample sites will again be sampled and leached in the same way, comparing the results.

Both sets of samples (before and after leaching) are saved and can be fire assayed.

July 19, 1973
(F)

B₃ Metal recovered by the small Merrill-Crowe plant will be compared with the original sampling estimate for the area treated to the heap and leach.

C₀ Extensive bulk samples will be taken after heap leaching and the following performed:

1. Back hoe will dig 200# samples from 10 locations; one ton of sample (bulk) will be taken after leaching.
2. The one-ton sample will be screened into about 5 size ranges.
3. Each size fraction will split and sample taken for fire assay and cyanide leach.

July 15, 1970

(8)

D. The above will be compared statistically and to leaching extraction by cyanide leaching completed.

E. Barrel tests will be used to supplement cyanide leach tests (see following data sheet). To date, 50# barrel tests have produced very similar results as the "sample-as-run" 100 gram flash tests. However, the barrel tests are superior for % precious metal extraction relative to size distribution vs. leaching extraction.

Sincerely,

Richard F. Hewitt

Barium Leach Test

Wgt. (Dry) C.C. _____ (A) Name _____

Wgt. Basin + Tray _____ (B)

Time / Constant Solub. (hr) _____

<u>Time</u>	<u>Total wgt</u> (A+B+Soln)	<u>Wgt.</u> <u>Solution</u>	<u>A+B+Soln Soln</u>		<u>Wgt. Soln</u> <u>Wgt. C.C.</u>	<u>Wt. / Tot. C.C.</u>	
			<u>A_s</u>	<u>A_g</u>		<u>A_s</u>	<u>A_g</u>
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____	_____

7-10-1970

~~XXXXXXXXXX~~
~~XXXXXXXXXX~~

Mill Operators Report DATE _____

CIRCUIT OPERATIONS

METER READINGS

Heap Sprays

GRAVEYARD DAY SWING

End..... End..... End.....

Start..... Start..... Start.....

Tons..... Tons..... Tons.....

Preg Solution

End..... End..... End.....

Start..... Start..... Start.....

Tons..... Tons..... Tons.....

RUNNING TIME

Sprays

Precipitation

SPRAY DATA

NaCN Titration

pH

PREGNANT DATA

Ag

Au

BARREN DATA

Ag

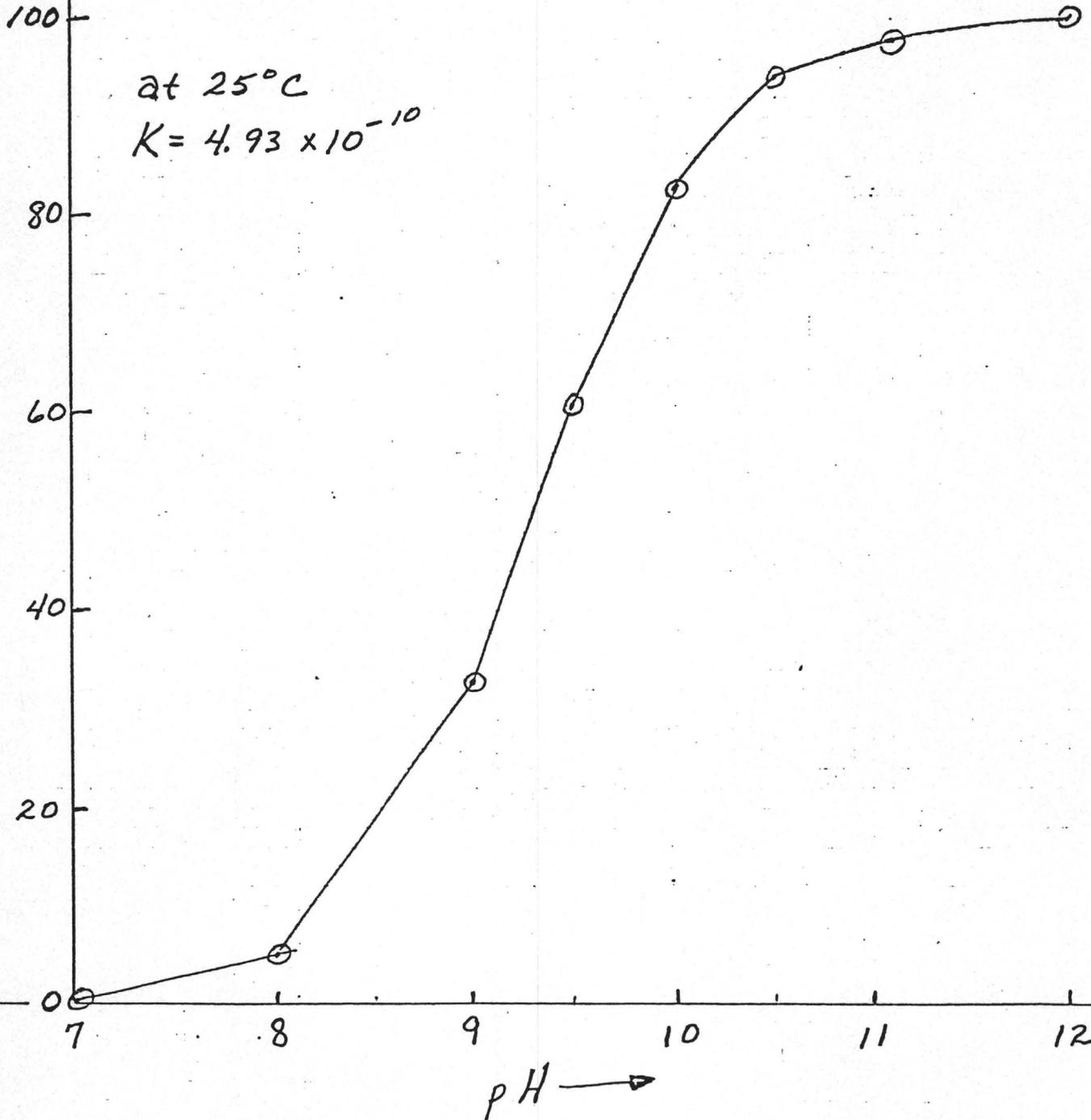
Au

OPERATOR-NAME

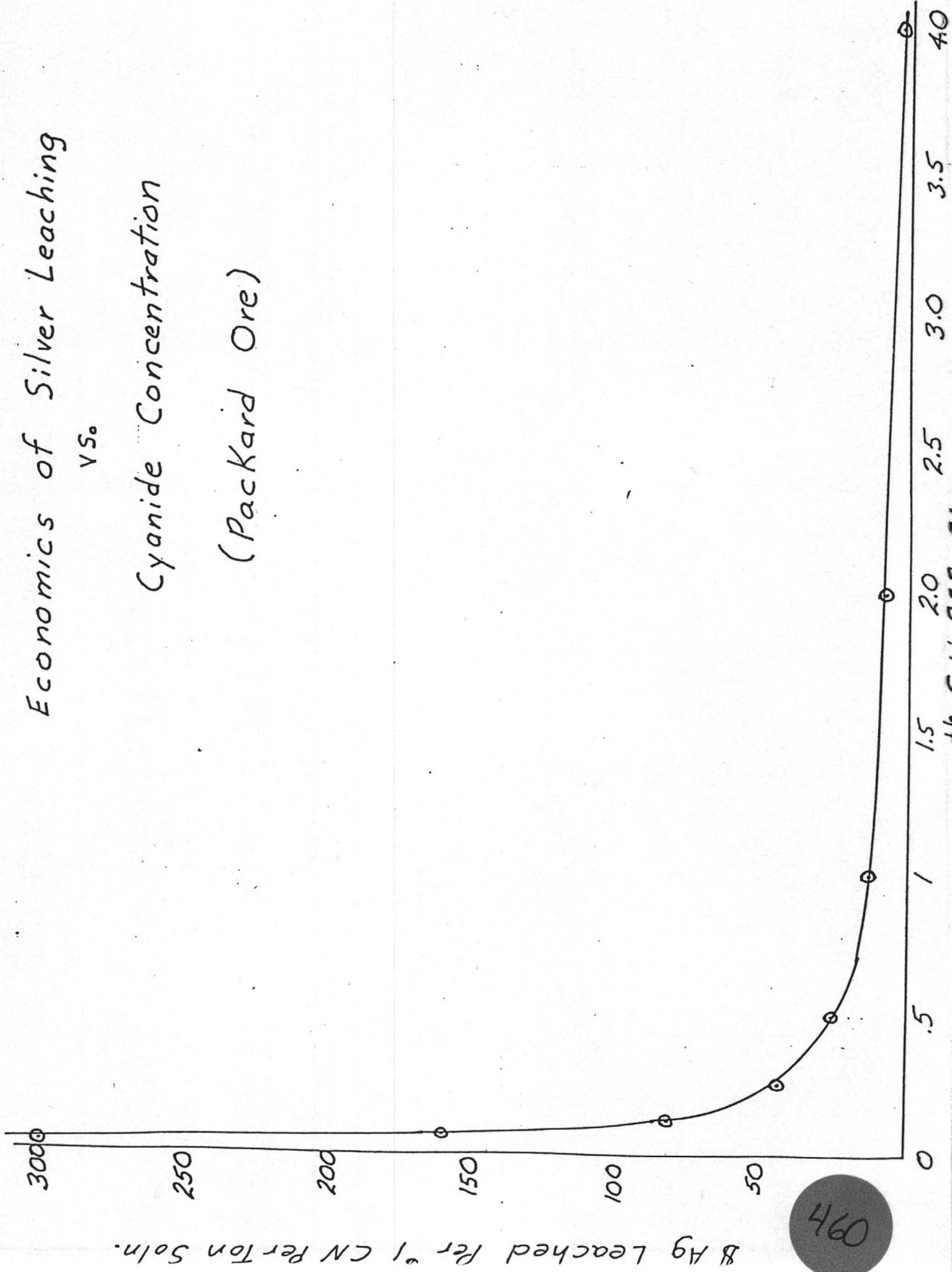
REMARKS:

Percent Cyanide as CN^{\ominus}
VS
pH

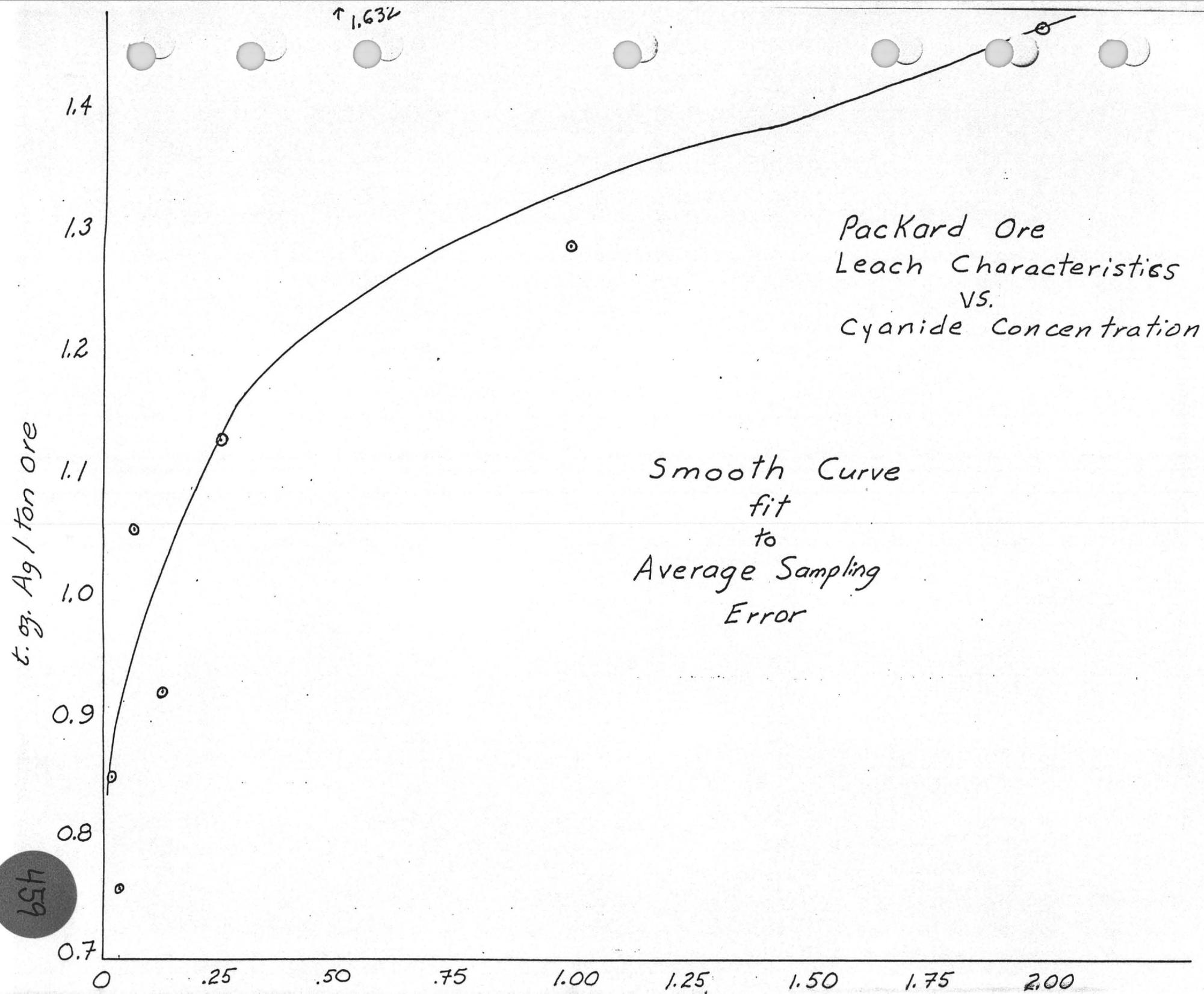
at $25^{\circ}C$
 $K = 4.93 \times 10^{-10}$



Economics of Silver Leaching
 vs.
 Cyanide Concentration
 (Packard Ore)



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PROCEDURE FOR THE DETERMINATION OF SODIUM
CYANIDE IN CYANIDE LEACH SOLUTIONS

Reagents:

Silver nitrate solution - dissolve 17.34 gm silver nitrate with 5 ml nitric acid and dilute to one liter with distilled water.

Potassium iodide solution - 5% - dissolve 5 gm potassium iodide in 95 ml distilled water.

Apparatus:

Erlenmeyer flask, 125 ml
Dropping bottle
Buret, titrating, 50 ml capacity
Graduated cylinder, 25 ml

Procedure:

Measure 20 ml of sample into a 125 ml flask. Add a few drops of 5% KI and titrate to a distinct yellow opalescence with the AgNO_3 solution.

Calculation:

1 ml AgNO_3 solution = 1 lb NaCN/ton solution, if a 20 ml sample was taken for titration.

References:

1. From Liebig's method for determination of Hydrocyanic acid-soluable cyanide.
2. From Denver Equipment Co., Technical Bulletin No. M3-B16.
3. Modifications and approval for use in this laboratory by L. M. Barstow, May, 1976.

PROCEDURE FOR THE ANALYSIS OF GOLD AND SILVER
IN ORES -- CYANIDE DISSOLUTION METHOD

Reagents:

Sodium cyanide solution - .25% - dissolve 10 gm NaCN and .5 gm NaOH in 4 liters of distilled water.

Gold standard solution - 171.4 ppm gold in KCN (Spex Industries)

1. Dilute 10 ml of 5 oz/ton standard (171.4 ppm) to 100 ml with .25% NaCN solution - equal to 0.5 oz/ton Au

2. Dilute 10 ml of 0.5 oz/ton solution to 100 ml with .25% NaCN solution - equal to .05 oz/ton

3. Dilute 20 ml of .05 oz/ton solution to 100 ml with .25% NaCN solution - equal to .01 oz/ton

4. Dilute 10 ml of .05 oz/ton solution to 100 ml with .25% NaCN solution - equal to .005 oz/ton

5. Dilute 20 ml of 0.5 oz/ton solution to 100 ml with .25% NaCN solution - equal to .10 oz/ton.

Silver standard solution - 171.4 ppm silver in KCN (Spex Industries). Follow same dilutions as for gold standard solution.

Apparatus:

1. Atomic absorption spectrophotometer
2. Shaker, modified to hold 50 ml centrifuge tubes
3. Centrifuge tubes, 50 ml, polycarbonate, VWR #21009-342
4. Support, centrifuge tube, VWR #60916-101
5. Buret, titrating, automatic, w/3-way stopcock
6. Ring stand and clamp to hold Buret
7. Tygon tubing
8. Hot plate
9. Aspirator bottle, glass, 4 liter
10. Balance, .01 gm sensitivity, 20 gm capacity
11. Funnel, powder transfer
12. Centrifuge w/accessories to accomodate 50 ml tubes

Procedure:

Twenty grams of finely ground (100% -80 mesh) ore are weighed into a 50 ml polycarbonate centrifuge tube.

Twenty grams of hot (80°C) cyanide solution (.25% NaCN) are added, the tube capped and shaken for one hour.

The sample is then centrifuged long enough to obtain approximately 1/2" of supernatant fluid above the solids.

The supernatant liquid is then aspirated into the flame of the previously calibrated atomic absorption spectrophotometer and the gold/silver concentration determined.

Calculation:

The sample weight and solution weight are equal so there is no dilution factor.

The equation for determining volumes of standard material to be diluted to achieve a desired concentration is as follows:

"A" = solution before dilution

$$\frac{\text{oz/ton in "A" X ml of "A"}}{\text{volume after dilution}} = \text{oz/ton after dilution}$$

Comments:

The described method is in essence a metallurgical testing procedure. The method does not give total gold and silver in a given sample but does give a reliable indication of the recovery that can be expected in a cyanide solution process.

References:

1. From a procedure developed by Danbury Labs, Newmont Mining Company.
2. Modification by S. R. Lindauer and L. M. Barstow, 1974.
3. Approved for use in this laboratory by L. M. Barstow, May, 1976.

MODIFICATION OF CYANIDE DISSOLUTION METHOD;
"PREG-ROB" ANALYSIS

Procedure:

Twenty grams of finely ground (100%-80 mesh) ore are weighed with a 50 ml polycarbonate centrifuge tube.

Twenty gram of hot (80°C) .10 oz/ton standard solution (in .25% NaCN solution) are added, the tube capped and shaken for one hour.

The gold/silver content is then determined following the standard procedure.

Comments:

This modification to the standard method is in essence a metallurgical procedure designed to indicate the presence and relative activity of carbonaceous materials that would act as gold absorbing carbon when used in conjunction with the standard cyanide dissolution method and/or the "burn" modification.

The presence of certain carbonaceous materials is indicated when results obtained are less than .10 oz/ton, or are less than .10 oz/ton higher than those results obtained using the standard dissolution method.

MODIFICATION OF CYANIDE DISSOLUTION METHOD;
"BURN" ANALYSIS

Procedure:

Twenty grams of finely ground (100% -80 mesh) ore is weighed into a sillimanite roasting dish (DFC Ceramic, Inc., number 990-261-20) and the sample roasted for two hours at 800°F (425°C).

The roasted material is then transferred to a 50 ml polycarbonate centrifuge tube.

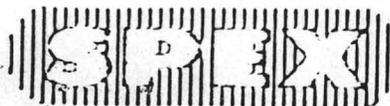
Twenty grams of hot (80°C) cyanide solution (.25% NaCN) is added, the tube capped and shaken for one hour.

The gold/silver content is then determined following the standard procedure.

Comments:

This modification to the standard procedure is used in conjunction with the standard cyanide dissolution method and/or the "preg rob" modification.

The presence of carbonaceous material (or other easily volatilized constituent) is indicated by an increase in apparant gold/silver content when compared to the standard dissolution method.



As with many analytical methods, the quality of an atomic absorption or flame emission analysis can only be as good as that of the reference against which it is standardized. We are confident that our new expanded line of Spex Standard Solutions is currently the most comprehensive and reliable on the market for the following reasons:

- PURITY:** Each standard solution is prepared from Spex high-purity metals or metal compounds which have been analyzed by emission spectroscopy to insure the minimum amount of impurities.
- STABILITY:** The standard solutions are all available in metal concentrations of 1000 µg/ml. Excess acid or base is added whenever necessary to enhance stability by preventing hydrolysis. All solutions are prepared in small batches to minimize time on the shelf and are stored and packaged in polypropylene bottles to avoid metallic contamination.

3. ACCURACY: Spectrographically pure metals are not necessarily good primary standards, since they may contain significant amounts of non-metallic impurities such as carbon, nitrides or oxides. High-purity metal oxides may also be unsuitable for primary standards because of non-stoichiometry, or absorbed CO₂ and moisture. To insure the utmost in accuracy, all Spex standard solutions are assayed by high-precision gravimetric or volumetric techniques after being prepared. That element concentration is then certified on the label.

4. MATRIX COMPATABILITY: Because matrix effects do exist in AA spectroscopy it is important that the standard and sample matrix be similar. Spex standards are available in a number of aqueous matrices so analysts can choose the standard solution best suited for a particular application.

AQUEOUS STANDARD SOLUTIONS FOR ATOMIC ABSORPTION AND FLAME EMISSION SPECTROSCOPY

ELEMENTAL CONCENTRATIONS 1000 µg/ml

ELEMENT	MATRIX	ALTERNATE MATRICES (see key below)	ELEMENT	MATRIX	ALTERNATE MATRICES (see key below)
Aluminum	2% HCl	2, 6, 7	Neodymium	2% HNO ₃	1
Antimony	20% HCl	7	Nickel	2% HNO ₃	1
Arsenic	2% KOH	1, 2	Niobium	5% HF	5
Barium	2% HCl	2	Potassium	2% HNO ₃	1
Beryllium	2% HCl	2	Praseodymium	2% HNO ₃	1
Bismuth	10% HNO ₃	3	Rubidium	2% HCl	2
Boron	H ₂ O	6, 7	Samarium	2% HNO ₃	1
Cadmium	2% HNO ₃	1	Selenium	10% HCl	7
Calcium	2% HCl	2	Silicon	2% KOH	6
Cerium	10% HNO ₃		Silver	2% HNO ₃	8
Cesium	2% HNO ₃	1	Sodium	2% HCl	2
Chromium	2% HCl	2	Strontium	2% HCl	2
Cobalt	2% HNO ₃	1	Tantalum	5% HF	5
Copper	2% HNO ₃	1	Tellurium	2% KOH	3
Dysprosium	2% HNO ₃	1	Terbium	2% HCl	2
Erbium	2% HNO ₃	1	Thallium	2% HNO ₃	
Gadolinium	2% HNO ₃	1	Thorium	10% HNO ₃	6
Germanium	2% KOH	3, 6	Tin	10% HCl	7
Holmium	2% HNO ₃	1	Titanium	5% HF	3
Indium	2% HNO ₃	1	Tungsten	5% HF	7
Iron	2% HNO ₃	1	Uranium	2% HNO ₃	1
Lanthanum	2% HNO ₃	1	Vanadium	2% HNO ₃	1, 7
Lead	2% HNO ₃	5	Ytterbium	2% HNO ₃	1
Lithium	2% HCl	2	Yttrium	2% HNO ₃	1
Magnesium	2% HNO ₃	1	Zinc	2% HCl	2, 8
Manganese	2% HNO ₃	1	Zirconium	5% HF	5
Molybdenum	H ₂ O	6			

\$ 8.00/100 ml
21.00/500 ml
38.00/liter
alt. matrix 50.00/liter



ELEMENT	MATRIX	ALTERNATE MATRICES (see key below)
Europium	2% HNO ₃	1
Gallium	2% HCl	2
Hafnium	5% HF	5
Palladium	10% HCl	
Rhenium	H ₂ O	
Ruthenium	10% HCl	
Scandium	2% HNO ₃	1
Thulium	2% HNO ₃	1

\$ 9.00/100 ml
23.00/500 ml
42.00/liter

alt. matrix 55.00/liter

Alternate Matrix Key

- | | | |
|------------------------|-------------------------|---------------------|
| 1) 2% HCl | 4) 10% HNO ₃ | 7) 2% KOH |
| 2) 2% HNO ₃ | 5) 20% HCl | 8) 2% KCN |
| 3) 10% HCl | 6) 5% HF | 9) H ₂ O |

NOTE: Solutions in Alternate Matrices may be purchased in 1-liter size only.

ELEMENT	MATRIX	ALTERNATE MATRICES (see key below)
Gold	2% HCl	2, 8
Iridium	10% HCl	
Lutetium	2% HNO ₃	1
Platinum	10% HCl	
Rhodium	10% HCl	

\$11.00/100 ml
28.00/500 ml
50.00/liter

alt. matrix 65.00/liter

1% Solutions of LaCl₃ or La(NO₃)₃ or KCl \$15.00/liter

These are prepared from high-purity materials for use as releasing agents or ionization buffers and are free from interfering elements. We invite your inquiries regarding still other matrices or concentrations to meet your requirements. Multi-element standards are also available.

ORGANIC SOLVENT SOLUBLE METAL SALTS FOR NON-AQUEOUS ATOMIC ABSORPTION STANDARDS

In addition to aqueous atomic absorption standards, Spex is now offering a number of metal compounds soluble in organic solvents. These materials are suitable for the determination of trace metals in oils, as internal standards for non-aqueous x-ray fluorescence analysis, or for many other applications requiring a metal compound soluble in non-aqueous media.

Each compound is prepared from a high-purity starting material in order to minimize the amount of metallic impurities present. Like all of our standards, the exact percentage of the metal in each lot is determined by wet-chemical analysis and is certified on the label.

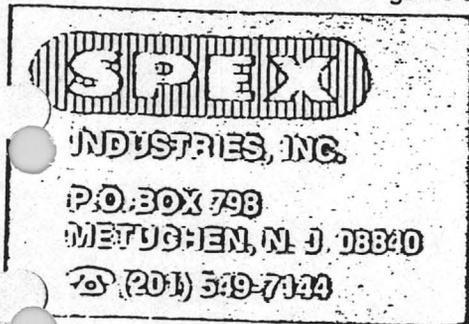
We invite your inquiries for any other metal compounds, including coordination compounds or organometallics, which are soluble in other organic solvents.

Metal	Salt
Aluminum	Aluminum 2-ethylhexanoate
Barium	Barium 4-cyclohexanebutyrate
Cadmium	Cadmium 4-cyclohexanebutyrate
Calcium	Calcium 2-ethylhexanoate
Cobalt	Cobaltous 4-cyclohexanebutyrate
Copper	Copper 4-cyclohexanebutyrate
Iron	Ferric 4-cyclohexanebutyrate
Lead	Lead 4-cyclohexanebutyrate
Lithium	Lithium 4-cyclohexanebutyrate
Magnesium	Magnesium 4-cyclohexanebutyrate
Manganese	Manganese 4-cyclohexanebutyrate
Mercury	Mercuric 4-cyclohexanebutyrate
Nickel	Nickel 4-cyclohexanebutyrate
Potassium	Potassium 4-cyclohexanebutyrate
Silver	Silver 2-ethylhexanoate
Sodium	Sodium 4-cyclohexanebutyrate
Strontium	Strontium 4-cyclohexanebutyrate
Zinc	Zinc 4-cyclohexanebutyrate

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72.00/25g

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DETERMINATION OF CYANIDE

Cyanogen Bromide with Pyridine and Benzidine in n-amyl Alcohol Method

Discussion

In a weakly acid solution, cyanide is converted to cyanogen bromide by bromine water. After removal of excess bromine, the cyanogen bromide reacts with pyridine and benzidine to form a red-orange color extractable into n-amyl alcohol. The optical density of the n-amyl alcohol layer is then determined on a spectrophotometer after 15 minutes.

Reagents

Phosphoric Acid, 2.5%

Dilute 15 ml. of concentrated phosphoric acid (85%) to 500 ml. with distilled water.

Sodium Arsenite, 2%

Weigh 2 grams sodium arsenite and dilute to 100 ml. with distilled water.

Pyridine Solution, 30%

Dilute 60 ml. of pyridine with distilled water, add 5.0 ml. concentrated hydrochloric acid and dilute to 200 ml. with distilled water. (Add acid to approximately 100 ml. of distilled water in a 200 ml. volumetric flask, mix and add pyridine, mix and dilute to 200 ml.) Prepare daily.

Benzidine Hydrochloride, 1.5%

Weigh 1.5 Gms. benzidine hydrochloride and make to 100 ml. with distilled water. Add a few drops of 1:1 HCl to assist solution of the material if necessary. Prepare daily.

Bromine Water, Saturated

Add several drops of bromine to 100 ml. distilled water and shake vigorously for 10 to 15 seconds. Since the solution loses strength with time, due to volatilization of bromine, it is advisable to resaturate with bromine just prior to use. Store in a glass bottle in a relatively cool area.

Stock Cyanide Solution

"A" Dissolve 0.198 grams of 95% NaCN, reagent grade, in distilled water made alkaline with NaOH solution to pH 11. Dilute to one liter with distilled water.

0.1 gram CN^- per liter

"B" Dilute 10 ml. of Solution "A" to one liter with distilled water made alkaline with NaOH solution.

0.001 gm. CN^- per liter

"C" Dilute 10 ml. of Solution "B" to 100 ml. with distilled water made alkaline with NaOH solution.

1 ml. = 0.1 μgm CN^-

(Standard solutions should be prepared fresh at frequent intervals, maximum weekly and stored in a cool place.)

n-amyl Alcohol, C.P.

Sodium Sulfate, Anhydrous, Crystal

Procedure

Measure a 100 ml. sample and place in a 251 ml. separatory funnel.

Measure 100 ml. of distilled water made alkaline with NaOH solution into a 250 ml. separatory funnel. (Blank)

Standards for preparation of a standard curve.

Add distilled water made alkaline with NaOH solution to pH 11.0 to three 250 ml. separatory funnels; 99 ml., 95 ml. and 90 ml. Now add 1 ml., 5 ml. and 10 ml. aliquots of the "C" Standard Stock Solution to the funnels by pipette. Equal to 1, 5 and 10 ppb for 100 ml. sample.

Carry standard samples, blank and unknowns, through the whole procedure.

Add 4 ml. phosphoric acid solution to each funnel and mix. Check the pH at this point. If the pH is above 3, using pHdrion paper, add an additional milliliter of phosphoric acid. Use a 25 ml. Mohr Pipette.

Add bromine water dropwise until a distinct pale yellow color is seen and mix. Usually one to three drops are sufficient, but more may be necessary for high samples. Use a 2 ml. transfer pipette.

Add sodium arsenite solution dropwise until the yellow color of excess bromine disappears, and add one additional drop and mix. Usually two drops plus one is sufficient. Use a 2 ml. transfer pipette.

Add 25 ml. n-amyl alcohol, preferably by buret, to each flask.

Add 1 ml. benzidine solution to each flask, stopper and shake vigorously for about 15 seconds.

Add 10 ml. pyridine solution to each flask.

Begin Timer.

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After 15 minutes, draw off the lower aqueous layer and discard.

Now add the n-amyl alcohol layer to a 125 ml. erlenmeyer flask containing roughly 20 grams anhydrous sodium sulfate. Swirl to remove water.

Transfer 20 ml. of each to nessler tubes and compare visually.

NOTES ON TRACE CYANIDE ANALYSIS

- a. The concentrations of Cyanide in solutions that this procedure is designed to detect and analyze are in the 10 parts per billion range. PanCana mill solutions contain 20 thousand ppb cyanide. Any contact with mill solutions via hands, or interchange of glassware would result in high Cyanide assays (incorrect because of contamination).
- b. Glassware used for this procedure must not be used for any mill solutions under any circumstances.
- c. Since most cyanides are very reactive and unstable, analysis should be made as soon as possible after sampling. If the sample cannot be analyzed immediately, add NaOH to raise the pH to 11.0 or above and store in a cool place.

GENERAL INFORMATION

REAGENTS

Certain reagents that are useful for atomic absorption analyses are not readily available. The suppliers noted below have proved satisfactory:

Ammonium pyrrolidine dithiocarbamate

K & K Laboratories
121 Express Street
Plainview, New York 11803

or

Distillation Products Industries
Eastern Organic Chemicals Department
Rochester, New York 14603

Lanthanum oxide

Lindsay Chemical Division
American Potash and Chemical Corp.
West Chicago, Illinois

or

Matheson Coleman & Bell
Division of The Matheson Co., Inc.
East Rutherford, New Jersey
and
Cincinnati, Ohio

Note: If lanthanum oxide is not available in a sufficiently pure form, it may be prepared by heating lanthanum nitrate (analytical grade, Merck) at 700° C for 2-1/2 hours in a large dish in a muffle furnace.

6-methyl-2,4-heptanedione

Chemicals Procurement Labs, Inc.
18-17 130th Street
College Point 56, New York

STANDARD SOLUTIONS

Solutions suitable for use as standards can be obtained from several sources. One per cent solutions are available from Hartman-Leddon Co., Philadelphia, Pennsylvania. Standard solutions called Brock Reagents are available from Aloe Scientific, 1831 Olive Street, St. Louis, Missouri. In certain cases where the preparation of

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standard solutions from readily available reagents is well known to us, this information is included in this book.

The concentration of solutions, particularly very dilute solutions, will change with time in certain cases. If 1% accuracy is required it is good practice to prepare working standard solutions daily from stock solutions of 500 or 1000 ppm. In our experience, solutions of 500 ppm or greater do not alter with storage for a year.

For the analysis of oil products, the standards must be soluble in the organic materials used to prepare the samples. National Bureau of Standards Monograph No. 54 describes metallo-organic compounds available from NBS and recommended for preparation of standards for spectrochemistry. These materials have been specified in this book.

ANALYTICAL INFORMATION

Lamp Current, Arc Discharge (Osram) Lamps

Osram discharge lamps are used for the determination of many of the alkali metals. They usually require about 10 minutes to warm up, but there is some variation among lamps.

In general, the absorbance will be greatest at the smallest current that will sustain the discharge. The recommended lamp current has been chosen on this basis. However, to produce a stable discharge some lamps require higher current than that recommended. If the discharge is not visibly stable, increase the lamp current until the characteristic color is obtained (yellow for sodium, violet for potassium, etc.).

A 500 volt-ampere constant voltage regulating sine wave transformer is useful to stabilize the discharge lamp output particularly for use with the Model 290. Such a transformer can be purchased from Perkin-Elmer by ordering P-E Part No. 997-0214 for 117 V, 60 cps line power, or P-E Part No. 997-0215 for 117 V, 50 cps line power.

Lamp Current, Hollow Cathode Lamps

Certain analytical problems can arise as a result of the properties of a hollow cathode discharge. At a particular current the mode of operation of the discharge can change. The critical current depends upon the element, the construction of the lamp and the gas pressure. If the lamp is operated at the critical current, the ENERGY meter can oscillate or become noisy. At a slightly higher or lower lamp current this oscillation will disappear.

A defect occasionally found in hollow cathode lamps is the presence of radiation background at the analytical wavelength. This

unabsorbed radiation will cause the working curve to be non-linear and will reduce the analytical sensitivity. The presence of background radiation can be observed by turning the wavelength control slowly to either side of the peak emission. If, when the control is moved away from the emission peak, the readout meter still indicates the presence of emitted radiation at the recommended slit opening, background radiation is implied.

Occasionally lamps that are stored for many months will display excessive background radiation. These lamps can usually be returned to original performance by running them at rated current for about 10 hours.

Dual-element and multi-element lamps containing as many as five metals are available for certain combinations of elements as noted in the standard conditions for the elements. These lamps will shorten the time required for changing lamps and lamp warmup when determinations involving the available element combinations are required. In general, the sensitivities obtained approach those obtained with single-element lamps.

High Brightness Lamps

For some elements, high brightness lamp emission improves the signal-to-noise ratio over that obtained from standard hollow-cathode lamps, enabling the operator to more readily achieve maximum read-out scale expansion. For detecting elements at low concentrations or with high precision, scale expansion is an advantage. To estimate optimum concentration for the sample and to test instrument performance, a useful term is the "sensitivity." This refers to the concentration of an element in water solution which will produce an absorption of 1%, and generally is expressed as ppm/1%. Another useful term is "detection limit," or the concentration in water solution which gives a signal twice the size of the background variability.

With a sufficiently bright lamp, it should be possible to detect about 0.05 of the stated sensitivity of a given element using the Model 303, and about 0.2 of the stated sensitivity of the particular element using the Model 290. For example, the sensitivity of cobalt is 0.20 - that is 0.20 ppm cobalt in aqueous solution will give an indication of 1% absorption with Perkin-Elmer equipment. With a sufficiently bright source, the Model 303 should be able to detect 0.01 ppm. Although this cannot always be achieved with the standard hollow cathode lamp, it can with the high brightness lamp. Except in special cases (e.g. nickel) the sensitivity is not changed by using a high-brightness lamp; however, the detection limit and operating stability are improved.

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Availability of a brighter emission source such as a high brightness lamp, makes possible a more linear working curve by taking absorbance readings with a narrower slit than is recommended for routine use. This is easy to investigate for particular types of determinations. High brightness lamps are especially useful for elements such as titanium, determined in a nitrous oxide-acetylene flame. Where the emission from such a flame is much brighter than from the standard lamp at the wavelength used, the signal-to-noise ratio is considerably reduced. Use of a high brightness lamp improves the signal-to-noise ratio substantially.

Interferences

At many places in this book and in other atomic absorption literature certain elements are claimed to be determined without interference. There are, however, certain effects related to the flame which must be considered.

If there is a significant difference between the surface tension or viscosity of the sample and that of the standard, the two solutions will be aspirated or atomized differently. High acid concentration can alter the absorption signal. High acid content in samples should be matched in standards. For aqueous solutions little bulk interference will be observed if the total solids content is below about 2%. Above this level it is often useful to use the Method of Additions (see the discussion of Analytical Methods which follows) to minimize bulk interference effects.

A number of workers have observed that radiation is scattered by particles in the flame when samples having a high salt content are burned. The effect is to produce an erroneously high analysis that cannot be detected by the Method of Additions. Correction for this effect is accomplished by measuring the apparent absorption of the sample at a wavelength near the analytical line that is available from the same lamp and is known to be nonabsorbing for the metal being determined. Flame scattering must be accounted for in trace analyses near the detection limit if the salt content is greater than 1%, particularly for those analyses performed below 2500 A.

Gold at 2478 & 2676

Gas Flowmeter Calibration

The data included in this book for flame conditions list arbitrary calibrations of the flowmeters. There is considerable variation among flowmeters, so the data should be taken as approximate. It is occasionally useful to know the approximate gas consumption in physical units. This can be determined by well-known techniques. Typical calibration curves for various gases are provided in Fig. 1. For flowmeters in the fuel line equipped with 2 balls, the curve represents the upper (plastic) ball.

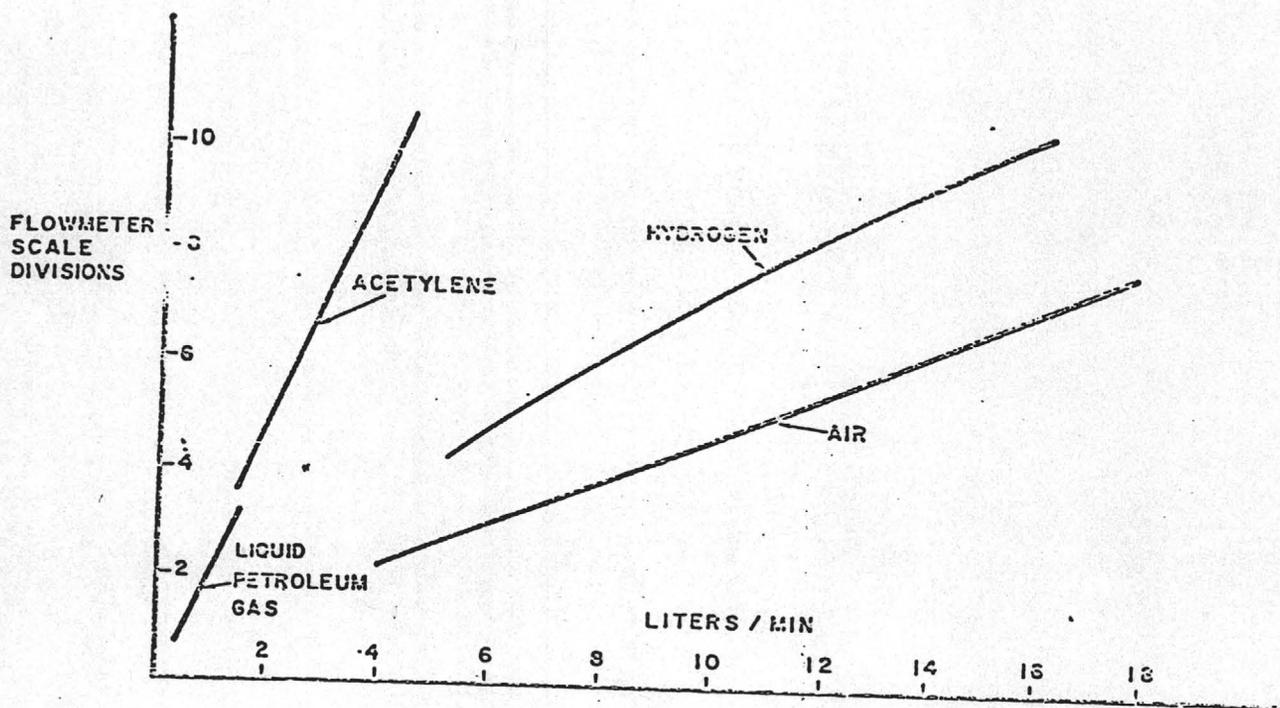


Fig. 1 - Model 303 Burner Regulator Flowmeter Calibration Curves for Various Gases

Acetylene Cylinders

There is considerable evidence that erratic and inconsistent results are obtained when an almost empty acetylene cylinder is used. This is a particular problem when the metals that require a very rich acetylene flame are determined. These include Cr, Mo, Sn and the alkaline earth metals. We change a tank when the pressure falls to about 75 psi.

It is dangerous to have acetylene trapped in a line. Therefore, when turning the equipment off at night, or for any extended period of time, shut off the main valve at the acetylene tank and bleed all lines. No pressure should be registered on any of the acetylene gauges.

Constant Voltage Transformer

Lack of stability in the laboratory power line may affect the stability of instrument readings. If results are not constant within satisfactory limits, it may help to connect a 250-to-500 watt constant voltage sine wave transformer between line power and the instrument. A 500-watt voltage regulating transformer is available from Perkin-Elmer (P-E Part No. 997-0214 for 60 cps,

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997-0215 for 50 cps) and provides a constant 118 V output with an input of from 95 to 130 V. This is suitable for either the Model 303 or the Model 290, together with the discharge lamp power supply when required.

Burner Operating Notes

The instrument operating conditions given in this book are usually for determinations in which the standard burner head provided with the instrument is used with an air-acetylene flame. Although these conditions will provide sensitivities and detection limits adequate for many requirements, the use of other gases or burner components will sometimes result in greater sensitivity and lower detection limits. These gases and burner components are listed below with their applications and, where applicable, instrument control settings.

Note: Burner alignment should always be performed with solutions that provide an absorption reading between 30% and 60% (0.15 and 0.4 absorbance).

WARNING: ALWAYS TURN OFF ACETYLENE FIRST.

Nitrous oxide: The nitrous oxide-acetylene flame is necessary for determining elements that form refractory oxides (Al, Ti, etc.). The nitrous oxide burner head, P-E Part No. 303-0195, must be used. The following initial control settings are recommended:

<u>Model 303</u>		<u>Model 290</u>	
N ₂ O Cylinder Regulator	40 psig	N ₂ O Cylinder Regulator	40 psig
OXIDIZER Control	30 psig	AIR FLOW Control	12.4
Air FLOW Meter Reading	8.5	C ₂ H ₂ Cylinder Regulator	8 psig
Fuel FLOW Meter Reading	>15 or 6*	FUEL FLOW Control	10.8

*On flow meters with two float balls.

After the flame is ignited, adjust the fuel flow, while aspirating a standard solution, to obtain maximum absorption.

Note: Wrap electrically-heated tape around the pressure regulator valve to prevent clogging by frozen nitrous oxide, formed by cooling when the liquified gas expands through the valve.

Light emission from the flame is very strong at some wavelengths when nitrous oxide and acetylene are used. When absorption measurements are made at wavelengths where flame emission is significantly high relative to lamp emission, electronic noise produced in the photo-

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multiplier by the high light energy received will be amplified. The signal obtained may consequently fluctuate when a relatively dim source is used. In extreme cases the detector will become saturated so that the instrument appears to receive no signal. When these effects are observed, a different analytical wavelength should be used, if possible, or the brightness of the source increased.

✓ Boling Burner Head (P-E Part No. 303-0202): This burner head, with three slots, is recommended for many analyses. The large cross-section of the flame provides a large quantity of metal atoms and permits more precise and more sensitive determinations, particularly for metals whose compounds do not readily dissociate in a flame; e.g., calcium, chromium, molybdenum, tin. At the present time this burner head is not recommended for the determination of gold, palladium, platinum, rhodium, or ruthenium.

Set both the fuel and air flows to produce flow meter readings of 9 on the Model 303. Set fuel and air flows to 13.25 and 12.4 respectively on the Model 290. For calcium, chromium, magnesium, molybdenum, strontium, or tin, use a standard solution and adjust for maximum absorption. Do not use a very lean (clear blue) flame; the heat developed by this flame will warp the slots. It may also be necessary to reduce the standard concentrations because of sensitivity increases.

High-Solids-Content Burner Head (P-E Part No. 303-0159):

If a Boling burner head is not available, this less expensive High-Solids-Content Burner Head (P-E Part No. 303-0159) may be used. It is recommended that the fuel flow be set at 13.30 and the air flow at 12.40 for the Model 290. For the Model 303, the fuel flow should be set at 13.30 and the air flow at 12.40. Whistling will occur for about 30 seconds. If it should continue for more than 1 minute, reduce the fuel flow slightly.

For the high-solids-content burner head on the Model 303, use the air and fuel flow settings recommended for the element to be determined as given in this book. On the Model 290, use settings for air at 12.40 and for fuel at 13.30. Whistling will occur for about 30 seconds. If it should continue for more than 1 minute, reduce the fuel flow slightly.

Propane: The air-propane flame may be useful for that minority of determinations which yield greater sensitivity in low-temperature flames. Interferences may be present in the air-propane flame that are not present in the air-acetylene flame. A propane burner head, P-E Part No. 303-0154, is required when this flame is to be used. The following initial control settings are recommended:

Model 303

Model 290

Air Cylinder Regulator	40 psig
OXIDIZER Control	30 psig
Air FLOW Meter Reading	4.5
Propane Cylinder	
Regulator	6 psig
Fuel FLOW Meter Reading	2.0

Air Cylinder Regulator	40 psig
AIR FLOW Control	13.30
Propane Cylinder	
Regulator	6 psig
FUEL FLOW Control	14.30

After the flame has been ignited, adjust the air and fuel settings, while aspirating a standard solution, to obtain maximum absorption.

Hydrogen: A hydrogen-air flame is most often used in determining tin for which initial recommended settings are:

Model 303

Model 290

OXIDIZER Control	30 psig
Air FLOW Meter Reading	4.0
Hydrogen Cylinder	
Regulator	15 psig
Fuel FLOW Meter Reading	8.0
	(steel ball)

Air Cylinder Regulator	40 psig
AIR FLOW Control	12.3
Hydrogen Cylinder	
Regulator	15 psig
FUEL FLOW Control	12.0

To obtain a lean flame, reduce the hydrogen gas flow.

Flame Shield: A glass flame shield is provided on all recent instruments to protect the operator from the effects of ultra-violet radiation produced by the flame. This shield should be kept in place at all times while the flame is lit. For Model 303 spectrophotometers not equipped with glass shields, a Flame Shield Kit (P-E Part No. 303-0196) is available.

Organic Solvents

Organic solvents generally enhance sensitivity and will improve detection limits by a factor of about four. Any organic that burns well can be used, but MIBK and other ketones or esters are particularly suitable.

When setting the fuel-to-air ratio of the gas mixture at the burner, start with the settings recommended for the analysis and gradually reduce the fuel flow until the flame is as blue as possible but does not lift off the burner. The atomizer also must be readjusted for organics. Turn the capillary outward while aspirating a standard in the organic until bubbling ("blowback") occurs in the solvent at the sample tube intake. Then turn the capillary inward to obtain maximum absorption. This adjustment should be made with

an element such as copper, which requires a clear blue flame and is not sensitive to changes in fuel-to-air ratio. It must not be made with an element having a wavelength shorter than 2500 Å (150.4 on the Model 290 dial) or with one for which absorption is critically dependent upon fuel-to-air ratio such as calcium.

Detection Limits

The detection limits given throughout this book are for the Model 303. Unless a statement appears to the contrary, detection limits for the Model 290 can be assumed to be between 2 and 4 times the detection limits reported.

ANALYTICAL METHODS

The four general procedures discussed below are suitable for the majority of determinations susceptible to analysis by atomic absorption spectrophotometry. Of these, the Routine Procedure is the most general, hence the most widely applicable; the other procedures satisfy specific requirements. Unless otherwise noted, the techniques described in the Routine Procedure apply as well to the other three.

✓ Routine Procedure

This procedure will provide a coefficient of variation of about 1-2% in the sample concentration for determinations in the optimum analytical range from 20 to 80% absorption (0.1 to 0.7 absorbance units). It should be used for all work where this precision is sufficient, and where the analytical levels do not press the detection limits given in the data for the element of interest.

Put the sample into a solution that can be easily aspirated through the sample tube of the burner-atomizer. The concentration of the metal to be determined should provide between 20 and 80% absorption at the analytical wavelength given for the element of interest if a coefficient of variation of about 1% is to be obtained by this method. The concentration required can be estimated from the sensitivities given. At least 2 ml of solution should be available for each measurement of absorption.

Prepare standard solutions having known concentrations of the metal to be determined in the same solvent as that of the sample. The standard concentrations should bracket the expected concentration in the sample. Normally, three different standard solutions are sufficient. If very dilute standards are needed for a period longer than one day, stock solutions in concentrations greater than 500 ppm should be made up. The stock solutions can then be stored and diluted as required when standards are needed. This will avoid changes in concentration (as much as 2 to 3% in 3 day

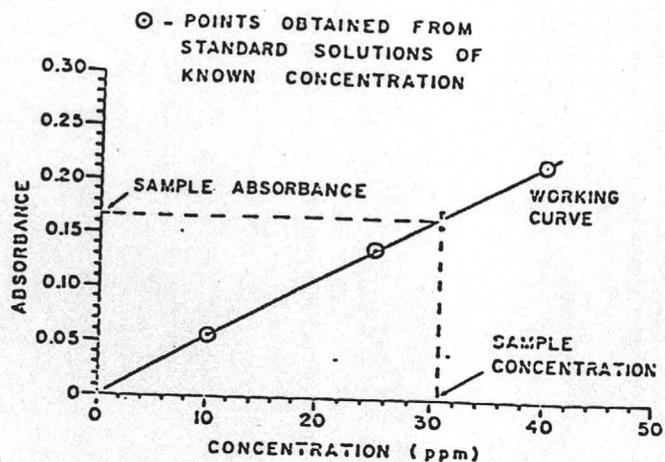


Fig. 2 - Example of Working Curve, Relating Absorbance to Concentration for a Routine Analysis

that occur when very dilute solutions are left standing, probably as a result of adsorption of the metal by the walls of the container.

When all sample and standard solutions have been prepared, run the solutions in the atomic absorption spectrophotometer in the following sequence: standards, sample, standards, sample, standards, and record the readings obtained. Average the readings for each solution and determine the concentration of the element of interest in each

sample. The method of determining concentration depends upon the data obtained from the equipment used. The Model 290 will provide readings directly in absorbance units (proportional to concentration). If a preliminary check indicates that the response of the Model 290 is linear with concentration for three different standards, the readout can often be calibrated directly in concentration units. There is no need to plot a calibration ("working") curve.

The Model 303, when equipped with a Digital Concentration Readout Accessory (DCR-1), will also provide readings directly in units of concentration, when properly calibrated. Also, the DCR-1 will automatically compute the average of several readings, eliminating the need for any calculation on the part of the operator.

Without the DCR-1, the Model 303 provides readings in per cent absorption. In this case, average the absorption readings for each standard and convert the result to absorbance using Table I. Plot a working curve of absorbance vs. concentration similar to that shown in Fig. 2. Average the readings for each sample, convert the results to absorbance, and using the working curve, determine the concentration of each sample.

When the absorbances of the standards are plotted against concentration a linear working curve generally results, so that it is usually necessary to determine the working curve with only three standards. If, however, in the judgment of the analyst the working curve is too nonlinear to allow sample determination within the desired precision, more standards may have to be used. The working curve may change somewhat from day to day owing to gradual changes in operating conditions beyond the control of the operator; it should be prepared, therefore, for every batch of samples.

Trace Determinations

In some determinations at low absorption levels, the random fluctuation, or noise, in the instrument reading is relatively low. It is possible in such cases to use scale expansion to expand the scale of measurement with which the sample absorption is read. In effect, therefore, the level of detectability can be improved to the detection limit given for the element of interest. Normally, determinations by this method will not provide a coefficient of variation better than about 3%. The standards and samples should be prepared and determined in succession, as in the Routine Procedure above, but with an expansion that will permit the expected analytical range to be covered. If the Model 303 is used with a scale expansion of 5X or 10X, plot the actual ABSORPTION counter readings against concentration to obtain a linear working curve. There is no need to convert the data to absorbance when these expansions are used. If 2X is used, the values must be divided by 2 before conversion to absorbance.

High-Precision Analysis

The Model 303 will provide greater precision than the 1% coefficient of variation available in the Routine Procedure given above. Determinations to a precision of 0.2% of the sample concentration can be obtained by applying the output of the Model 303 to a Perkin-Elmer Recorder Readout Accessory (part number 303-0103), and measuring the result with any commercially available 0 to 10 mv potentiometric recorder. The DCR-1 will also provide the same precision.

For best precision, samples should have a sufficient concentration of the metal to be determined to give an absorption reading of about 60%. Determine the approximate metal concentration in the sample by the Routine Procedure given above, then prepare standards with concentrations about 10% higher and 10% lower than that determined for the sample. Use the scale expansion and zero suppression provided on the Recorder Readout Accessory or DCR-1 and measure the expanded absorption (or absorbance, in the case of the DCR-1) of the standards and sample on the recorder. Run the standards and sample the same number of times as for a routine analysis. Plot the averaged absorption (absorbance) readings for the standards against concentration. The result will be a straight working curve. Now, average the readings for the sample and determine the metal concentration in the sample from the working curve.

Example

Problem - Determine the calcium concentration in a sample of cement (approximately 67% limestone, 29% clay, and 4% gypsum).

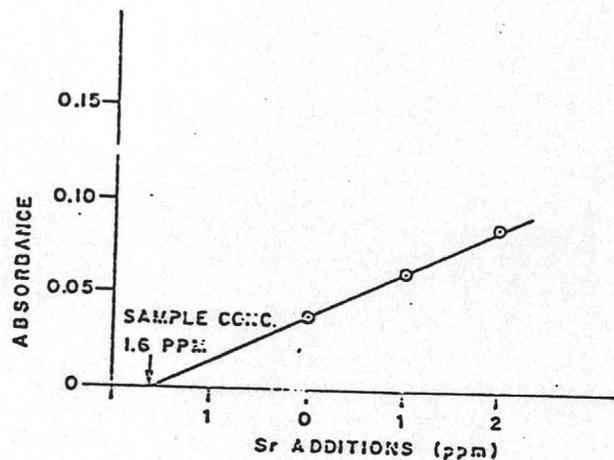
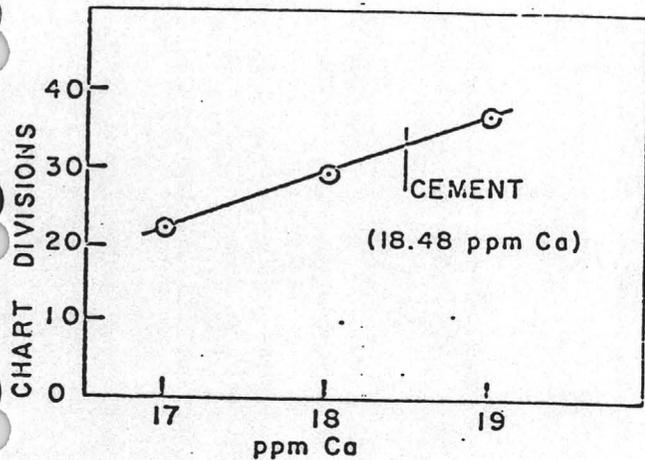


Fig. 3 - Typical Working Curve for a High-Precision Determination

Fig. 4 - Typical Working Curve for the Method of Additions

Method - A one gram sample of cement was put into an aqueous solution containing 1% lanthanum using the procedure recommended in ASTM Standards, 4, 110 (1961). The approximate concentration of the solution was then determined by the Routine Procedure. Standards containing 1% lanthanum and having calcium concentrations within 5% above and below that of the sample were then prepared. The standards and sample were run in the sequence given in the Routine Procedure. A scale expansion on the Recorder Readout Accessory of 10X was used with zero suppression, and the average expanded readings from the recorder were used to plot the working curve and determine the sample concentration (see Fig. 3). It was not necessary to convert the readings to absorbance because of the closeness of the sample and standard concentrations.

Results - The calcium concentration in the diluted sample solution, as determined from the working curve, is 18.48 ppm. This represents a concentration of 46.19% calcium in the original sample.

Method of Additions

It is difficult to prepare aqueous standard solutions whose absorptions will change with metal concentration in the same fashion as the absorption of the sample. This condition may occur when the sample contains high and variable concentrations of matrix materials. It may also occur when the sample matrix has a very high solids content whose effect on absorption is hard to duplicate with the aqueous

standards. In such instances, the method of additions should be used.

Take three aliquots of the sample. Dilute the first to a known volume with solvent. Make up the second and third to the same volume with suitable quantities of known standards so that the final solutions contain different known concentrations of the metal to be determined.

On the Model 290, determine the meter reading for each sample. Plot the signal obtained against the added concentration. If the readings are at the lower end of the scale, readability can be improved by turning the MAXIMUM CONCENTRATION control clockwise.

On the Model 303, plot absorption readings against concentration if less than 10%; otherwise convert readings directly to absorbance. Absorptions below 10% are proportional to concentration within the limits of instrumental error. Extrapolate the resulting straight line through zero absorbance (see Fig. 4). The intercept on the concentration axis gives the concentration of the metal in the original sample. For an accurate determination by this method, the working curve must be straight.

Example

Problem - Determine the content of strontium in a specimen of ashed pine needles. The effects on the absorption measurement of other components in the sample were unpredictable and expected to be sufficiently pronounced to warrant use of the method of additions.

Method - Enough material to give 0.3 to 0.5 g of ash was put into a 25-ml solution using the method described by D. J. Davidson in Analyst, 87, 576 (1962).

Three 4-ml aliquots of the solution were taken. The first was mixed thoroughly with 1 ml of water, the second with 1 ml of a 5.0 ppm solution of strontium as the chloride, and the third with 1 ml of a 10.0 ppm solution of strontium.

The known additions to the resulting 5-ml solutions were, therefore, 0.0 ppm, 1.0 ppm, and 2.0 ppm. The absorptions of the three solutions were measured and converted to absorbance. A working curve of absorbance vs. strontium additions was plotted as shown in Fig. 4 and extrapolated through the 0 absorbance line.

Results - The strontium concentration in the sample is given by the point at which the line drawn intersects the 0 absorbance line - i.e., 1.6 ppm. The concentration in the original solution is obtained by multiplying 1.6 ppm by the dilution factor (1.25). The result, 2 ppm, can then be converted to weight of metal in the ash sample.

REFERENCES

An atomic absorption bibliography follows. This bibliography is referred to throughout this book by numerical references in parentheses. For example, the reference (72) refers to the literature numbered 72 in the bibliography.

PanCana Industries Inc.

Procedure for the analysis of cyanide solutions for gold and silver using the Chiddey Method.

Requirements:

Apparatus:

1. 1000 ml beaker
2. 1000 ml graduated cylinder
3. Teflon stirring rods
4. dropper bottle
5. bone ash cupels, 1½"
6. porcelain parting cup

Reagents:

1. Sodium cyanide, Reagent grade
2. Sodium hydroxide, Reagent grade
3. Hydrochloric acid, Reagent grade
4. Silver nitrite solution, 35 gm/500 ml H₂O
5. Acetic acid glacial, Reagent grade
6. Lead acetate, Reagent grade
7. Nitric acid, Reagent grade, 1:7 in water
8. Zinc dust, Reagent grade
9. Ammonium Hydroxide, Reagent grade

Procedure:

Measure an appropriate size sample using a graduated cylinder and transfer it to a one liter beaker. A 600 ml sample (20.57 A.T.) yields acceptable results for barren and preg solutions. Add Sodium Hydroxide to pH of greater than 11. Add Sodium cyanide to insure a concentration of at least 0.5% NaCN.

Stir to dissolve all solids.

If assaying for gold only, add enough Silver nitrate solution to insure the bead will part. One drop is equal to 2 mg (equal to one Herman in-quart).

Add 5 to 7 gm of Zinc dust and stir well. Add 15 gm Lead acetate and 10 ml glacial acetic acid. Stir well and allow to settle. The supernatant liquid should be clear. If not, add another gram of Zinc dust and stir.

Place the sample on the hot plate and warm without boiling.

Add 50 to 75 ml concentrated Hydrochloric acid and boil until all the Zinc is dissolved.

Decant and discard the solution, washing the lead sponge with tap water several times, being careful not to lose any of the lead.

Press the lead sponge into a cube and dry it on the hot plate.

Place the dried sponge in a pre-heated bone ash cupel in the assay furnace.

When the cupellation is completed, remove the dore' bead, flatten with a hammer, and place in a glazed procelain parting cup.

If the analysis is for silver, weigh the dore' bead.

Add dilute (1:7) Nitric acid and heat to dissolve the silver.

Wash the gold bead with distilled water, 5% ammonium hydroxide solution, and distilled water again.

Dry the gold bead and then anneal it in the assay furnace.

Weigh the bead.

Calculations:

1. If for gold only:

$$\frac{\text{ml of solution}}{29.167} = \text{A.T. sample}$$

$$\frac{\text{wt of Au bead (in mg)}}{\text{A.T. sample}} = \text{oz/ton Au in solution}$$

2. If for gold and silver:

$$\frac{\text{ml of solution}}{29.167} = \text{A.T. sample}$$

$$\text{dore' (in mg)} - \text{Au (in mg)} = \text{Ag (in mg)}$$

$$\frac{\text{Ag (in mg)}}{\text{A.T. sample}} = \text{oz/ton Ag in solution}$$

$$\frac{\text{Au (in mg)}}{\text{A.T. sample}} = \text{oz/ton Au in solution}$$

Notes: When silver is to be run on solutions containing less than the 3 to 1 ratio of silver to gold needed for parting, a duplicate assay containing excess silver is run. The inquarted sample is parted and weighed, the uninquarted sample (dore') is weighed without parting.

Chemical Safety Data Sheet SD-30

PROPERTIES AND ESSENTIAL INFORMATION

FOR

SAFE HANDLING AND USE

OF

SODIUM CYANIDE

Chemicals in any form can be safely stored, handled or used if the physical, chemical and hazardous properties are fully understood and the necessary precautions, including the use of proper safeguards and personal protective equipment, are observed.

REVISED 1967



MANUFACTURING CHEMISTS ASSOCIATION

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WASHINGTON, D. C. 20009

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Chemical Safety Data Sheet

SODIUM CYANIDE

PREFACE

Sodium cyanide is a white solid which is extremely poisonous if ingested and may cause poisoning by contact with the skin. In strong solution it is also corrosive to the skin.

Poisonous and flammable hydrocyanic acid gas is liberated when sodium cyanide comes in contact with acids.

Sodium cyanide is classified by the Department of Transportation as a Class B, POISON and must be packaged, marked, labeled and shipped in compliance with the Code of Federal Regulations.

The full text of this chemical safety data sheet should be consulted for details of the hazards of sodium cyanide and suggestions for their control.

FIRST AID — SEE PAGE 16

For assistance in the event of any emergency involving this chemical in transportation, call MCA's Chemical Transportation Emergency Center.

CHEMTREC

(800) 424-9300 * (Use 483-7616 in District of Columbia)

Toll-free, day or night

* Use long distance access number if required.

In CANADA, call Canadian Chemical Producers Association's TEAP
(Transportation Emergency Assistance Plan)

SODIUM CYANIDE

1. NAMES

Chemical Name: Sodium Cyanide
Common Name: Sodium Cyanide
Formula: NaCN

2. PROPERTIES

2.1 GRADES AND STRENGTHS

97-99% molded shapes, granular
Aqueous solutions (up to approximately 30% NaCN)

2.2 IMPORTANT PHYSICAL AND CHEMICAL PROPERTIES

Physical State.....	Solid
Color.....	White
Odor.....	Odorless when dry. When moist it has a slight odor of hydrocyanic acid. It may also have the odor of ammonia.
Boiling Point.....	1500°C. ± 10°C. (2732°F. ± 18°F.)
Melting Point.....	560°C. (1040°F.)
Corrosiveness.....	Corrosive to skin due to strong alkalinity.
Reactivity.....	Reacts with acids and acid salts to liberate highly toxic HCN gas. Strong reducing agent.
Deliquescence.....	Deliquescent
Solubility in Water.....	Very soluble in cold or hot water

3. HAZARDOUS PROPERTIES

3.1 HEALTH HAZARDS

Sodium cyanide is extremely poisonous if ingested and it may cause poisoning by skin contact. When in strong solution the material is corrosive to the skin. In contact with acids it liberates poisonous and flammable hydrocyanic acid gas.

3.2 FIRE AND EXPLOSION HAZARD

Sodium cyanide will not burn or support combustion. When stored in sealed metal containers it

offers no direct hazard in case of fire unless the container becomes perforated or opened so that the contents are subjected to the action of water, which may liberate small amounts of poisonous hydrocyanic acid gas. In a flaming fire, the HCN will burn to harmless gases. High temperatures will melt sodium cyanide (see 2.2 Melting Point), and in melting the material expands slightly. Long exposure to temperatures above the melting point is necessary to melt the entire contents of the container. Water coming into contact with molten sodium cyanide will cause a steam explosion.

4. ENGINEERING CONTROL OF HAZARDS

4.1 BUILDING DESIGN

4.1.1 The building and partitions should be of non-combustible construction.

4.1.2 Ample emergency exits from buildings should be provided (see NFPA "Life Safety Code").

Fire doors should open in the direction of travel and be of an approved type.

4.1.3 All rooms in which sodium cyanide is stored or handled should be provided with adequate ventilation.

4.2 EQUIPMENT DESIGN

4.2.1 The technical problems of designing equipment in which sodium cyanide is made or handled, providing adequate ventilation, and establishing operating procedures which promise maximum security should be handled by qualified engineers and safety experts.

4.2.2 For safety, it is essential that suitable equipment be used and maintained. If in doubt, the manufacturer of sodium cyanide should be consulted.

4.3 VENTILATION

4.3.1 Where sodium cyanide in cast shapes is handled occasionally and where there is no danger

of the material coming in contact with acids, natural ventilation is sufficient.

4.3.2 Where long exposure to sodium cyanide is required, where the material is moved in powdered or granular forms, where it is used in electroplating work, or in a fused state, mechanical ventilation should be provided.

4.3.3 Sodium cyanide solutions in contact with appreciable amounts of carbon dioxide gas will liberate hydrocyanic acid gas. Experimental work has shown that under such circumstances sufficient hydrocyanic acid gas is liberated to kill rats within a relatively short period of time. Solutions of sodium cyanide should therefore be kept from contact with carbon dioxide by means of adequate ventilation. (See Section 6.)

5. EMPLOYEE SAFETY

5.1 EMPLOYEE EDUCATION AND TRAINING

5.1.1 Safety in handling sodium cyanide depends, to a great extent, upon the effectiveness of employee education, proper safety instructions, intelligent supervision and the use of safe equipment.

5.1.2 The education and training of employees to work safely and to use the personal protective equipment or other safeguards provided for them is the responsibility of supervision. Training classes for both new and old employees should be conducted periodically to maintain a high degree of safety in handling procedures.

5.1.3 Employee education and training should emphasize the need to handle sodium cyanide according to the methods outlined in this Data Sheet and the necessity to avoid spills, leaks, burns, inhalation of the dust, and ingestion.

5.1.4 New employees should be instructed thoroughly in the proper handling of sodium cyanide before they are allowed to work in an area where the material is made, handled, or used. Older employees should be reinstructed and quizzed periodically.

5.1.5 Each employee should know the location, purpose, and methods of maintenance of personal protective equipment. They should also be trained thoroughly as to when and how to use this equipment.

5.1.6 Each employee should know the location of safety showers, bubbler fountains for flushing the eyes, hose lines, and other washing facilities.

5.1.7 Each employee should know what to do in an emergency arising from the handling of sodium cyanide. He should realize the necessity for the

prompt application of first aid in case of ingestion, inhalation, or skin contact.

5.1.8 All employees should be trained to wash out their mouths with water if the sense of taste indicates the presence of sodium cyanide. The water must not be swallowed.

5.1.9 All employees should be instructed to report to the proper authority all equipment failures and/or signs of illness.

5.1.10 Job instructions, including safety precautions, should be posted in the work area.

5.2 PERSONAL PROTECTIVE EQUIPMENT

5.2.1 Availability and Use

While personal protective equipment is not an adequate substitute for good, safe working conditions, adequate ventilation, and intelligent conduct on the part of employees working with sodium cyanide, it is, in many instances, the only practical means of protecting the worker, particularly in emergency situations. One should keep firmly in mind that personal protective equipment protects only the worker wearing it, and other unprotected workers in the area may be exposed to danger.

The correct usage of personal protective equipment requires the education of the worker in proper employment of the equipment available to him. Under conditions which are sufficiently hazardous to require personal protective equipment, its use should be supervised and the type of protective equipment selected should be capable of control over any potential hazard.

The following personal protective equipment should be used when indicated.

5.2.2 Eye Protection

5.2.2.1 Chemical Safety Goggles. Cup type or rubber framed goggles equipped with approved impact resistant glass or plastic lenses, should be worn whenever there is danger of sodium cyanide in water solution coming in contact with the eyes. Goggles should be carefully fitted by adjusting the nose piece and head band to insure maximum protection and comfort.

5.2.2.2 Spectacle Type Safety Goggles. Metal or nonflammable plastic rim safety spectacles with side shields which can be obtained with prescription safety lenses, or suitable all plastic safety goggles may be used where continuous eye protection is desirable, for example, in working with fused salts containing sodium cyanide. These types, however, should not be used where complete eye protection against chemicals is needed.

5.2.2.3 Face Shields. Nonflammable plastic shields (full length, 8 in. minimum) with forehead protection may be worn in lieu of, or in addition to, chemical safety goggles where complete face protection is desirable. Chemical safety goggles should always be worn as added protection where there is danger of material striking the eyes from underneath or around the sides of the face shield.

5.2.3 Respiratory Protection

Two distinct respiratory hazards are possible where sodium cyanide is manufactured, stored, or used: (1) The hazard of inhaling hydrocyanic acid gas in the event of acids or acid salts coming in contact with sodium cyanide, and (2) the hazard of inhaling sodium cyanide dust.

Respiratory protective equipment intended for use in connection with the hazards of hydrocyanic acid gas or sodium cyanide dust must be carefully maintained, inspected, cleaned and sterilized at regular intervals, and always before use by another person. Personnel wearing such equipment must be carefully instructed as to its operation and limitation.

5.2.3.1 Air or oxygen supplied masks must be worn for protection where an oxygen deficiency, less than 16 percent by volume, or a concentration of a harmful gas above 2 percent by volume may be encountered for a few minutes in connection with rescue work or a similar emergency such as:

(a) In fumigating with sodium cyanide and an acid, the liberated hydrocyanic acid gas being the fumigant.

(b) In emergencies when the vapor concentration of sodium cyanide is not definitely known.

Only masks approved for this purpose by the U.S. Bureau of Mines should be used and the manu-

facturer's instructions must be carefully followed. Types generally available include:

(a) *Self-contained Breathing Apparatus permitting the wearer to carry a supply of oxygen or air compressed in the cylinder, the self-generating type which produces oxygen chemically, and the re-breathing type.* These allow considerable mobility. The length of time a self-contained breathing apparatus provides protection varies according to the amount of air, oxygen or regenerating material carried. Compressed oxygen should not be used in confined spaces such as tanks or pits.

(b) *Positive Pressure Hose Masks supplied by blowers requiring no internal lubrication.* The wearer must be able to use the same route for exit as for entrance and must take precautions to keep the hose line free of entanglement. The air blower must be placed in an area free of contaminants.

(c) *Air-line Masks supplied with clean compressed air.* These are suitable for use only where conditions will permit safe escape in case of failure of the compressed air supply. These masks are usually supplied with air piped to the area from a compressor. It is extremely important that the air supply is taken from a safe source and that it is not contaminated by oil decomposition from inadequate cooling at the compressor. The safer method is to use a separate compressor of the type not requiring internal lubrication. Pressure reducing and relief valves, as well as suitable traps and filters, must be installed at all mask stations. An alternative arrangement frequently used is high pressure breathing air from standard (200 cu. ft.) cylinders, with a demand-type valve and face piece. This arrangement may also be used with 50-100 lb. clean piped plant air, and, as an additional precaution with the demand mask, a small cylinder of compressed air may be worn for use as an emergency escape from the area. Consult a reliable safety equipment dealer for details on the proper use of Bureau of Mines approved equipment.

(d) *Industrial Canister Type Gas Masks approved by the U.S. Bureau of Mines, fitted with the proper canister for absorbing hydrogen cyanide vapor.* These will afford protection against concentrations not exceeding 2 percent by volume when used in accordance with manufacturers' instructions. The oxygen content of the air must not be less than 16 percent by volume. The masks should be used for relatively short exposure periods only. They may not be suitable for use in an emergency since, at that time, the actual vapor concentration is unknown and an oxygen deficiency may exist. The wearer must be warned to leave the contaminated area immediately on detecting the odor of a harmful vapor. This may indicate that the mask is not functioning properly, that the vapor concentration is too high, that

the canister is exhausted or that the mask is not properly fitted.

5.2.3.2 Because hydrocyanic acid may be absorbed through the skin, persons entering a gas-filled area for emergency purposes must wear gas-tight garments, such as those designed for gas decontamination squads during the war, in addition to the prescribed respiratory protection. Gas-tight suits are available commercially.

5.2.3.3 Dust respirators approved by the Bureau of Mines will afford protection against sodium cyanide dust. The respirators should be cleaned at frequent and regular intervals, and the filters should be changed when breathing resistance increases. If the odor or taste of hydrocyanic acid becomes noticeable, a full face mask approved for the material should be used.

5.2.4 Head Protection

5.2.4.1 Safety, or "Hard" hats will provide protection against accidental liquid leaks, falling tools and other objects.

5.2.4.2 Brimmed felt hats may be substituted for safety hats where the danger of falling objects is remote.

5.2.5 Foot Protection

5.2.5.1 Leather or rubber safety shoes with built in steel toe caps are recommended. Rubbers may be worn over leather safety shoes.

5.2.6 Body, Skin, and Hand Protection

5.2.6.1 Aprons made of rubber or other suitable protective material should be used for protection against accidental contact.

5.2.6.2 Dry cotton gloves should be worn to protect the hands from solid sodium cyanide.

5.2.6.3 Gloves made of rubber or other suitable protective material should be worn to protect the hands from sodium cyanide solution.

5.2.6.4 Sleeves made of suitable protective

material should be worn when the need for complete arm protection is indicated.

5.2.6.5 Suits made of rubber or suitable protective material and properly designed should be used to provide complete body protection where sodium cyanide or its solutions are handled and when such protection is indicated.

5.2.6.6 Clothing wet by sodium cyanide solutions *must* be removed immediately, and the body *must* be washed thoroughly before clean clothing is put on. Splashed clothing *must* be washed thoroughly and dried before it is worn again.

5.3 EMERGENCY KITS (See 11.1.4)

Emergency kits should always be quickly available and readily accessible to every operating area. However, they should not be located in the operating area lest they not be accessible in case of a spill.

5.4 SAFETY SHOWERS AND EYE BATHS

5.4.1 A readily accessible, well marked, rapid action deluge type safety shower should be available in any area where sodium cyanide either as a solid (dust or granular) or in solution is handled. Special eye washing fountains, or a ready source of running tap water such as a bubbler fountain, or a hose with a soft, gentle flow of water, should be available for eye irrigation. All of this equipment should be inspected at frequent and regular intervals to insure that it is in working condition at all times.

5.5 WASHING FACILITIES

5.5.1 Adequate washing facilities should be conveniently located for the use of employees before eating, smoking or leaving the plant. A shower is recommended for the latter time. Locker facilities also should be provided for a complete change of clothing.

5.6 EATING FOOD AND CHEWING TOBACCO

5.6.1 Food, gum and tobacco should not be carried in work areas where contamination with sodium cyanide is possible.

6. FIRE FIGHTING

Sodium cyanide will not burn or support combustion. If exposed to water, as through perforations in the steel container, the sodium cyanide will dissolve and small amounts of HCN gas may form by hydrolysis reaction.

Carbon dioxide type extinguishers should not be used to combat fires involving sodium cyanide solutions because of the possible formation of toxic hydrocyanic acid gas. This gas is also formed when sodium cyanide comes in contact with acids or acid

salts. If presence of HCN is suspected, fire fighters should approach the fire from upwind and should wear self-contained breathing apparatus and com-

plete firemen's clothing (rubber coat, boots and helmet).

7. HANDLING AND STORAGE

7.1 USUAL SHIPPING CONTAINERS

7.1.1 Federal Classification and Regulations

Sodium cyanide molded shapes and granules is classified by the Department of Transportation as Poisonous Solid, Class B. Sodium cyanide liquid is classified as Poisonous Liquid, Class B. As such it must be packaged, marked, labeled and shipped in compliance with the Code of Federal Regulations.

7.1.2 Type and Size

7.1.2.1 For Solid Sodium Cyanide

(a) Bags, Spec. 45B, cloth and paper lined, authorized for globular or pellet form—diameter not less than $\frac{3}{4}$ inch. Net weight not over 100 pounds.

(b) Metal Drums, Spec. 37A or 37B.

(c) Fibre Drums, Spec. 21C—authorized net weight not over 225 pounds.

(d) Motor Vehicles—in bulk in watertight metal bodied covered motor vehicle.

(e) Rail Cars—in bulk in watertight metal cars or in watertight container car in metal containers.

7.1.2.2 For Liquid Sodium Cyanide

(a) Metal Drums, Spec. 5, 5A or 5B returnable drums; and Spec. 17E or 37B (single trip) drums with welded side seams and openings not exceeding 2.3 inches in diameter.

(b) Tank Motor Vehicles, Spec. MC300, MC301, MC302, MC303, MC305.

(c) Tank Cars, Spec. 103, 103-W, 103A, 103A-W, 111A60-F-1, 111A60-W-1, 111A100-F-2 or 111A100-W-2.

7.1.2.3 Other

Several other containers, especially small containers for both dry and liquid sodium cyanide, are authorized by the Regulations (49CFR Parts 171 thru 179).

7.2 LABELING AND IDENTIFICATION

7.2 Federal Requirements

7.2.1.1 Shipping containers of sodium cyanide,

for other than bulk quantities, must display a "POISON" label on the outside container. Outside containers of sodium cyanide solid, other than bulk, must be plainly marked, optionally, as follows (1) "Cyanide of Sodium, Solid", or (2) "Sodium Cyanide, Solid". Outside containers of sodium cyanide liquid, other than bulk, must be plainly marked, optionally, as follows (1) "Cyanide of Sodium, Liquid" or (2) "Sodium Cyanide, Liquid".

7.2.1.2 Motor vehicles transporting sodium cyanide in quantities of 1000 pounds or more, and tank motor vehicles, whether loaded or empty, shall be marked "POISON" on all four (4) sides in blue letters not less than 4 inches high using approximately a $\frac{5}{8}$ " stroke on a white background (placard). Placard must be larger than the lettering required thereon by at least 1" on top and bottom sides. Such marking or placarding must be contained in an area on the vehicle which has no other marking, lettering, or graphic display for at least 3" in each direction.

7.2.1.3 Rail cars containing one or more containers of sodium cyanide and tank cars must display the "DANGEROUS" placard on all four (4) sides.

7.2.1.4 The labeling and identification can be eliminated under certain conditions of shipment for certain containers. Consult the EODA Regulations for specific information (49 CFR Parts 171 thru 179).

7.2.2 Precautionary Labeling

The Manufacturing Chemists' Association recommends that all containers of sodium cyanide should bear one of the labels as shown. The text is designed for the product as shipped for industrial use. It should be used in addition to or in combination with any specific wording required by law. Since individual statutes, regulations, or ordinances may require that particular information be included in a label, that certain information be displayed in a particular manner, or that a specific label be affixed to a container, the use of this label text will not necessarily insure compliance with such laws. Such laws include the Federal Hazardous Substances Labeling Act; Federal Insecticide, Fungicide and Rodenticide Act; and similar state and municipal legislation.

(a) Sodium Cyanide, Solid.

SODIUM CYANIDE

**DANGER! MAY BE FATAL IF SWALLOWED OR INHALED
CONTACT WITH ACID LIBERATES POISONOUS GAS
CAUSES EYE BURNS AND MAY IRRITATE SKIN**

BEFORE USING, READ MCA CHEMICAL SAFETY DATA SHEET SD-30.

Do not breathe gas or dust.

Do not get in eyes.

Avoid contact with skin.

Wash thoroughly after handling.

Keep container closed and away from acids. Store in a dry place.

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes; for eyes call a physician.

Sweep up spillage. Do not flush to sewer which may contain acid.



POISON



First Aid

Always have on hand a Cyanide First Aid Kit.

Carry patient to fresh air, have him lie down.

Remove contaminated clothing but keep patient warm.

Start treatment immediately.

Call a physician.

Antidote

If gas is inhaled: Break an amyl nitrite pearl in a cloth and hold lightly under nose for 15 seconds. Repeat 5 times at about 15-second intervals. Repeat as necessary using a fresh amyl nitrite pearl every three minutes. Use artificial respiration if breathing has stopped.

If swallowed: Break an amyl nitrite pearl in a cloth and hold lightly under nose for 15 seconds. If patient is conscious, or when consciousness returns, give emetic (1 tablespoonful of salt in a glass of warm water) and repeat until vomit fluid is clear. Repeat inhalation of amyl nitrite 5 times at about 15-second intervals. Repeat as necessary using a fresh amyl nitrite pearl every three minutes. Use artificial respiration if breathing has stopped.

Never give anything by mouth to an unconscious person.

(b) Sodium Cyanide Solution.

SODIUM CYANIDE SOLUTION

**DANGER! MAY BE FATAL IF SWALLOWED OR ABSORBED
THROUGH SKIN
CAUSES BURNS
CONTACT WITH ACID LIBERATES POISONOUS GAS**

BEFORE USING, READ MCA CHEMICAL SAFETY DATA SHEET SD-30.

Do not breathe gas.

Do not get in eyes, on skin, on clothing.

Wash thoroughly after handling.

Keep container closed and away from acids.

In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes and call a physician.

Treat spillage with strong calcium hypochlorite solution and flush to sewer.



POISON



First Aid

Always have on hand a Cyanide First Aid Kit.

Carry patient to fresh air, have him lie down.

Remove contaminated clothing but keep patient warm.

Start treatment immediately.

Call a physician.

Antidote

If gas is inhaled: Break an amyl nitrite pearl in a cloth and hold lightly under nose for 15 seconds. Repeat 5 times at about 15-second intervals. Repeat as necessary using a fresh amyl nitrite pearl every three minutes. Use artificial respiration if breathing has stopped.

If swallowed: Break an amyl nitrite pearl in a cloth and hold lightly under nose for 15 seconds. If patient is conscious, or when consciousness returns, give emetic (1 tablespoonful of salt in a glass of warm water) and repeat until vomit fluid is clear. Repeat inhalation of amyl nitrite 5 times at about 15-second intervals. Repeat as necessary using a fresh amyl nitrite pearl every three minutes. Use artificial respiration if breathing has stopped.

Never give anything by mouth to an unconscious person.

7.3 SPILLS AND LEAKAGE

7.3.1 Sodium Cyanide, Solid

Sodium cyanide is supplied in fused shapes and in granular form. The fused shapes are not likely to leak from a container, and if spilled during transfer from one container to another, they can be picked up readily with a shovel. Spilled granular material must be completely swept onto a shovel and returned to the container or preferably used immediately.

To avoid such spills, hooks should never be used for moving containers of sodium cyanide. A sign "USE NO HOOKS" should be prominently displayed.

7.3.2 Sodium Cyanide, Liquid

See Section 9—Waste Disposal. Small spills of liquid sodium cyanide may be flushed to the sewer with water. The volume of water used for flushing must insure prompt dilution of the cyanide to acceptable concentrations.

7.4 DRUMS

7.4.1 When a carload or truckload of drums containing sodium cyanide is received, the truck doors or the doors on both sides of the car, as the case may be, should be opened to allow thorough ventilation of the vehicle before it is entered. Each shipment should be examined for leaking drums.

7.4.2 The contents of the drums should be dumped into carrying containers which should be marked with a POISON label, or into the vessel in which the sodium cyanide is to be used. Splashing should be avoided when dumping the material into a tank of water or electrolyte. A shovel should be used for transferring solid sodium cyanide from containers to pots of fused salt commonly used for case hardening.

7.4.3 Returnable containers are not used for shipping sodium cyanide.

7.4.4 The non-returnable containers should be destroyed. Metal containers should be flushed with large volumes of water, and then thoroughly drained. (See Section 9—Waste Disposal.) The washing and draining should be repeated before containers are discarded to a dump or junk yard.

7.5 TANK CARS

7.5.1 Unloading operations should be conducted by carefully instructed, reliable employees under adequate supervision.

7.5.2 Shippers' instructions should always be followed and all caution markings on both sides of tank and dome should be read and observed.

7.5.3 The train or engine crew should accurately spot the car at the unloading line. The unloading track should be level.

7.5.4 It is considered good practice that derrails be placed at one or both ends of the unloading track approximately one car-length from the car being unloaded, unless the car is protected by a closed and locked switch or gate.

7.5.5 The hand-brake should be set and the wheels blocked at the time the car is placed for unloading. "CAUTION" signs should be placed fore and aft of the car. These should be fastened to the track, preferably near the entering switch, as a warning to persons and switching crews approaching the car. These signs, as described in the Regulations must not be removed until the car has been unloaded and all fittings disconnected.

7.5.6 It is recommended that tank cars be unloaded through dome connections rather than through bottom outlet.

7.5.7 Immediately before unloading is started, all valves and connections should be checked so as to be sure flow will be properly directed. When flow has been started re-examine all valves, fittings, etc. for leaks. Should repairs be necessary, stop unloading procedure until repairs can be completed and spills cleaned up.

7.5.8 Disconnecting Tank Car

7.5.8.1 As soon as the tank car is completely unloaded all valves must be made tight, the unloading connections removed and all other closures made tight.

7.5.8.2 Empty tank cars should be returned as promptly as possible in accordance with instructions received from the shipper. The shipper's routing instructions should always be strictly followed.

7.6 TANK TRUCKS

7.6.1 Unloading operations should be conducted by carefully instructed reliable employees under adequate supervision and in cooperation with the tank truck driver who is responsible for the handling of the truck and its appurtenances. The driver should be in constant attendance during the unloading of the truck.

7.6.2 The shipper should be consulted for details on proper unloading procedure.

7.6.3 Before unloading a truck, the engine should be stopped and not started again during the entire unloading operation unless it is necessary to operate the pump by power take-off.

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7.6.4 Truck brakes should be set and, if necessary, the wheels blocked.

7.6.5 A sign should be placed near the truck stating in effect "Danger—Unloading Sodium Cyanide" to caution others to stay away from the operation.

7.7 STORAGE

7.7.1 Building Design

Type of construction is immaterial as long as it conforms to local building codes and protects containers of sodium cyanide from excessive moisture, rain, or snow. However, buildings with floors that can be washed down whenever the need arises are recommended.

7.7.2 Isolation of storages for sodium cyanide is not necessary unless it is required by local building codes.

7.7.3 Dangerously Reactive Materials. Sodi-

um cyanide containers should not be stored where they will be exposed to acid vapors or to acids liberated by spillage or leakage from other containers. They should also not be stored in close proximity to containers filled with nitrate—nitrite mixtures (drawing salts), or peroxides.

7.7.4 If the conditions outlined in 7.7.1 and 7.7.3 are met, storage spaces need not be especially ventilated, natural ventilation being sufficient.

7.7.5 Metal drums may corrode if they are stored for a long time in a damp place. They should not be stored in cellars, or near open windows or ventilators which may permit rain or snow to enter. A drum perforated by corrosion may permit moisture or water to enter with the liberation of dangerous hydrocyanic acid gas. Fiber containers should likewise be stored in a dry place.

7.7.6 Sodium cyanide is not affected by temperature changes or by excessive heat occasioned by an overheated radiator or steam pipe.

8. TANK AND EQUIPMENT CLEANING AND REPAIRS

(See MCA Safety Guide SG-10)

8.1 TANK CLEANING

8.1.1 The hazardous nature of inspecting, cleaning, or repairing tanks which are used for sodium cyanide solutions and which therefore may contain hydrocyanic acid gas requires that the foreman and crew assigned to this work be selected, trained and drilled carefully. They should be fully familiar with the potential hazards, and with the safeguards necessary for the safe performance of the work. In all cases, written approval should be secured from the plant management or safety department before work is started.

8.1.2 In order to clean out a tank or another piece of equipment which contained sodium cyanide solution, the following steps should be taken:

(a) The tank or piece of equipment should be drained as completely as possible.

(b) It should then be filled with water; and, if the vessel is fitted with an agitator, its contents should be stirred for 15 minutes. If the vessel is not provided with an agitator, its contents should be allowed to stand for an equal length of time. Then, in either case, the vessel should be drained as completely as possible. (See Section 9—Waste Disposal.)

(c) The procedure under (b) should be repeated.

(d) The vessel is then ready for a preliminary inspection, which should be made from the outside with the aid of a large flashlight or properly guarded extension light. If any sludge or salt incrustation is found, it should be removed mechanically or by means of a stream of water from a hose.

8.2 ENTERING TANK

8.2.1 If the vessel must be entered to make repairs or alterations, the atmosphere within the tank should then be tested for hydrocyanic acid gas, for ammonia content, and for oxygen deficiency.

It is suggested that methyl orange-mercuric chloride test papers be used in determining whether or not a given space has been entirely cleared of hydrocyanic acid. These are small strips of paper of a canary yellow color which, in the presence of an atmosphere containing hydrocyanic acid, turn pink or red and are very sensitive to relatively low concentrations of the gas.

Competent authorities have determined that if methyl orange-mercuric chloride test papers do not change color within two minutes after exposure to a supposed concentration of hydrocyanic acid, the space is safe for human occupancy. These test papers are very sensitive and will detect the slightest presence of hydrocyanic acid. Methyl orange-mercuric chlo-

ride test papers may be prepared in accordance with the following formula: Ten grams (10g) mercuric chloride dissolved in five hundred milliliters (500 ml.) of distilled water. Two and one-half grams methyl orange (2.5g) dissolved in two hundred and fifty milliliters (250 ml.) of distilled water.

It is necessary to warm these solutions somewhat until solution is complete. Cool to 30°C. or lower. Mix with fifty milliliters (50 ml.) of glycerine, U.S.P.

Immerse sheets of filter paper in this solution and hang up to dry in air entirely free of hydrocyanic acid. At the end of the drying period the paper should still be soft. Overdrying results in loss of sensitivity. Cut the dried paper into strips and preserve in glass containers, tightly stoppered and protected from light. Any high grade white filter paper may be used.

8.2.2 Pipe lines into or out of the vessel should be disconnected, preferably by removing a complete small section and providing a blank flange on the open end of the line to guard against human error and unsuspected leaks.

8.2.3 If the vessel is provided with an agitator, the electrical switches should be locked in the "off" position and the drive belts, if any, removed to safeguard against the accidental starting of the agitating equipment or any part of it.

8.2.4 Danger signs should be suitably placed to indicate that workmen are in the tank or other equipment. It should also be ascertained that the vessel can be left by the original entrance.

8.2.5 Before a foreman directs men to enter a vessel, he should inspect its interior. He should be equipped with a life belt, a life line, and a hose mask, an air-line mask or a self-contained breathing apparatus. Another person should be on guard during the inspection, and two other workmen provided with suitable rescue equipment should be nearby to assist in rescue work, if necessary.

8.2.6 Proper personal protective equipment should be worn by anyone entering a vessel for inspection, cleaning, or repairs.

8.2.7 During the course of work inside a vessel, tests should be frequently made by a qualified person to determine that no harmful gases are present and that no oxygen deficiency exists.

8.2.8 Respiratory protection and rescue equipment should be readily available near the entrance to the vessel, to be used in case of emergency. This equipment should be available regardless of the type of respiratory protection or the air supply which is provided for employees inside the vessel.

8.2.9 In addition to protecting the workmen actually engaged in cleaning or repairing the inside of a vessel, attention should be paid to the protection of workers in nearby areas.

8.2.10 Portable electric tools, including extension lights, should bear the Underwriters' Laboratories label of approval and be properly grounded.

8.3 OTHER EQUIPMENT CLEANING

8.3.1 Solid sodium cyanide may require crushing, grinding and screening. The equipment used for crushing or grinding should be enclosed and provided with mechanical exhaust ventilation. To clean this equipment, the sodium cyanide dust and larger particles may be removed by carefully brushing with a soft bristled brush. Traces of sodium cyanide may be removed by repeated flushing with a gentle stream of water from a hose. The wash water must be drained to a sewer and the floor flooded with water to remove traces of sodium cyanide in solution. (See Section 9—Waste Disposal.) The operator should wear protective rubber clothing and a full face shield during this operation to avoid contact with splashes which might otherwise get on the face or into the mouth.

9. WASTE DISPOSAL

9.1 Disposal of waste sodium cyanide and materials containing it must be done with full consideration of the potentially adverse effects cyanide can have on water courses. All federal, state and local regulations concerning such disposal should be determined and observed in all cases.

9.2 Cyanides in low concentrations are toxic to fish and other aquatic life and are of concern to streams used as a source of public water supply. The aquatic Life Advisory Committee of ORSANCO in its Third Progress Report recommended that concentrations of

free cyanide in excess of 0.25 mg/1 be considered unsafe in the waters of the Ohio River. In 1962, USPHS Drinking Water Standards set a limit of 0.01 mg/1 and a mandatory limit of 0.2 mg/1. Cyanides discharged into a sewer can also interfere with biological sewage treatment processes.

9.3 Several methods of treating cyanide-bearing wastes have been developed. The method which has gained wide acceptance is alkaline chlorination. In this process, the cyanide waste is treated with caustic in chlorine or one of chlorine's alkaline compounds,

the hypochlorites, at a pH of 8.5-10.0. The alkaline chlorination is presented in the following reactions:

- (1) $2\text{OH}^- + \text{Cl}_2 \rightarrow \text{OCl}^- + \text{Cl}^- + \text{H}_2\text{O}$
- (2) $\text{CN}^- + \text{OCl}^- \rightarrow \text{CNO}^- + \text{Cl}^-$
- (3) $2\text{CNO}^- + 3\text{OCl}^- + \text{H}_2\text{O} \rightarrow 2\text{CO}_2 + \text{N}_2 + 3\text{Cl}^- + 2\text{OH}^-$

This method is applicable to practically every type of cyanide waste that is encountered.

9.4 CAUTION. In no case should sodium cyanide waste be run into ditches or sewers which might contain acidic liquors which would liberate the highly toxic hydrocyanic acid gas.

10. MEDICAL MANAGEMENT

10.1 HEALTH HAZARDS

10.1.1 General

Sodium cyanide is highly toxic, and dangerous if not handled properly. Toxic symptoms occur if it is swallowed, inhaled as a dust, or absorbed through the skin. It is a skin irritant, and in solutions of high concentration may also act as a corrosive. In the presence of even weak acids, sodium cyanide liberates highly toxic hydrocyanic acid gas.

Sodium cyanide is rapidly absorbed after being swallowed or inhaled as dust. Skin absorption of sodium cyanide in amounts sufficient to cause poisoning is debatable. However, in the presence of sweat which is usually acidic, it may react to form hydrogen cyanide which is readily absorbed through the skin and in this manner could produce cyanide intoxication. Toxic symptoms appear quickly due to the mechanism of poisoning. The time until death after taking a fatal dose is variable, but usually if death does not occur within an hour, the patient recovers.

Sodium cyanide does not interfere with oxygen transport to the body tissues, but it is a chemical asphyxiant because it prevents the utilization of oxygen at the cellular level by inhibiting the activity of the tissue oxidative enzymes. Since the function of cellular respiration is necessary to life, any marked degree of interference with it quickly causes serious illness or death. Because of this interference, oxygen cannot be absorbed from the arterial blood by the tissues, with the result that, in severe poisoning, venous blood retains the bright red color of arterial blood.

Sodium cyanide exposed to the air may become coated with a hard layer of sodium carbonate. If such a compound is swallowed, the symptoms of poisoning may be delayed.

10.1.2 Acute Toxicity

10.1.2.1 Toxic Effects After Swallowing

Following ingestion of sodium cyanide, systemic effects appear quickly. After a large dose the patient may become unconscious within a few seconds. The respirations are at first rapid but soon

become slow and gasping. Convulsions may occur but in most cases of severe, untreated cyanide poisoning, coma and death occur within a few minutes without the occurrence of convulsions.

After smaller doses, one of the more prominent symptoms is weakness. This may be accompanied by dizziness, confusion, headache, and vomiting. These symptoms are rapidly followed by coma and occasionally by convulsions. The heart beat is weak and irregular; respirations initially are rapid but soon become slow and shallow as the intoxication deepens. Milder forms of acute intoxication will result only in weakness, headache, dizziness, and nausea.

The characteristic picture in cyanide intoxication is the rapid onset of coma and cessation of respirations except for the mildest of exposures. If the patient does not die within an hour after the ingestion of sodium cyanide, he usually recovers quickly and completely.

10.1.2.1.1 Fatal Dosage by Mouth

Information is scant on the fatal dosage of sodium cyanide by mouth, but 180-200 milligrams of 95-100 per cent material would undoubtedly be a minimum lethal dose.

10.1.2.2 Toxic Effects After Inhalation of Dust

The development of poisoning after inhalation of sodium cyanide dust follows the same pattern as when this agent is taken by mouth.

10.1.2.3 Effects of Skin Contact

Contact of the skin with sodium cyanide may lead to irritation. Strong solutions of the cyanide act as a corrosive, producing ulcers which are slow in healing. If sodium cyanide is absorbed through the skin in sufficient quantity to produce acute poisoning, the symptoms would be like those described under 10.1.2.1 above.

10.1.2.4 Effects of Eye Contact

Sodium cyanide coming in contact with the eyes may, in the presence of tears, liberate cyanide

ion which can be absorbed and cause systemic poisoning. Also, sodium cyanide may be damaging to the eyes because of its corrosive nature. Therefore, if it enters the eyes, they should be flushed immediately with copious quantities of water.

10.1.3 Chronic Toxicity

The existence of chronic sodium cyanide poisoning is denied by most investigators. The symptoms which some attribute to chronic poisoning are most likely due to repeated episodes of mild acute poisoning.

10.2 PREVENTIVE MEASURES

10.2.1 Environmental Control

See Section 4. As with all toxic chemicals, sound engineering and industrial hygiene practices must be observed as they apply to the chemical in question; in this case, sodium cyanide which is toxic upon ingestion, inhalation, and skin contact.

10.2.2 Personal Hygiene

Readily accessible, well-marked, frequently inspected, rapid action, deluge-type safety showers must be available in the areas where sodium cyanide is handled. They should be capable of supplying large quantities of tepid water under moderately high pressure. Blankets should be located near the safety showers. Special eye wash fountains, a ready source of running tap water, a soft bubbler drinking fountain, or a hose with a soft, gentle flow of drinking water should be available for eye irrigation. All of the above equipment should be inspected and tested frequently. The locations of such equipment should be marked clearly.

Food should never be stored, handled or eaten, and tobacco or gum should never be chewed where sodium cyanide is used. The hands should be thoroughly washed with soap and running water after cyanide has been handled.

Personal protective equipment for workers who may be exposed to sodium cyanide is described in 5.2.

10.2.3 Physical Examinations

The usual pre-placement and periodic examinations should be performed, and only persons in good

physical and mental health should be permitted to work in areas where potential exposure to sodium cyanide exists.

10.3 SUGGESTIONS TO PHYSICIANS

10.3.1 See 11.1.4 regarding contents of first aid kit for use in the treatment of cyanide poisoning. While preparing to administer the treatment outlined below, the physician should have someone break, one at a time, the pearls of amyl nitrite in a handkerchief or gauze and hold the latter over the victim's nose for 15 to 30 seconds each minute. The amyl nitrite inhalation should then be discontinued and the physician should administer intravenously the solution of sodium nitrite (10 cc of a 3% solution) at the rate of 2.5 cc per minute, followed by the solution of sodium thiosulfate (50 cc of a 25% solution) at the same rate. Care should be taken to avoid extravasation. The patient should be kept under continuous observation for at least the first 24 to 48 hours. A temporary improvement of the patient's condition after the initial medication does not insure ultimate recovery or indicate discontinuance of careful surveillance. When signs of poisoning persist or reappear, a further injection of one-half of the first dose of the nitrite and thiosulfate solutions may be given. Even though the signs of poisoning do not persist or reappear, it is wise to give a further injection of the antidotes in one-half the original dosage two hours after the initial treatment as a precaution against a later relapse by the patient.

10.3.1.1 **WARNING:** A patient who has been treated with amyl nitrite, with or without the injection of sodium nitrite and sodium thiosulfate, should not be treated with methylene blue.

10.3.2 If the cyanide is swallowed, gastric lavage should be performed by a physician, in addition to the administration of the antidotes intravenously.

10.3.3 The gastric lavage may be followed by the oral administration of one pint of a 1 per cent solution of sodium thiosulfate if the patient is conscious, to be repeated in 15 minutes.

10.3.4 It is also advisable to give oxygen while the above treatment is being administered.

11. FIRST AID

11.1 GENERAL PRINCIPLES

11.1.1 Prompt treatment of cases of sodium cyanide poisoning is of the utmost importance. If

the patient has breathed sodium cyanide dust, he should be immediately removed to an area free from dust. If solutions of cyanide or molten cyanide have contaminated the skin or clothing, the clothing should

be immediately removed and contaminated skin areas copiously flushed with water until all cyanide has been removed. The clothing should be thoroughly cleansed before being reworn.

11.1.2 Someone should be sent immediately to call for a physician, and in the meantime first aid should be started. The physician should be told the exact location of the patient and the nature of the accident.

11.1.3 Maintenance of respiration is the most important initial first aid measure. If breathing has ceased, an effective method of artificial respiration should be started at once. Anyone properly trained may use a resuscitator or give mouth-to-mouth resuscitation.

11.1.4 In all areas in which sodium cyanide is manufactured or handled, a first aid kit containing the following items should be readily available. (A Cyanide Antidote Package is available only from Eli Lilly and Company, Indianapolis, Indiana.)

- 2 boxes (2 dozen) of amyl nitrite* pearls
- 2 sterile ampules of sodium nitrite solution (10 cc of a 3% solution in each)
- 2 sterile ampules of sodium thiosulfate solution (50 cc of a 25% solution in each)
- One 10 cc and one 50 cc sterile syringe with sterile intravenous needles
- 1 tourniquet
- 1 stomach tube
- 1 dozen gauze pads and 1 small bottle of 70% alcohol
- 2 one-pint bottles of 1% sodium thiosulfate solution
- * Amyl nitrite is unstable and should be replaced annually.

The kit should be conveniently located and checked at regular intervals by a responsible person.

11.1.4.1 **WARNING:** Amyl nitrite should not be used near any source of ignition such as an open flame or cigarette.

11.2 CONTACT WITH SKIN OR MUCOUS MEMBRANES

If the patient has inhaled sodium cyanide dust or swallowed sodium cyanide, first aid for inhalation and/or ingestion should be given first (See Sections 11.4 and 11.5).

11.2.1 The emergency shower should be used immediately to remove the sodium cyanide with large quantities of water. Contaminated clothing should be removed under the shower. Skin areas should be washed with large quantities of soap and water. Contaminated clothing and shoes should not be worn until they have been thoroughly washed and

decontaminated. No ointments or salves should be applied for 24 hours. A physician should see all cases other than minor exposures.

11.2.2 Sodium cyanide may be absorbed through the skin, especially if the skin is broken by small wounds, and fatal poisoning can follow. Therefore, additional first aid procedures may be necessary. (See Section 11.1.)

11.3 CONTACT WITH THE EYES

If sodium cyanide has entered the eyes, they should be irrigated immediately with large quantities of water for a minimum of 15 minutes. The eyelids should be held apart during the irrigation to insure contact of water with all tissues of the surface of the eyes and lids. A physician, preferably an eye specialist, should be called into attendance. If a physician is not available, the eye irrigation should be continued for a second period of 15 minutes. No medications should be instilled in the eyes unless ordered by a physician.

11.4 TAKEN INTERNALLY

11.4.1 The patient should be removed to fresh air; and if he is conscious, he should be made to vomit by giving him an emetic of warm salt water (1 tablespoon of salt to each cup of water). This should be repeated until the vomit fluid is clear. To induce vomiting, the patient should be encouraged to stick his finger down his throat. He should then be given orally one pint of a 1 per cent solution of sodium thiosulfate, to be repeated in 15 minutes.

11.4.2 *Nothing should ever be given by mouth to an unconscious patient.*

11.4.3 If breathing has stopped, an effective means of artificial respiration or resuscitation should be started as soon as it is certain that the patient has a clear airway. This is done by examining the mouth to see if the tongue has dropped back. If it has, it should be pulled forward. False teeth, loose bridges, chewing gum, tobacco, etc., should be removed to prevent the patient from choking. Oxygen is recommended and may be administered by anyone properly trained.

11.4.4 If the victim is breathing unassisted, amyl nitrite may be administered 15 to 30 seconds each minute as described in 10.3.1. This may be alternated with the administration of oxygen which should be carried out the remaining part of each minute.

11.5 INHALATION

11.5.1 A worker with symptoms or signs of cyanide poisoning should be moved promptly to an uncontaminated area.

11.5.2 An effective method of artificial respiration or resuscitation must be started at once if breathing has ceased, and it must be continued uninterrupted until breathing has been resumed. If available, oxygen administration is advisable.

11.5.3 A physician should be called immediately, and the first aid kit made ready. The physician should be told the exact location of the patient and the nature of the injury.

11.5.4 If able, the patient should breathe the contents of amyl nitrite pearls 15 to 30 seconds each

minute until, if necessary, five pearls have been used. The pearls are to be wrapped lightly in a handkerchief or gauze pad, then broken in the wrapping and the latter held about one inch from the patient's mouth and nose.

WARNING: Those giving first aid should be careful to keep the broken pearls away from their own mouths and noses; otherwise, they may inhale the amyl nitrite, become dizzy, and be rendered incompetent to give proper assistance to the poisoned worker.

OTHER CHEMICAL SAFETY DATA SHEETS AVAILABLE

(Date of latest available edition, as of Oct. 1974, given in parentheses)

Acetaldehyde	(1952) SD-43	Cresol	(1952) SD-48	paraNitroaniline	(1966) SD-94
Acetic Acid	(1973) SD-41	Cyclohexane	(1957) SD-68	Nitrobenzene	(1967) SD-21
Acetic Anhydride	(1962) SD-15	o-Dichlorobenzene	(1974) SD-54	Nitrocellulose	
Acetone	(1962) SD-87	Diethylamine	(1971) SD-97	(Wet Types)	(1970) SD-96
Acetylene	(1957) SD-7	Diethylenetriamine	(1959) SD-76	Ortho-Dichlorobenzene ...	(1974) SD-54
Acrolein	(1961) SD-85	Dimethyl Sulfate	(1966) SD-19	Paraformaldehyde	(1974) SD-6
Acrylonitrile	(1974) SD-31	Dinitrotoluenes	(1966) SD-93	Perchloroethylene	(1971) SD-24
Allyl Chloride	(1973) SD-99	Ethyl Acetate	(1972) SD-51	Perchloric Acid Solution..	(1965) SD-11
Aluminum Chloride	(1956) SD-62	Ethyl Chloride	(1953) SD-50	Phenol	(1964) SD-4
Ammonia Anhydrous	(1960) SD-8	Ethyl Ether	(1965) SD-29	Phosgene	(1967) SD-95
Ammonia Aqua	(1947) SD-13	Ethylene	(1973) SD-100	Phosphoric Acid	(1958) SD-70
Ammonium Dichromate ..	(1952) SD-45	Ethylene Dichloride	(1971) SD-18	Phosphoric Anhydride....	(1974) SD-28
Aniline	(1963) SD-17	Ethylene Oxide	(1971) SD-38	Phosphorus, Elemental ...	(1947) SD-16
Antimony Trichloride		Formaldehyde	(1960) SD-1	Phosphorus Oxychloride ..	(1968) SD-26
(Anhydrous)	(1957) SD-66	Hydrochloric Acid	(1970) SD-39	Phosphorus Pentasulfide..	(1958) SD-71
Arsenic Trioxide	(1956) SD-60	Hydrocyanic Acid	(1961) SD-67	Phosphorus Trichloride...	(1972) SD-27
Benzene	(1960) SD-2	Hydrofluoric Acid	(1970) SD-25	Phthalic Anhydride	(1956) SD-61
Benzoyl Peroxide	(1960) SD-81	Hydrogen Peroxide	(1969) SD-53	Propylene	(1974) SD-59
Benzyl Chloride	(1974) SD-69	Hydrogen Sulfide	(1968) SD-36	Sodium Chlorate	(1952) SD-42
Betanaphthylamine	(1949) SD-32	Isopropyl Alcohol	(1972) SD-98	Sodium Cyanide	(1967) SD-30
Boron Hydrides	(1961) SD-84	Isopropylamine	(1959) SD-72	Sodium, Metallic	(1974) SD-47
Bromine	(1968) SD-49	Lead Oxides	(1956) SD-64	Sodium and Potassium	
Butadiene	(1974) SD-55	Maleic Anhydride	(1974) SD-88	Dichromates	(1952) SD-46
n-Butyllithium in		Methanol	(1970) SD-22	Styrene Monomer	(1971) SD-37
Hydrocarbon Solvents ..	(1966) SD-91	Methyl Acrylate and		Sulfur	(1959) SD-74
Butyraldehydes	(1960) SD-78	Ethyl Acrylate	(1960) SD-79	Sulfur Chlorides	(1960) SD-77
Calcium Carbide	(1967) SD-23	Methylamines	(1955) SD-57	Sulfur Dioxide	(1953) SD-52
Carbon Disulfide	(1967) SD-12	Methyl Bromide	(1968) SD-35	Sulfuric Acid	(1963) SD-20
Carbon Tetrachloride ...	(1963) SD-3	Methyl Chloride	(1970) SD-40	Tetrachloroethane	(1949) SD-34
Caustic Potash	(1968) SD-10	Methylene Chloride	(1962) SD-86	Toluene	(1956) SD-63
Caustic Soda	(1974) SD-9	Methyl Ethyl Ketone	(1961) SD-83	Toluene Diisocyanate ...	(1971) SD-73
Chlorine	(1970) SD-80	Mixed Acid	(1974) SD-65	Toluidine	(1961) SD-82
Chloroform	(1974) SD-89	Naphthalene	(1956) SD-58	1, 1, 1-Trichloroethane ...	(1965) SD-90
Chlorosulfonic Acid	(1968) SD-33	Nitric Acid	(1961) SD-5	Trichloroethylene	(1956) SD-14
Chromic Acid	(1952) SD-44	Nitric-Sulfuric Acid		Vinyl Acetate	(1970) SD-75
		Mixtures	(1974) SD-65	Zirconium and Hafnium	
				Powder	(1966) SD-92

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(602) 795-6097

LETTER
IN REFERENCE TO:

FIRST CLASS MAIL INTER-OFFICE

FOR James Briscoe,
Dr. John Dean
Tom Schloss

HOW TO USE THIS
DAY/TIMER
Time-Saver LETTER TO SAVE TIME.
Type or write your reply in the space below. Then mail the white copy to us and keep the pink copy for your files. You'll save time and effort, and we'll have your answer much faster! Thank you.

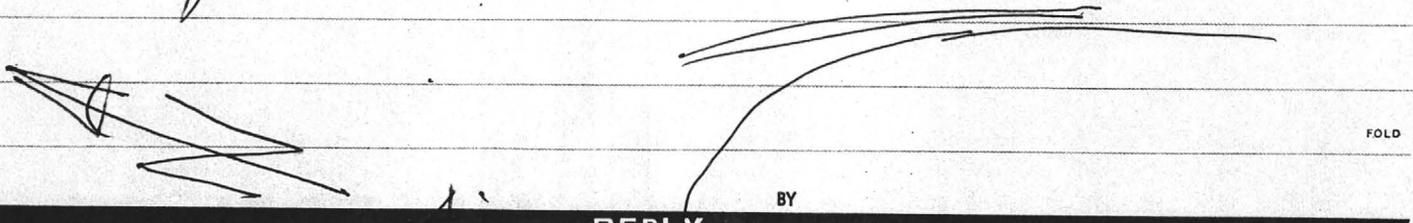
MESSAGE

DATE: July 17, 1979 (Tues), FOLD
REVIEWED

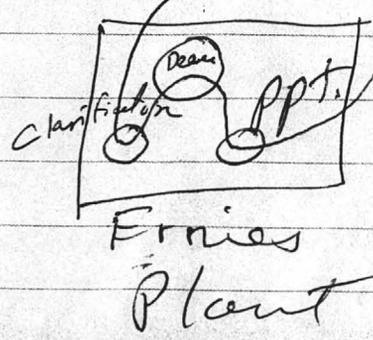
Plant

JUL 19 1979
By *MS*

Fixed problem with vacuum pump.
Plant and entire leaching system
is now operative. Needed to
borrow *4-2-4* in coupler
caps for 2" because George
Jewitt borrowed our 4 inch
couplers.



Our Plant
OOOO
OOOO



DATE:

BY Plant-Leach System

412

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JUL 19 1979

By FIRST CLASS MAIL INTER-OFFICE

FOR Briscoe - Dean - Schloss
- 2 -

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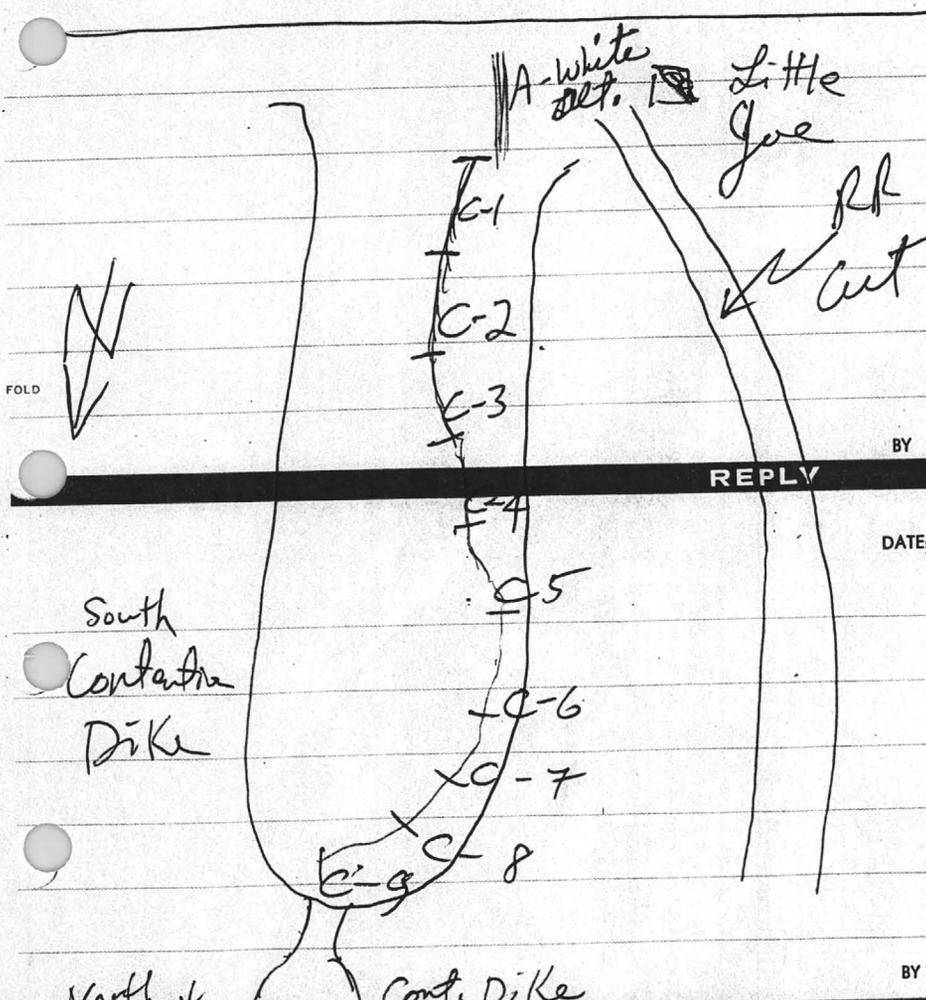
MESSAGE

DATE: July 17, 1979

FOLD

Plant now works and we will circulate tomorrow - Wed.

Have AgNO_3 + KI for CN titration



Sample Channel - 35' long
→ from IC-1 35 feet horizon

Sample #	t. oz. ton Ore g		
	Ag	Cu	250/8
C-1	.24	-	81.92
C-2	1.02	.035	16.94
C-3	1.20	.031	17.35
C-4	2.52	.048	32.16
C-5	1.17	.031	17.11
C-6	1.71	.053	26.93
C-7	3.72	.061	45.01
C-8	4.02	.053	45.41
C-9	.33	.026	9.14
A	.27	.018	86.66

REPLY

DATE: C-4 2.52 .048 32.16
C-5 1.17 .031 17.11
C-6 1.71 .053 26.93
C-7 3.72 .061 45.01
C-8 4.02 .053 45.41
C-9 .33 .026 9.14
A .27 .018 86.66

BY

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LETTER
REVIEWED.

JUL 19 1979

By *JMZ*

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FOR

Brisco - Dear - Schloss

- 3 -

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MESSAGE

Procedure

DATE:

July 17, 1979

FOLD

The above so. Contention Dike horizontal channel samples were taken along 35 feet of the NW wall of the dike structure with a rock-dip hammer - collecting 5 pounds. The 5 pound sample was split and 100 grams of sample was used with a 300 ml cold CN solution at 1 g/l. (CN). They were sample run - which is a mini barrel test. BY no crushing

REPLY

or pulverizing. DATE: The results should be recoverable Au/Ag with CN.

BY

410

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A -

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MESSAGE

DATE: July 17, 1979

FOLD

The dozer has ripped a large entrance in the south of the dike feature and has pushed the ore sampled by C-1 to C-9 into an area that we will load for test B's Contention Dike South

FOLD

We have made progress in

FOLD

REPLY

BY

connecting the north & south portions of the dike structure.

DATE

The ore looks very good - is easy to rip & push with the D-6.

BY

409

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IN REFERENCE TO:

JUL 19 1979

By *[Signature]*

FIRST CLASS MAIL INTER-OFFICE

FOR

Brisco - Dean - Schloss

- 5 -

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MESSAGE

DATE:

July 17, 1979

FOLD

Doing density studies on so. end
Contention Dike ore (Little Joe area). I want
to repeat the tests tomorrow.
Found that when Ed Rice - first
day on a scraper Sat. hauled
bat - he was only getting
8 tons per load. Dusty is
working some (not much) with him to
improve.

FOLD

FOLD

Think your plane was overhead

BY

REPLY

around noon till 2:?

DATE

Look forward to the photos.

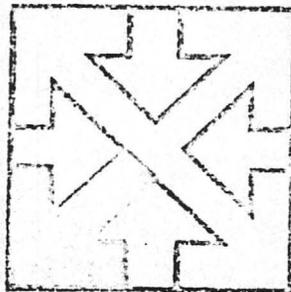
I need help sampling the
Contention Dike - Big area

Sincerely - R.F. Dewlett

408

Consultants in:

- Hydrometallurgical recovery
- Heap and conventional leaching
- Precious and base metals
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- Tungsten
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2-48

YAS

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Richard F. Hewlett
Vice President and General
Chemical Engineer
Mining Engineer

REVIEWED

JUL 19 1979

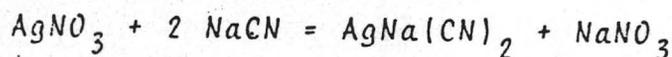
By *JFB*

NaCN Titration

A. General

A cyanide mill solution is titrated for NaCN content using silver nitrate and potassium iodide as an indicator.

B. Stoichiometry



Molecular Weight

$\frac{\text{AgNO}_3}{169.89}$

$\frac{2 \text{ NaCN}}{98.04}$

C. Parameters

For a 20 ml sample:

$$\frac{1 \#}{\text{Ton Soln.}} = 500 \text{ mg/liter}$$

Therefore, for a 20 ml sample;

$$500 \text{ mg/liter} :: X/20 \text{ ml} \quad X = 10 \text{ mg CN}$$

Grams CN titrated per liter:

<u>Divisions Per ml</u>	<u>Grams CN/liter</u>
1	10
4	2.5
13.9	0.72

407

Standard Preparation:

$$\frac{\text{Grams CN/l}}{98.04} :: \frac{X}{169.89} ; \text{ where } X = \text{grams AgNO}_3/\text{liter}$$

<u>Divisions/ml</u>	<u>Standard Grams AgNO₃ Per Liter</u>	<u># CN/ton solution ml reading X Factor</u>
1	17.329	1.00
4	4.332	.25
13.9	1.248	.072

D. Standard Preparation

Disolve the desired Silver Nitrate in one liter of distilled water.

The KI is a 5% solution.

E. Procedure

1. Measure 20 ml cyanide solution
2. Add 3 drops KI solution
3. Add enough AgNO₃ standard to zero buret reading
4. Add drop-wise AgNO₃ untill a constant yellowish-white turbidity is obtained.
5. Record ml used for ghosts to turn to clouds (end-point)
6. Multiply by factor or use table

F. End-Point Standards

In order to determine the proper end-point, cyanide standards must be prepared to calibrate the titrator's "vernier scale".

<u>Cyanide Standard</u>	<u>Standard Preparation</u>
3 #CN/ton	1500 mg. CN/l
2 "	1000 "
1 "	500 "
.5 "	250 "
.25 "	125 "

CYANIDE TITRATION TABLE (1.248 gr. AgNO_3)

<u>ml AgNO_3 Standard</u>	<u># CN/ten solution</u>
0.00	0.000
1.0	.072
2.0	.144
3.0	.216
4.0	.288
5.0	.360
6.	.432
7.	.504
8.	.576
9.	.648
10.	.720
11.	.792
12.	.864
13.	.936
14.	1.008
15.	1.080
16.	1.152
17.	1.224
18.	1.296
19.	1.368
20.	1.440
21.	1.512
22.	1.584
23.	1.656
24.	1.728
25.	1.800
26.	1.872
27.	1.944
28.	2.016
29.	2.088
30.	2.160

MEMO

To: Richard F. Hewlett

From: JAB

Date: July 19, 1979

Re: RECORD KEEPING AND SUBMITTAL TO S.E.A. OFFICES

A memo has just gone out to the rest of the S.E.A. staff requiring that Daytimers be submitted to the front office at the end of each month, with submittal of the last timesheet for that month. This new policy applies to you also. This will greatly simplify our billing procedure; many times we must refer back to daytimers for substantiation of work performed. This will give us one central location for all daytimers and will enable one person to do the detail investigations without involving many employees.

Also, we must have all toll call record slips (WHITE AND YELLOW COPIES ONLY; the pink copy remains in your book as your record) turned in at the end of each month. Without these toll call records we are unable to bill projects for phone calls. We have yet to receive any toll call records from you for some time now and, therefore, our billing of phone calls is behind for Project 418.

I might also take this opportunity to restate our policy that any unsubstantiated telephone calls are charged to the responsible employee and deducted from that person's paycheck.

Please see that these items are submitted to the front desk as soon as possible and that they will be submitted monthly in the future.

JAB

JAB:cmd
P-418

MEMO

To: R.F. Hewlett

Copies To: John Dean, Tom Schloss

From: J.A. Briscoe

Date: July 19, 1979

Re: Sample Collecting Procedure, Tombstone Project P-418, Tombstone Hills, Tombstone Mining District, Cochise County, Arizona

The following will standardize our sample collecting procedures for all future sampling at Tombstone, and will remain in effect until written changes should be received superceding this procedure, by myself and/or John Dean.

The main parameters in sample collection are:

1. The sample should be representative of the rock or mineral environment which it is meant to test. Therefore, great care should be used in determining the sample boundaries in relation to:
 - a. Rock type
 - b. Mineral zonation
 - c. Oxidation state
 - d. Geologic structures
 - e. The amount of continuity that can be determined for the above characteristics so that the volume of rock represented by the sample can be calculated.

2. Whether or not the sample is representative of the rock volume it is meant to test is a critical factor which relates to:
 - a. Size of the sample taken
 - b. Coarseness and degree of homogeneity of the mineral contained within the sample

- c. Its physical characteristics with regard to breaking and ease of homogenization
- d. Its unit value.

This is a very complex subject as you know. However, correct sampling is critical to our evaluation of the precious metal content of material proposed for treatment at Tombstone. Appended is a Xerox copy of page 5-72 to 5.4.2 of the SME Mining Engineering Handbook, Volume 1 which is a good guide to sample size and crushing sizes required before splitting. This guide should be adhered to as closely as possible.

impossible *photography*
S.E.A. has used standardized sampling procedures over the last 5 years. These procedures include numbered sample sacks, wooden sample stakes with possible metal tags, character sample sacks, standard geochem assay forms, and topography of the sample site after the sample has been taken, using a 35mm camera. Notes on the photography are taken on standard NCR photographic note forms similar to the geochem sample form.

I'm transmitting to you with this memo 150 individual forms issued for 150 samples and 150 photographs, and 10 rolls of Kodak Ektachrome ASA64 35mm in 36-shot cassettes. I'm also transmitting to you 100 8-lb. size sample sack kits which include a cloth sample sack with number imprinted on it and two wooden stakes to be placed at the beginning and end of the channel sample. These wooden stakes have metal embossable tags for annotation of the sample number. Also enclosed is a plastic character sample sack. Monday I am sending you large 100-lb. ore sacks with essentially the same kit attached. The sampling procedure will be as follows: identify a specific rock type - mineralogic type or other feature which will be meaningful to sample. Obviously for very large features in excess of 20 to 30 feet (this may vary according to circumstances) multiple samples should be taken. First, mark the sample location with green spray paint, then take channel chip samples or other samples as

may be appropriate with careful description on the attached sample bags. When the sample is completed, raise numbered sample sack along the painted sample spray paint mark and with your 35mm camera photograph the sample location. If specific geologic or mineralogic features justify, take a close-up view of those features. Be sure and keep sample sack with the number visible in the photographic frame. In this manner, the photograph will always be identified with the sample. Take a small geologic character sample and place it in the transparent plastic bag. The remainder of the sample can be assessed for analysis. Careful notes of rock type, mineralogy and all other pertinent features should be annotated onto the NCR sample forms along with the sample number. The photograph can also be briefly noted on the NCR photo note sheet.

If any of this is not clear, please write your questions to me and I will reply to them in writing.

James A. Briscoe

JAB/kar

P-418

5.4.2—FOR ANALYSIS

Care must be exercised in the selection and preparation of material for analysis so that it represents an accurate sample of the material under study. The principal elements for consideration are the weight of the sample and the method of selection.

The weight of the sample is dependent on several factors: size of the largest particle, size of mineral liberation and density of the various minerals are most important. These factors recently have been reduced to a sampling formula and a slide rule by Gy¹⁰⁰ in which

$$M = \frac{Cd^3}{S^2}$$

with M the weight of sample in grams; C, constant developed from mineral shape factor, particle size, liberation factor, and mineralogic composition; d, dimension of the largest pieces of the lot in centimeters; and S, the measure of statistical error committed by sampling or the error which can be tolerated in the assay of the sample. This equation also is useful in sample selection of mill products.

TABLE 5-7—Minimum Permissible Sample Weight at Different Particle Size

Diameter of Largest Pieces		Very Low Grade or Very Uniform Ore, Lb	Medium Ores, Lb	Rich or Spotty Ores, Lb
In.	Mesh			
4		4,800	35,556	51,200
2		1,200	8,889	12,800
1		300	2,222	3,200
0.5		75	556	800
0.25		19	139	220
0.131	6	5.15	38.1	55
0.065	10	1.29	9.5	13.76
0.0328	20	0.322	2.37	3.44
0.0164	35	0.081	0.59	0.86
0.0082	65	0.020	0.15	0.215
0.0041	150	0.005	0.038	

Richards¹⁰⁰ has prepared a table (5-7) which presents a guide to sample-size selection based on type of ore and size of largest particles.

Either Gy's formula or Richard's table is used to determine the size reduction to be achieved in the crushing or grinding step preceding sample division.

Working the sample down to an analytical pulp requires care and is a step that is frequently slighted. The preparation procedure should include alternate crushing, blending and splitting steps until the desired quantity and product are obtained. The equipment should be thoroughly cleaned between samples and properly maintained to give accurate sample division. In the final preparation step, it often is necessary to screen the pulp and regrind oversize material to reduce the complete sample to the desired size before use in the analysis. On ores which contain high specific gravity minerals or minerals difficult to digest in the chemical procedure, such as tungsten, molybdenum or gold ores, it is necessary to reduce all material to minus 150- or 200-mesh for the sample pulp.

When sampling zones from open cuts or trenches, select large samples if the rock is coarse and blocky and not of a uniform nature. This material generally can be stored and moved in 55-gal drums, then reduced to sample pulps with commercial crushing and handling equipment.

Drill core is best split or sawed along the longitudinal axis, with half being used for assay or metallurgical tests and half for permanent storage and/or future reference. When large quantities are required, it may be possible to take a color photograph of the boxed core for the permanent file and crush all material for the testing program. Under such a program, occasional samples of core or chip should be selected and also stored for reference and mineralogic examination.

In modern drilling programs, the samples often are collected as wet sludge from a rotary drill or dry fine ore from a wagon or percussion drill. Special equipment is required for sample collection and handling, and this varies with the drilling method. Care is required to collect representative samples of both the fine and coarse fractions as many ores, such as vanadium and uranium sandstones, have the values concentrated in the finer fractions. Wet collection procedures also are used for obtaining sludge samples from churn drills or diamond drilling.

Smaller samples generally are collected in a geochemical program, and a number of special procedures have been developed for handling these materials. Care always should be taken to seal each sample to avoid cross contamination or possible salting. Contamination is best avoided by using plastic bags or heavy paper envelopes with waterproof glue. The bags can be closed with wire and a lead seal. Soil samples can be prepared in the field by screening out oversize material using an aluminum household tea strainer. In the laboratory, the samples are screened on sieves with plastic frames and silk or nylon mesh. Any pulverizing step is best carried out with high-purity aluminum-oxide plates. Care should be taken to avoid preparation and analysis of geochemical samples in laboratory areas used for higher-grade ore samples.

5.4.3—FOR ORE TESTING AND ENGINEERING STUDIES

The procedures used in the selection of samples for an ore-testing program are similar to those for analytical needs. The size of samples varies with the testing program. Small bench-scale flotation or ore-dressing studies can be completed on 50 to 500 lb of material, while pilot-plant studies often require 25 to 1,000 tons of ore feed. The samples selected for the metallurgical work should be retained in a coarse size so that the metallurgist can measure crushing and grinding index and the effects of various methods of size reduction on the process under study. The natural oxidation of sulfide ores is held to a minimum by retaining coarse samples and storing the samples dry in sealed containers, or by storing dam samples in a freezer. Lubricants and chemical contaminants must be excluded from samples to be used in flotation test work.

The collection of metallurgical samples often is overlooked in the early stages of an exploration program. Several inexpensive steps can be taken to insure the availability of samples if the need for metallurgical studies should develop. Excess drill cuttings or trench samples can be placed in plastic-lined gunnysacks, labeled and stored in sealed drums near the sample site. Samples can be selected at a later date after the drilling data are available. It is a common practice in uranium drilling to leave small piles of cuttings by footage in a line near the drill hole. They may remain several years with little disturbance.

It is recommended and a desired practice that all reject samples be saved in an active exploration program which may develop a commercial ore body. If large amounts of material are available, it is best to set aside the reject after crushing to ¾ or ½ in. If finer crushing is required for analytical needs, then 6-mesh is a desirable size for metallurgical work. The samples should be kept separate and labeled until sufficient information is available to develop composite lots for a test program. Such lots are made up from geologic and analytical data to represent individual rock types, unusual ore or gangue mineralization or probable stages in the mining program.

If wet sludge samples are retained, care must be taken to avoid loss of the slime sizes which normally overflow in a settling box. Flocculants may be used in some cases without adversely affecting metallurgical test work. As a rule, if

2-45

REVIEWED

JUL 19 1979

By *JHB*

July 10th, 1979

Dear Mr. Hewlett ✓
&
Dr. Dean

Tom has asked me to type up this report re:
Combined Progress Report and "Pilot Test" Design.

Would you kindly review and/or correct where
needed. We have the original hand written copy
on hand here at our office.

Thank you.

Sincerely,

Angie Cassidy

Angie Cassidy
Secretary to
Thomas H. Schloss
Chairman of the Board

MS/

Attch:

*Yours is not your own
I've seen kind me
back from done
and*

FAMCO | 1700 Broadway • New York, New York 10019 • (212) 247-0420

399

TOMBSTONE

TO: Tom Schloss, Dr. John Dean, James Briscoe
 DATE: June 27th, 1979
 FROM: Dick Hewlett
 RE: COMBINED PROGRESS REPORT AND "PILOT TEST" DESIGN

TOMBSTONE PILOT LEACH

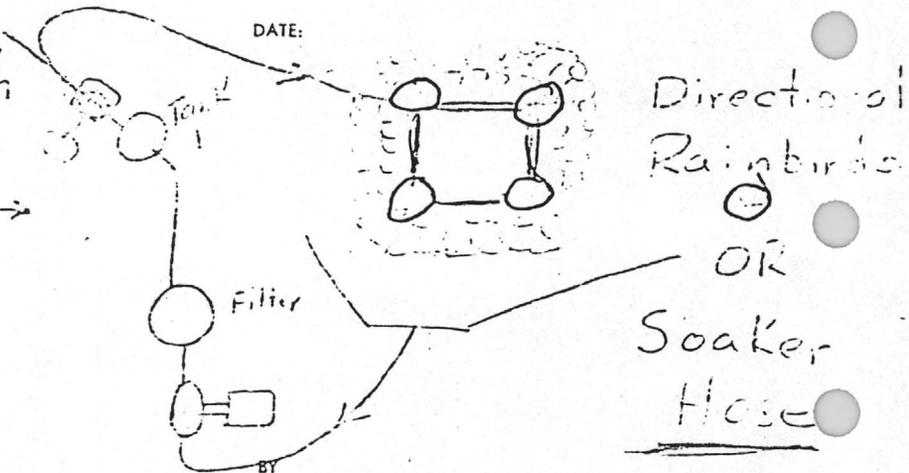
A pad and leaching area will be constructed on the north side of the heap, starting near the north ramp and extending north around the heap (see sketch A).

Activities required are:

1. Doze brush and prepare site.
2. "Grade" area to level and build in a drainage slope.
3. Haul tails on to site.
4. Level to 3-inch lift.
5. Water -saturate with water truck
6. Compact with loaded - loader
7. Repeat 3-6 until 4-3 inch lifts are layed down, leveled, saturated & compacted.

The above constructed in a manner such that in addition to provide an impermeable base for "pilot" leach tests, the pad will later be used for production without further construction.

The "pilot" leach will be, as shown opposite →



Page 2, contd.

Heap Pilot Tests:

Tonnage for each test to be "heaped" on each separate section of the pad will be 200 tons. This will occupy a square area of:

$$200 \text{ T} = \frac{L w h}{\text{TF}} = \frac{Lw (5 \text{ ft high})}{\text{Tonnage factor } 18.5}$$

$$200 \text{ T} = L w \frac{5}{18.5} \quad Lw = 740 \text{ ft.}^2$$

or $L=w= 27 \text{ ft.}$

Therefore, the area would be 30' x 30' and 5 foot high.



Pilot Spray Parameters:

<u>Lift Height</u>	<u>Ore Mean Surface Area</u>	<u>Number Sprays</u>	<u>Tons Treated per Spray</u>	<u>Gal/min per Spray</u>	<u>Gal/Min per 100 ft²</u>
5'	740 ft ²	4	50	5	0.68

Flow Rates:

20 6PM = $\frac{20 \text{ 6PM (60 M.P.Hr.)}}{240 \text{ Gal/Ton}}$ = 5 ton/hour

For Spray Mainfold for 20 6 PM

Pipe size (Di) = $\frac{2.2 W}{e}$ $\left. \begin{matrix} 0.45 \\ 0.31 \end{matrix} \right\}$ Di = 1.9 or 2 inches

Where Di = Pipe Diameter
 W = Weight flow (thousand #'s mass/hr)
 e = Fluid density = mass/ft³

Solution Balance:

A. Water of saturation
 10% of tonnage = 0.10 (200 T) = 20 tons

B. Period of total saturation

$\frac{20 \text{ tons}}{5 \text{ tons/hr}} = 4 \text{ hours}$

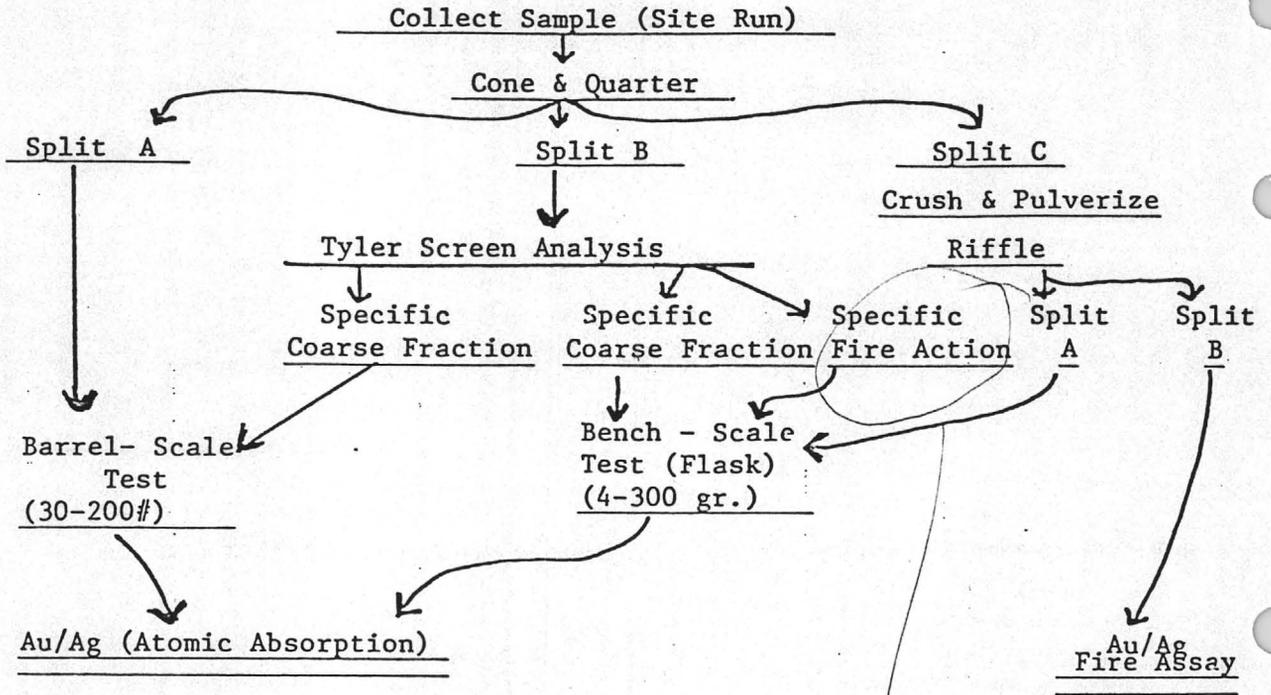
C. Circulation Rate: 5 tons/hour

D. Evaporation: Very small because no pond will be used for circulation. (the pond will be used to test -evap. 9 decomposition of hypo, etc.)

*7/19/79
 I don't agree with this as most evap. would occur in the ponds. ✓*

What size sample

General Analysis Procedure:



What does this mean

what

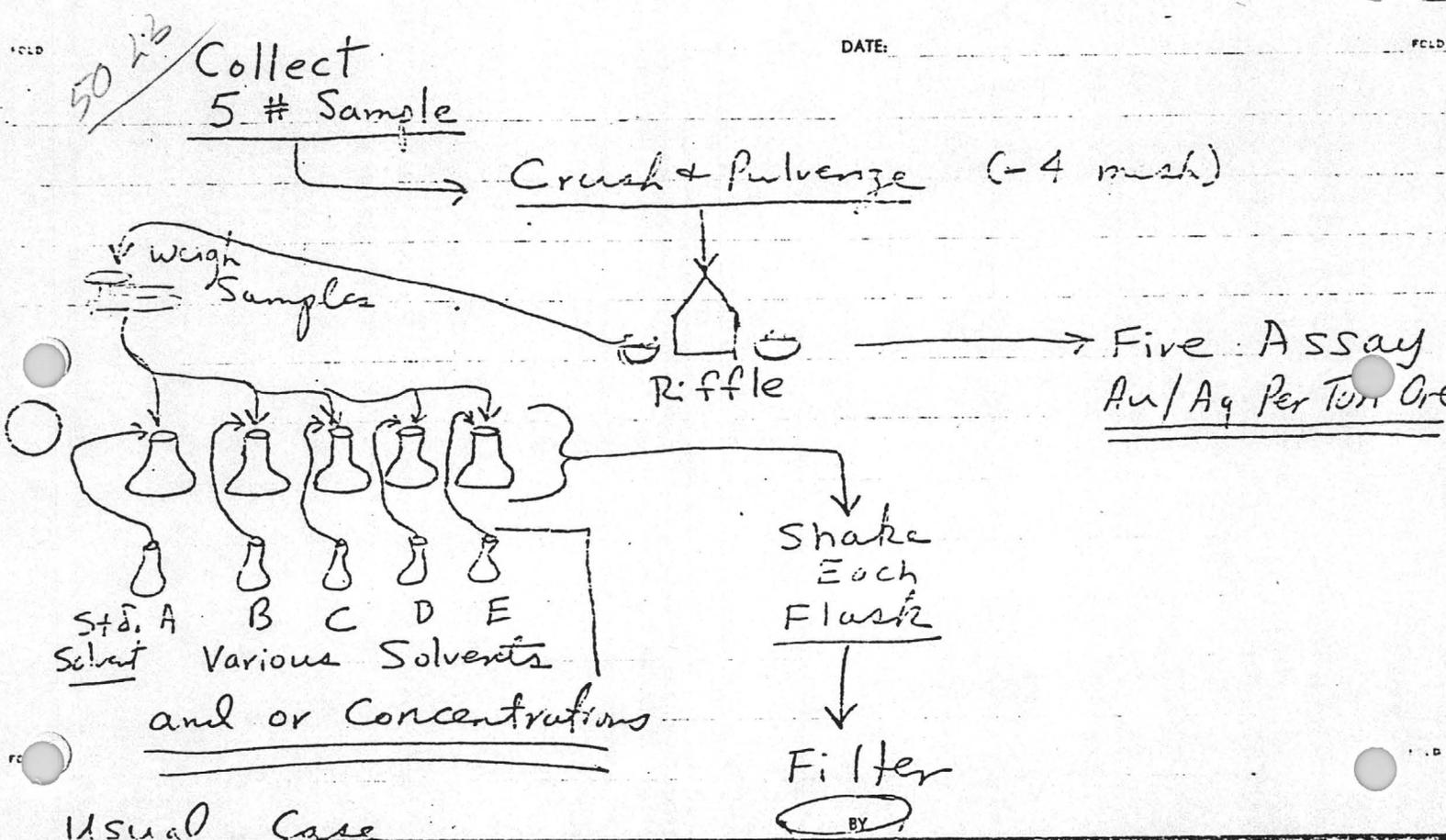
DISCUSSION OF GENERAL ANALYSIS

PROCEDURE:

I don't think this is enough - 50 lbs much better.

A. Objective - Solvent Analysis & Economics

1. Collect 5 # sample → crush & pulverize.
2. Cone & quarter if other tests are to be made from this site.
3. Riffle to obtain desired sample sizes.
4. Send 1 # sample for fire assay (lab uses 1 assay ton \approx 30 grams)
5. Weigh as many samples as there are solvent tests. I usually use 30 grams.
6. Label and charge each sample (30 grams) with solvents previously prepared. Save a blank solvent sample 50 ml.
7. Shake 8. filter
9. Determine Au & Ag concentration using atomic absorption



DATE: _____

Usual Case

30 gr. Sample
 90 ml. Solvent Solution
 Shake 2 hours - Room Temp.

$$AA \left(\frac{t. oz.}{ton Soln} \right) \left(\frac{90}{30} \right) = \frac{t. g. Precious Metals}{Ton Ore}$$



Test for Interference
 no yes
 Correct

Determine Au / Ag Concentration

ATOMIC ABSORPTION METHODS

Basic are:

1. Sample size (4 → 200 grams)
2. Sample Type:
 - A. Screened → Fires
 - B. Sample Run → Coarse & Fires
 - C. Crushed & Pulverized
3. Sample Weight: Solution weight ratio

Sines?
Sines

Procedure:

- A. Weigh sample
- B. Select solvent c. agitate (shaker)
- C. Filter
- D. Prepare filtrate for AA determination

Conversion of AA determination (t. oz./ton soln) to t. oz./ton ore:

$$\left[\begin{array}{l} \text{AA Determination} \\ \text{(t.oz./ton soln)} \end{array} \right] \left[\frac{\text{wgt. soln.}}{\text{wgt. ore}} \right] = \frac{\text{t. oz.}}{\text{ton ore}}$$

EXAMPLE:

$$\left[\text{AA} \right] \left[\frac{90 \text{ ml} = 90 \text{ gr. soln}}{30 \text{ gr.}} \right] = \left[\text{AA} \right] \frac{90}{30} \text{ or } 3$$

Other Example: Larger Test

$$\frac{300 \text{ ml soln}}{30 \text{ gr. sample}} = \left[\text{AA} \right] \left[\frac{300}{30} \right] = \left[\text{AA} \right] 10 = \frac{6 \text{ oz.}}{\text{Ton Ore}}$$

Atomic Absorption Interference Problems:

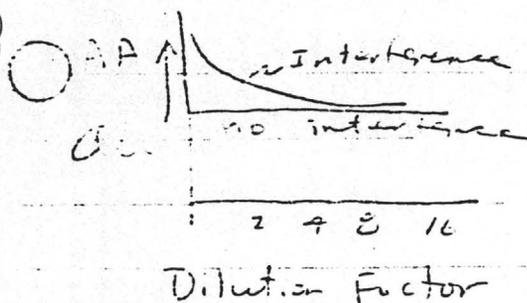
Effect of common elements on absorbance of Au resonance lines

Solution		(Air- C ₂ H ₂) Au 242.8
1000 ppm	K	.002
1000 ppm	Na	.003
1000 ppm	Al	.030
1000 ppm	Mg	.002
1000 ppm	Ca	.015
1000 ppm	Fe	.017

Therefore, when aqua regia or other acid digests (as Hbr + Br₂) are used, various elements as mentioned above cause interference in the gold wave length yielding a false Au reading.

Interference Test: Gold wave length

Dilution



Dilute sample and compare calc. Au value with AA reading is higher than calculated and various interference.

Note: Yellow or colored flame indicates possible interfering element. Also blank of solvent solution indicates and quantifies interference except for interfering soluble elements as aqua regia and iron (acid soluble).

Example 3

Dilution Factor

	1	2	4	8	16	32	
AA	.21	.069	.033	.014	.00625	.003125	Interfer
(Au)	.10	.05	.025	.0125	.00625	.003125	No Inter

200ml Sol. + Resin + Shake → Filter/Wash → 200 ml (1/2) → A

Solve } by Load Au on Resin → Filter → Wash Residue → Elute with equal vol. 1/4 Aqua Regia

Ferrous Sulphate

Source: McKesson - Tucson

50 # Bags

Bags

4 - 9
10 - 39
40 - 100
+ 100

Price

\$24.15/100 #
19.50/100 #
14.15/100 #
12.65/100 #

Ferrous Chloride

Source: McKesson - Tucson

Chem West - Fontana, Calif.

Tank car = 50,000# = 25 tons
30% solution → \$140/ton } anhydrous F.O.B. L.A.



Price Tankcar

\$1050 = \$0.021/#

Freight LA-Tombstone (May Frt. Ra

\$2.45/100 #
\$1,225

10.478

#/Gal

50,000 #



4772 Gal

Total \$2,275

\$.477/Gal T

.0455/# T 30%

Solvent/Reagent Prices

Na OCl (Sodium Hypochlorite)

Source: Copper States -Tucson
14% Solutions -55 gal Drums

Quantity: 55 gal. Drums

Price: Plus \$30.00/Drum Deposit

1-5	.90/gal
6-9	.85/gal
10-14	.80/gal
15+	.75/gal

14% Soln	
<u>NaOCl</u>	
Sp. Gr.	= 1.1365
Gr/	= 159.1
#/Gal	= 1.328
[9.475 # ^T /Gal]	

Fe Cl₃ Ferric Chloride

Source: McKesson- Tucson

55 Gal Drums				<u>Drums</u>	
				1-4	\$9.50/100#
<u>Be</u>	<u>Sp.Gr</u>	<u>FeCl₃</u>	<u>Gr/l</u>	<u>#/FT³</u>	[11.77 ^T #/Gal]
42.3	1.4118	44%	621.2	38.78	5.184 #/Gal.

ACID

Source: Apache Powder = St. David

NITRIC
60% HNO₃
\$150/100% Ton

SULFURIC
70% H₂SO₄
\$6/100% Ton

Average tanker wgt = 22 tons

60% HNO₃ = 6.843 #/Gal
= 1.3667 Sp. Gr.
= 11.394 #/Gal
= 175.5 Gal/Ton

70% H₂SO₄ = 9.408 #/Gal.
= 1.6105 Sp/Gr.
= 13.472 #/Gal.
= 148.96 Gal/Ton

22T (HNO₃) = 3861 Gal.
22 (.60) = 13.2 100% Tons
(13.2) (\$150/T) = \$1980

22T (H₂SO₄) = 3277.12 Gal.
22 (.70) = 15.4 100% Tons
(15.4) (\$6/Ton) = 92.30

+ Freight = 90

+ Freight = 90

HNO₃ \$ 2070
\$94.09/Ton
.047/#
.078/# - 100%
.536/Gal-Dil
.894/Gal-100%

COST
Ton (dil.)
(dil.)
(undil)
Gal (dil)
Gal (undil)

H₂SO₄ \$182.40
\$8.29/Ton
.004/#
.006/# - 100%
.056/Gal - dil.
.080/Gal - 100%

IRON PELLETS

Kore Industries
Georgetown, S. Carolina

1-803-546-2525

Texas Steel
Beaumont, Texas
A.R. Holzworth

1-713-768-1251

Oregon Steel
Bill Bottomley

1-503-286-9561

Page 10, contd.

Midoex

Source: Charleston Steel Mills

Lime

Source: Paul Spur- , Douglas, Ariz.

Processed - Stock Dust (62% CaO)

\$6/Ton or \$.003/#

Sodium Thiosulfate: $(Na_2 S_2 O_3 \cdot SH_2O)$

Source: Hills Bros., Tucson Ariz.

	<u>Bags</u>	<u>Price</u>
100#	1-10	\$24.60/100 #
Bags	20	\$19.70

\$0.197/#

Salt: (NaCl)

Source: Southwest Salt - PHX
\$15/ton + \$15/ton Freight = $\frac{\$30}{2000\#}$ or 1½¢/#

SUMMARY

Chemical & Reagent Cost - Delivered to Tombstone

<u>Solutions</u>			
<u>Name</u>	<u>(% Soln.)</u>	<u>Cost-Dil</u>	<u>Cost/# - 100% (Tombstone)</u>
NaOCl	14%	75¢/gal	\$.560/#
FeCl ₃	44%	1.12/gal	.216/#
FeCl ₂	30%	47.7¢/gal	.150/#
H ₂ SO ₄	70%	5.6¢/gal	.006/#
HNO ₃	60%	53.6¢/gal	.078/#

Solids

<u>Name</u>	<u>Cost/# - Tombstone</u>
Fe SO ₄ · H ₂ O	\$.1265/#
Na ₂ S ₂ O ₃ · 5 H ₂ O	.197/#
NaCl	.015/#
Lime	.003/#
NaCN	.587/#
Zn Dust (Memllite)	.662/#
Na ₂ S	.248/#
Lead Acetate	2.30/#
Na ₂ O	.18/#

SR-3 Resin
\$ 6.50/# - Small Lots

LEACH TEST SOLVENTS

For Bench Scale ; then Barrel; the pilot

<u>Type of Solvent Phase</u>	<u>Case A (Limontic Clay-Ls.)</u>	<u>Case B (Limontic Clay-Ls.)</u>	<u>Case C (Mn-in Ls. with limontic → jarosites)</u>
Pre-treatment	H ₂ SO ₄ + NaCl + NaOCl	H ₂ SO ₄ + NaCl + NaOCl	H ₂ SO ₄ + Fe Cl + NaCl
Leach (ag)	Na ₂ S ₂ O ₃ · SH ₂ O	NaCN Lime	Na ₂ S ₂ O ₃ SH ₂ O or CN

Then?

Computation of Solvent Concentrations Having the Same Cost/Ton Solution

Method A: Cost/Ton Soln. Method

Example:

X = 1/# & concentration = 1#/Ton Soln.

$$\frac{60 \text{ ml} \text{ @ } 1}{\text{l}} = \frac{\$.0011023/\text{lb}}{\text{l}} \left(\frac{\text{Dil. Cost}}{\text{Gal} / \text{\$}} \right) \left(\frac{3785.4118 \text{ ml}}{\text{gal}} \right)$$

Method B: # / Ton Soln. Method

$$\frac{60 \text{ ml} \text{ @ } 1}{\text{l}} = \text{Economic} \left(\frac{\text{Ton Soln.}}{340 \text{ Gal.}} \right) \left(\frac{\text{Gal}}{3,785.4118 \text{ l}} \right) \left(\frac{\text{Gal}}{\text{\# X}} \right) \frac{3785.4118}{\text{Gal}}$$

Solvents/Reagents
Delivered to Tombstone

Table of Comparative Solvent Strengths (50¢/Ton Solution)

<u>Solvent</u>	<u>\$/#</u>	<u>50¢/Ton</u> <u>#/Ton</u>	<u>gr/l</u>	<u>ml Soln./</u>
H ₂ SO ₄ (70%)	\$.006	83.3	-	37.2
NaOCl (14%)	.560	.9	-	2.8
Fe Cl ₂ (30%)	.150	3.3	-	4.4
HNO ₃ (60%)	.078	6.4	-	3.9
FeCl ₃ (44%)	.216	2.3	-	1.9

<u>Solvent</u>	<u>\$/#</u>	<u>50¢/Ton</u> <u>#/Ton</u>	<u>gr/l</u>
NaCl	.015	33.3	16.7
Na ₂ S ₂ O ₃ .5H ₂ O	.197	2.5	1.3
NaCN	.587	.9	.45
FeSO ₄ .H ₂ O	.1265	4.0	2.0

Solvents/Reagents
Delivered to Tombstone

Table of Comparative Solvent Strengths (50¢/Ton Solution)

<u>Solvent</u>	<u>\$/#</u>	<u>50¢/Ton</u> <u>#/Ton</u>	<u>gr/l</u>	<u>ml Soln./</u>
H ₂ SO ₄ (70%)	\$.006	83.3	-	37.2
NaOCl (14%)	.560	.9	-	2.8
Fe Cl ₂ (30%)	.150	3.3	-	4.4
HNO ₃ (60%)	.078	6.4	-	3.9
FeCl ₃ (44%)	.216	2.3	-	1.9
<u>Solvent</u>	<u>\$/#</u>	<u>50¢/Ton</u> <u>#/Ton</u>	<u>gr/l</u>	
NaCl	.015	33.3	16.7	
Na ₂ S ₂ O ₃ .5H ₂ O	.197	2.5	1.3	
NaCN	.587	.9	.45	
FeSO ₄ .H ₂ O	.1265	4.0	2.0	

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Southwestern Exploration Associates
4500 E. SPEEDWAY, SUITE 14
TUCSON, ARIZONA 85712

DAY/TIMER
Time-Saver

LETTER

IN REFERENCE TO:

FIRST CLASS MAIL INTER-OFFICE

FOR

Jim

URGENT

HOW TO USE THIS

DAY/TIMER
Time-Saver LETTER TO SAVE TIME.

Type or write your reply in the space below. Then mail the white copy to us and keep the pink copy for your files. You'll save time and effort, and we'll have your answer much faster! Thank you.

MESSAGE

REPLY

DATE

7/18 4:30

DATE

7/18/79 5:26

Received word that Dorothy's car is broken - she's trying to find transportation for tonight's shift (to Kris's house) at 9:00 pm -
(1) How extensive is the Combstone material you need?
(2) When can it go to the DEC?
SIGNED *Chris*

I'll try to get to it ASAP so Kris can do some work on it before she leaves.

[Signature]

SIGNED

2-44

Southwestern Exploration Assoc., Inc.
4500 E. SPEEDWAY, SUITE 14
TUCSON, ARIZONA 85712

(602) 795-6097

FOR James Brice, Dir. John
Dean, & Tom Schlosser

HOW TO USE THIS
DAY/TIMER
Time Saver LETTER TO SAVE TIME.
Type or write your reply in the space below. Then mail
the white copy to us and keep the pink copy for your files.
You'll save time and effort, and we'll have your answer
much faster! Thank you.

MESSAGE

DATE: July 18, 1975

Plant

Vacuum Pump worked, on - starter not working
except manual. Plants working - line
feeder not plugged.

Circulation started & need 6-4 inch
couplers (sch. 40) at 2 inch saddle depth,
the mine inspector would shut us down

Circulation uncompleted today.
Hesf is nearly saturated, but

REPLY

rain at 4:00 shut down the
spraying due to the risk of
more rain in the system
than our tank can handle
and the the prog would
overflow

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FOR B. Escob - Dean Schless
 - 2 -

HOW TO USE THIS

REPLY

Use Saver LETTER TO SAVE TIME.

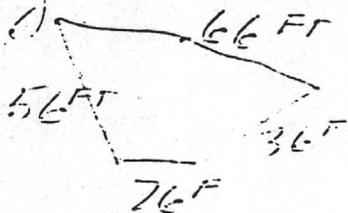
Type or write your reply in the space below. Then mail the white copy to us and keep the pink copy for your files. You'll save time and effort, and we'll have your order much faster! Thank you.

DATE: July 18, 1970

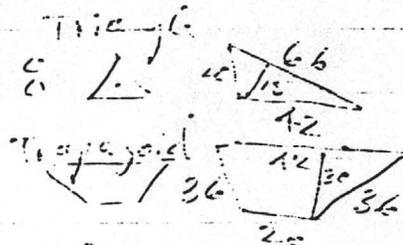
Test A Parameters:

South end of Contention Dike Ore

1. Tonnage = Previous irregular heap was



g which was divided into a triangle



$$\text{Vol. } \triangle = \frac{1}{2} h \cdot b \cdot d = \frac{1}{2} (66 \cdot 15 \cdot 2) = 990 \text{ FT}^3$$

$$\text{Vol. } \text{trapezoid} = \frac{1}{2} (B_1 + B_2) \cdot h \cdot d = \frac{1}{2} (12 + 36) \cdot 20 \cdot 2 = 990 \text{ FT}^3$$

$$\text{Vol. } \square = (h) \left(\frac{B_1 + B_2}{2} \right) \cdot d$$

$$= 20 \left(\frac{12 + 36}{2} \right) \cdot 2 = 990 \text{ FT}^3$$

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FOR *Bucco - Near - Schloss*
 - 3 -

HOW TO USE THIS

DAY/TIMER

Time Saver LETTER TO SAVE TIME.

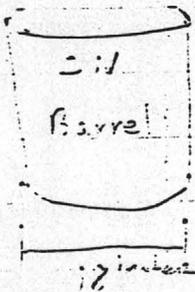
Type or write your reply in the space below. Then mail the white copy to us and keep the pink copy for your files. You'll save time and effort, and we'll have your answer much faster! Thank you.

MESSAGE

DATE:

FOLD

Tonnage Factor ϕ



Volume = $\pi r^2 h$
 $= \pi \left(\frac{18}{12 \times 2}\right)^2 \frac{28}{12} = 4.123 \text{ ft}^3$

Struck weight = 395 #

$\# / \text{ft}^3 = 395 \# / 4.12 \text{ ft}^3 = 95.8 \# / \text{ft}^3$

Note: Previous jump tests were 150 #/ft³
 71 Mineral energy

BY

REPLY

DATE:

Tonnage Factor = 30.873 ft³/ton

\therefore Test # tonnage = 169 ton

BY

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Briace - Dear - Schloss

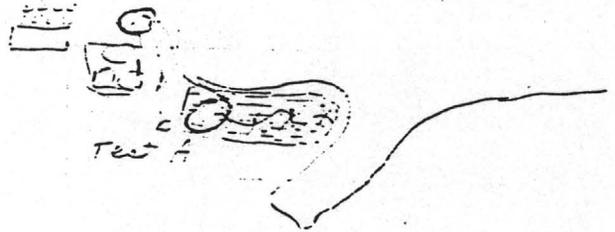
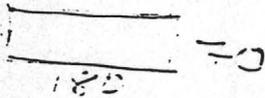
- 4 -

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DATE:

OK on Test to have been sampled and
 marked - will be done Thursday

Find Parameter



Surface Area = $12,600 \text{ ft}^2$

Surface Area	Over Height
12,600	2'
31,500	5'
63,000	10'
94,500	15'
12,600	20'
159,750	25'
187,900	30'

Tank (C=1) Spec

9' Dia. x 43 inches

REPLY

BY

Vol. = $\pi r^2 h = 228 \text{ ft}^3$

$228 \text{ ft}^3 \left(\frac{7.48 \text{ gal}}{\text{ft}^3} \right) =$

1707 Gallons

7.1 Tons

BY

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FOR

Briscoe-Dean-Schloss
- 5 -

HOW TO USE THIS

DAY/TIMER

Time Saver

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MESSAGE

DATE:

FOLD

Solution Charge:

1 # CN/Ton Solution

For each spray-tank full;

7 Tons (1 #/ton) = 7 # CN

Lime added to each 7 ton = 20 #
due to nature of remaining lime
mostly insoluble

FOLD

FOLD

BY

REPLY

DATE:

On Wed (July 18) we sprayed
2 tank fulls of 14 tons of CN solution
(1 # CN/ton) onto the heap (B).
No return yet - stopped due to rains

BY

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FOR *Briscoe - Dean - Schloss*
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HOW TO USE THIS

REPLY

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DATE:

Saturation Period

16.9 tons (10%) = 16.9 tons

*Calc. saturation period is 2.4 tank
fills → or about 1/2 of a tank-
full drift till weeping.*

*This will occur about 6:30 in the
morning (start at 5:00).*

In yesterday's report I included

BY

REPLY

my CN titration method.

DATE:

*I had Tombaton Doug weigh
2 1/2 grams AgNO₃ and had Doug
make up a 5% KI solution
so that we can do our own titrations
with the Ervies Buret.*

BY

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FOR Priscoe - Dean - Schost
 - 3 -

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MESSAGE

DATE:

South Contention Dike

Cre Reserve Calculations

Length = 300 FT
 Width = 65 FT Plus 12" on each side

→ requires more sampling

$$\text{Tonnage} = \frac{300(1)(65)}{1.5 \text{ bank}} = 13,000 \text{ TON}$$



North Contention Dike Area

South Contention Dike Area

FOLD

FOLD

REPLY

BY

DATE: So. Cont. Dike

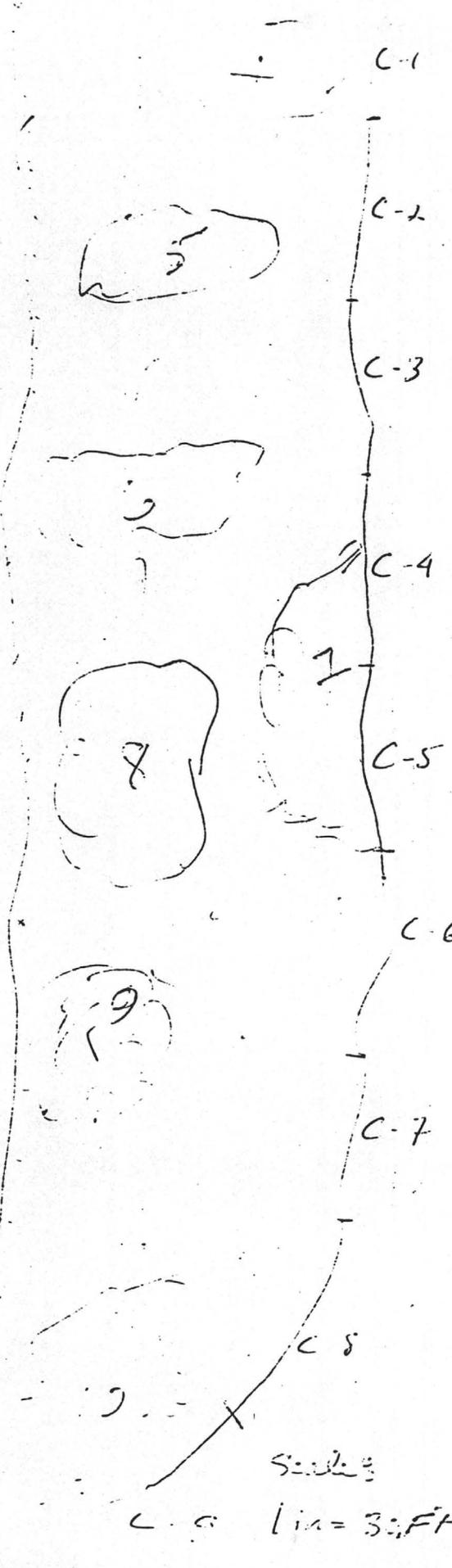
with our method of sampling - ripping - digging we can project for production 10 ft in depth as we have

<u>Depth</u>	<u>Tonnage</u>
10 FT	13,000
25 FT	32,500
50 FT	65,000
75 FT	130,000

BY

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South Centention Bike



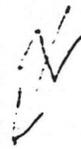
West Wall

Sample No.	Unit	Qty	% Total
A 3-10-10-10-10	.018	.27	86.5
C-1: Bant-ait	-	.24	1.5
C-2: (cob- ^{نصبت} ^{سك})	.075	1.02	16.3
C-3: ^{سك (مينا)}	.031	1.20	17.7
C-4: ^{سك} Hornfelds- ^{صا}	.048	2.52	32.16
C-5: ^{سك} Hornfelds- ^{صا}	.031	1.17	17.11
C-6: ^{صا} Hornfelds- ^{صا}	.053	1.71	26.2
C-7: ^{صا} La-Pike?	.061	3.72	45.0
C-8: "	.053	4.02	45.4
C-9: Sil. Hornfelds	.026	.33	5.1

Muck in bottom of Pit

1	.072	2.94	41.5
2	.030	1.52	22.8
3	.065	3.93	48.6
4	.051	1.86	21.6
5	.006	.57	6.0
6	.075	3.54	47.0
7	.050	4.56	58.5
8	.048	.99	12.5
9	.021	.81	11.7
10	.050	7.23	80.34
11	.024	0.42	5.30
12	.065	4.56	53.75

Scale:
1 in = 30 FT



Sample from 2' depth

Sample from 2' depth

2.5 / 100 = 2.5%

Sample = W W W Total

A	.048	1.68	*25.41
B	.051	2.66	34.03
C	.039	1.81	24.23
D	.052	2.54	33.32
Channel	.045	.45	14.85
E ^{Composite} * * * *	.030	4.53	43.74
F - 5' Back	.024	2.91	29.28
G - 25' Back	.033	1.77	22.41
H - 50' Back	.027	.39	5.87



Scale: 1 in = 30 ft.

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Priscoe - Dean - Schloss
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Estimated Ore Reserve For CN Leaching
Available for Push Leaching of Scrapers
South Contention Dike

15,000 tons @ \$25/ton = \$375,000
North Contention Dike
20,000 tons @ \$30/ton = \$600,000

Scraper Time Study

With John Escapule operating;

DATE:

Tons per Load = 10 tons
Cycle Time = 10 minutes
(New Road Completed Wed-Today)

Tons/hr = (10 tons/load) (load/10 min) $\left(\frac{60 \text{ min}}{1 \text{ hr}}\right)$ = 60
Tons/8 hr = $\left(\frac{60 \text{ tons}}{1 \text{ hr}}\right)$ (8 hrs) = 480 tons

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FOR *Ernie - Dean - Schless*
- 9 -

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$$\text{Tons per week} = \left(\frac{480 \text{ Tons}}{\text{Day}} \right) \left(\frac{6 \text{ days}}{\text{week}} \right) = \underline{\underline{2880 \text{ tons}}}$$

$$\text{Gross Value } 2880 \text{ tons (81\% Recovered)} = \$43,200 \text{ per week}$$

This could be accomplished on our
previously developed \$10,000/week
budget including the T.D.C.E.

REPLY

BY

DATE:

BY

372

"South Ramp"

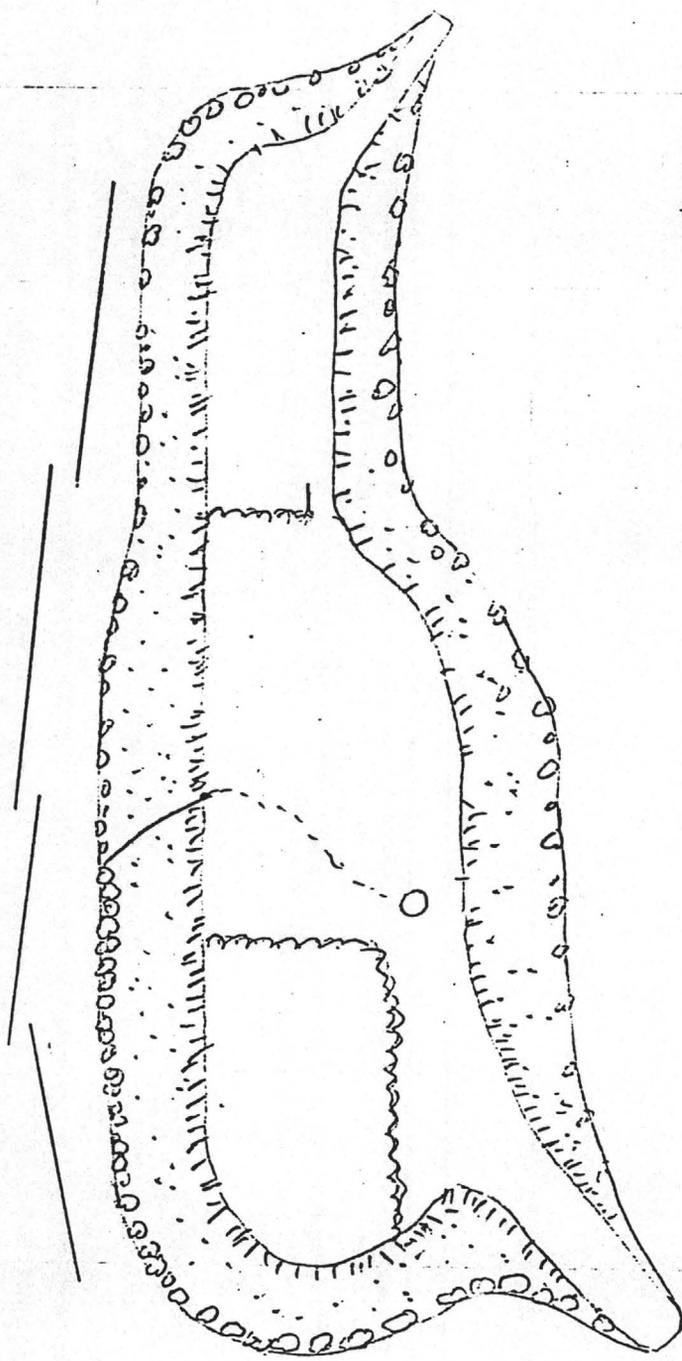
Tombstone

Heap

June 25, 1979

RFH

Scale: 1 in = 200 Ft



"North Ramp"



Pond

Plant Area

