PLAINTIFF'S EXHIBIT
UC-3150

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MAY 16 1960
Union Carbide Nuclear Company

UNION CARBIDE INTERNAL CORRESPONDENCE

UNION CARBIDE NUCLEAR COMPANY • RESEARCH CENTER, P. O. BOX 324, TUXEDO, NEW YORK

To (Name) Messrs. T.S. Ary ✓
J.A. Connors
T.J. Hall
H.L. McKinley
L.P. Twichell

Company
Location

Date May 10, 1960

Originating Dept.

Answering letter date

Copy to Messrs. L.A. Bliss
J.C. Brantley
S.J. Cromer/ R.J. Klotzbach
W.N. Johnson (NY-RC)
J.L. Lake/ J. Emerson
A.Q. Lundquist
A.E. Pufahl
H.F. Reichard
R.M. Sarla
C.O. Strother
L.E. Wright

Subject Asbestos Project - Status Report

Direct to	Handle	
~~TSA~~	Filing	
~~[illegible]~~	Mineral	Property
~~JATJK7~~		
TSA		

This report covers new developments on the asbestos project during the month of April, 1960. Also included are the minutes of the meeting held at Tuxedo on May 4 and 5, 1960. The following is a summary of the activities. The more detailed reports from each group are attached.

SUMMARY

Exploration and Property

Carbide now controls approximately 75% of the known asbestos deposit in the Coalinga area. Approximately 20% is controlled by Mr. Tanner, with the remaining 5% distributed among several others. It has not been possible to contact Mr. Tanner with respect to making a purchase agreement with him.

The mine development drilling program is in progress. Eighteen drums of material have been shipped to date. Some difficulties have been encountered with equipment and rainfall. It is hoped that thirty drums can be shipped each week starting May 9th.

Process Development

Capacities and conditions have been established for most of the processing equipment. Additional work is required to find a type of opening equipment of suitable capacity.

The pilot plant shift operation in connection with the mine development program is now expected to start no earlier than May 23rd.

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ACL Doc 17986 · Page 1 of 31 asbestosclaims.law/library/17986/1

Product Development

Vinyl tile formulations have been worked out using 22% UCNC asbestos. Resultant tile properties are satisfactory when using either the aspirated product from the 20 mesh screen, or the aspirated product from the Bauer separator. Color degradation due to thermal decomposition does not appear to be severe even with multiple pass recycle of scrap to succeeding batches.

Engineering

Studies are in progress on various methods of conveying ore and product. Main emphasis is being placed on pneumatic conveyors. Revised estimates have been prepared for a pilot plant operation at Coalinga. A facility duplicating the batch type pilot plant at Tuxedo is estimated to cost $50,000, and could produce 360 tons of fiber in a year. An alternate installation would include the same equipment, but provisions for continuous operation. This installation is estimated to cost $170,000 and could produce 2000 tons of fiber in a year.

Sales

Reception from floor covering manufacturers has been good with respect to use of our material in both vinyl and asphalt tile. We have received considerable encouragement in several other applications areas. Several of the floor covering manufacturers are now interested in testing one-ton samples of our material. We are still aiming at August 1st for receiving enough letters of intent from customers to proceed with plant construction.

Bishop

Tentative calculations have been made which indicate that a ripper-scraper mining operation should be the most economical.

Some dry grinding and screening tests have been made which look promising with respect to upgrading of the ore.

Meeting - May 4 and 5, 1960

The following is the agenda that was followed at the meeting:

General Information

Property Evaluation and Drilling Program	T.S.Ary
Pilot Plant Program	L.P.Twichell
Vinyl Tile Program	H.F.Reichard
Engineering	J.A.Connors
Sales	T.J.Hall
Bishop	L.E.Wright

Discussion

Information required for plant design.
Assignment of responsibilities for obtaining above information.
Cost and feasibility of testing various types of earth moving equipment on the site.

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ACL Doc 17986 · Page 2 of 31 asbestosclaims.law/library/17986/2

Cost and feasibility of obtaining title to most of the asbestos deposit.
Desirability of operating a second pilot plant at Coalinga.

During the discussion period a review was made of all information needed for process design of a plant installation. Assignments were made of responsibility for gathering this information. J.A. Connors is to be the central collection point for all design information. *

The last three items on the agenda were discussed and recommendations made to the Company officers for their consideration. These recommendations were briefly as follows:

1) Approval was requested to proceed with experimental mining and ore handling program as soon as possible. This approval has already been granted.

Work started SAT it won't to begin

2) It was recommended that consideration be given to authorizing a sum of money for negotiations on obtaining title to the remaining asbestos properties not now in our control.

3) It was recommended that if funds are requested for a full scale plant, a pilot plant be installed at Coalinga as rapidly as possible to operate during the construction period.

General

Attached are the more detailed reports submitted by each group and the detailed minutes of the meeting. Also attached is a map showing the location of drill holes in the current mine development program. These holes are numbered from V1 through V41. In subsequent reports, as fiber yield data becomes available from the pilot plant operation, it will be reported according to drill hole number and depth. Thus each of you can keep track of the yield data and its location as it is reported.

Very truly yours,

L. P. Twichell

L. P. Twichell

LPT:AB

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ACL Doc 17986 · Page 3 of 31 asbestosclaims.law/library/17986/3

EXPLORATION AND PROPERTY - T.S. Ary

The agreement between Union Carbide Corporation and Kirk and Oyster has been executed and is being forwarded to our New York office for review and execution.

The San Francisco attorneys are cooperating with the Kirk and Oyster attorneys in the preparation of a petition for the court concerning the bankruptcy proceedings of Mr. Thickstun. There is no new information on the status of the compromise settlement and the ratification of the compromise by the court on the Condor-Thickstun bankruptcy problem; however, the court has approved the compromise and the attorneys do not feel there will be any problem concerning the ratification.

We are continuing our surveying work on the Sandoval and Green properties and we will be issuing a new map with the location of this land platted as noted by our surveyors. This new map will also have the exact location of the Kirk and Oyster land so noted.

As of May 1, 1960 the following holes have been drilled on the preliminary drilling program on the Condor property: Holes 1, 8, 15, 22, and 29. Hole No. 29 is at a depth of 116 feet.

One shipment of samples has been made to Bound Brook containing 18 samples. There are now 18 drums of samples in the warehouse at Coalinga. We are holding these barrels until the requested 24,000 pounds of material is available for shipment.

Recently, we had wet weather in the Coalinga area and it has hindered our drilling considerably. We have lost several days because of the weather.

We have lost a total of five days of drilling due to a series of problems; weather, losing a string of tools in a hole, and contract problems.

The following is a tabulation of reported precipitation in the Coalinga area. This may be useful information with respect to mining, handling, and drying problems.

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ACL Doc 17986 · Page 4 of 31 asbestosclaims.law/library/17986/4

PRECIPITATION REPORT FOR THE COALINGA AREA

	Coalinga	Priest Valley	Hernandez
January	1.06	3.84	2.69
February	1.31	4.46	3.06
March	1.34	3.34	2.88
April	.58	1.56	1.65
May	.21	.43	.27
June	.04	.10	.07
July	.01	.02	Trace
August	.01	.03	.01
September	.07	.08	.03
October	.26	.64	.68
November	.49	1.48	1.48
December	1.54	4.32	3.68
Total	6.92	20.30	16.50
Greatest - 1941	14.21	36.99	30.93
Least - 1947	1.98	8.0	6.03

The above figures are from the U. S. Weather Bureau and cover the years 1941 through 1952 for Coalinga and Hernandez, and the years 1931 through 1952 for Priest Valley. This is the best information available in the area as there are no weather collecting stations in the immediate area of the property.

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ACL Doc 17986 · Page 5 of 31 asbestosclaims.law/library/17986/5

PROCESS DEVELOPMENT - L.P. Twichell

The attached flow sheet shows the equipment presently being used in the pilot plant operation. The percentage figures shown are the approximate average splits of material for material balance purposes. Most of the process development work is complete with respect to type of equipment, capacity of equipment, and conditions of operation. Some additional data is yet to be obtained on the following:

1) Maximum capacity of the Hammer mill.

2) Optimum feed rate for the Bauer cleaner.

3) Selection of an alternate type of opening equipment (Mikro-pulverizer now being used has too low a thruput) for the fiber opening step.

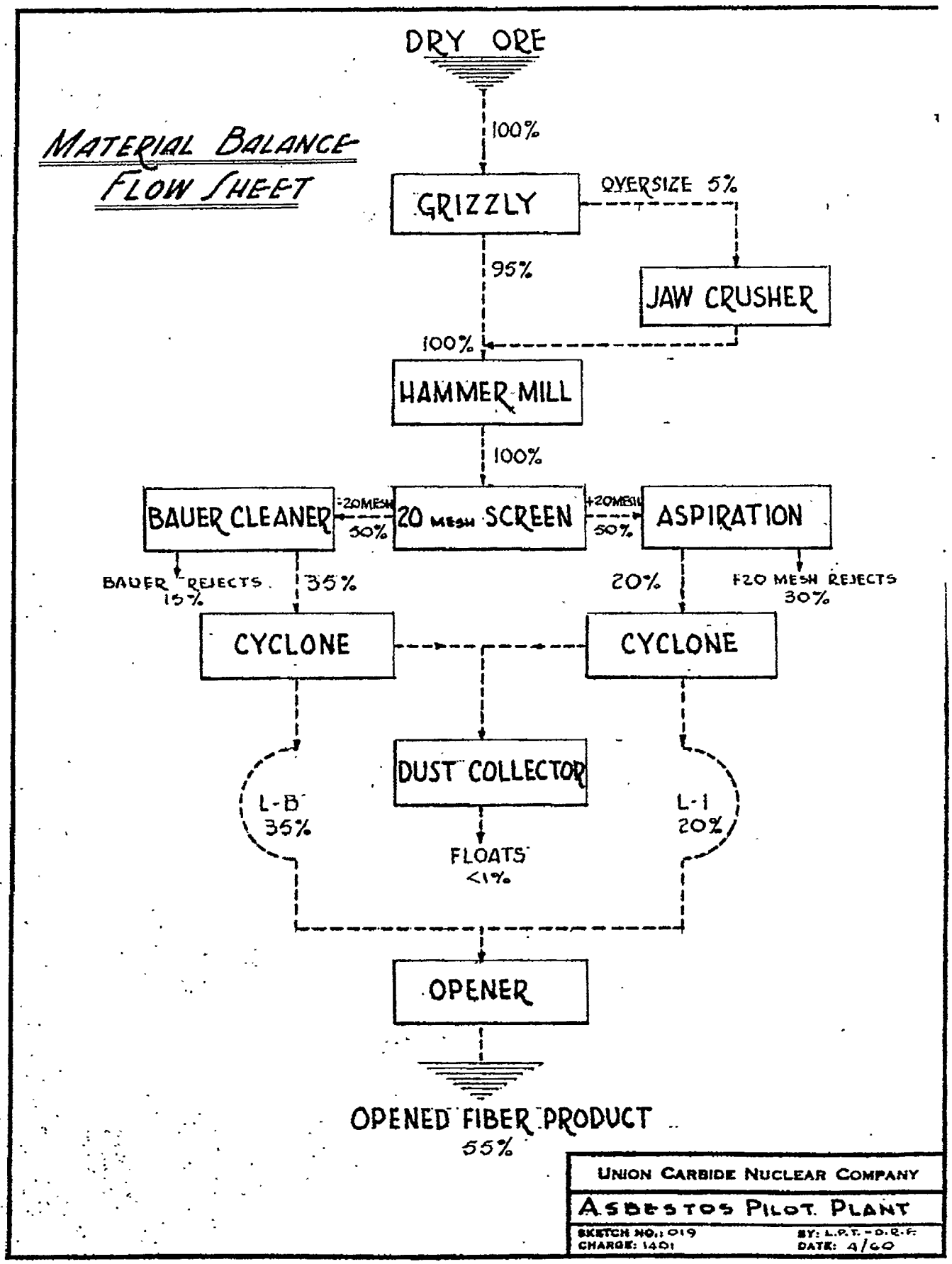
Due to some delays in the Condor drilling program it is now expected that the shift operation of the pilot plant will not begin before May 23rd. The entire program is expected to last five or six weeks. Exact operating procedures and conditions have been established and written in the form of an operating manual. These conditions will be strictly adhered to during the pilot plant campaign. A second manual has been prepared giving the procedure for all physical property measurements to be made on the various samples taken. Determination will be made of the following:

1) Screen analysis before and after Hammer mill.

2) Screen analysis, grit, bulk density, oil absorption, and Quebec standard screen test on both the aspirated products from the 20 mesh screen and the Bauer cleaner.

The attached chart shows typical physical property measurements made on samples processed to date.

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ACL Doc 17986 · Page 6 of 31 asbestosclaims.law/library/17986/6



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ASBESTOS PHYSICAL CHARACTERISTICS

The physical characteristics of the opened asbestos products vary slightly from drum to drum. The following tabulation shows approximate average values.

Type Material		L-1	L-1	L-1	L-1	L-B	L-1	L-1	Canadian 7R
Type Opener		.029-2P M-P	.029-1P M-P	.035-1P M-P	.046-1P M-P	.029-1P M-P	Sprout Waldron	Bauer Hurricane	-
Particle Size Distribution (%)	+12	-	-	-	-	-	-	-	-
	-20+20	-	-	-	5	-	5	-	-
	-20+40	15	20	10.0	20	5	20	5	5
	-40+100	60	60	75	60	10	45	90	40
	-100+200	10	10			30	10		25
	200 x D	15	10	15	15	55	20	5	30
Grit (%)		0.2	0.4	2.0	7.0	0.2	5.0	nil	0.3
Oil Absorption Number (Relative Units)		8	8	8	8	7	7	7	6
Bulk Density (lb/ft^3)		5.5	6.5	8	8	14	13	7.5	14

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ACL Doc 17986 · Page 8 of 31
Published by AsbestosClaims.Law
asbestosclaims.law/library/17986/8

PRODUCT DEVELOPMENT - H.F. Reichard

Formulations and Physical Properties

From the formulations listed below tiles can be made which all have the desired indentation hardness. The values of other physical properties such as dimensional stability point to use of about 20% asbestos as a minimum. This is also about the minimum with commercial users.

	20% Asbestos	22% Asbestos	25% Asbestos
UCPC Vinyl Resin VYHH	16.03	15.67	15.43
UCCC Plasticizer Dioctyl phthalate	4.26	4.57	4.77
Rohm and Haas Stabilizer G-62	0.71	0.76	0.79
Argus Stabilizer Mark 225	1.50	1.50	1.50
TiO_2 (Anatase)	3.00	3.00	3.00
Limestone 40 mesh XD	54.50	52.50	49.70
UCNC Asbestos L-1-029-2P	20.00	22.00	24.81
	100.00%	100.00%	100.00%

Following are comparative physical properties of tiles containing 22% of UCNC fully-opened asbestos in one case and 22% Quebec 7-R type in the other:

	22% UCNC asbestos, Fully opened 53% limestone. No heat on mixer 2 passes on calender rolls	22% COMMERCIAL QUEBEC Asbestos 7R Grade 53% limestone. No heat on mixer 2 passes on calender rolls
1-Minute McBurney Indentation, Mils on a 0.125" tile	9.4	10.1
Tensile Strength, psi	686	597
% Elongation	8.9	10.0
Tensile Modulus, psi (Measure of stiffness)	25,068	20,997

Although these values do not fall onto expected levels between those reported last month for tiles containing 20% and 25% asbestos, they are considered satisfactory by UCPC personnel. They are useful for comparing UCNC and Quebec products mixed, processed, and tested by the same people and under similar conditions.

Strain release shrinkage in mils per linear foot during heating finished tiles at 80°C were:

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ACL Doc 17986 · Page 9 of 31 asbestosclaims.law/library/17986/9

	Shrinkage, Mils/Lin. Ft.
A. Virgin 22% UCNC asbestos, 53% limestone fill	10.0 milling direction 3.0 transverse direction
B. 30% scrap (3rd cycle) 22% UCNC asbestos, 53% limestone fill	10.2 milling direction
C. 30% scrap (4th cycle) 22% UCNC asbestos, 53% limestone fill	6.5 milling direction 1.6 transverse direction
D. Virgin 22% Quebec asbestos, 53% limestone fill	5.9 milling direction 2.4 transverse direction

Although all meet the Federal Specification, these too did not align exactly with the values reported last month but indicate that differences were small among batches with Quebec material and UCNC virgin and rerun blends. The departure from values previously reported for mixes with 20% and 25% asbestos is attributed to variations in stress during cooling and cutting of the sheets.

Base Color

Recycle of trim scrap at 22% for the first recycle and 30% each time thereafter has not adversely affected color (or other properties) through four cycles. Addition of 20 PPM of a standard oil-soluble blue dye (UCPC code 81-Y) produces tile matched to the desired neutrality and exhibiting a lighter shade than blends containing Quebec asbestos. It appears certain that colors equivalent to or lighter than the lightest commercial products can be made from UCNC asbestos using the 5% TiO_2 normally added for these in industry.

Samples from virgin mixes, recycle blends, and color-adjusted formulations have been started in 40-day ultra violet color stability testing.

Bulk Density

Die-pressing tests indicate fully-opened UCNC asbestos can readily be compacted to densities of 60-70 pounds per cubic foot (standard pressure packing density is 58 lb. per cu. ft.).

Thermal Discoloration

Improved milling behavior was obtained in mill stability test batches containing 1% citric acid by changing from the normal roll temperatures of 150°C and 150°C to 140°C and 160°C. The variables of roll temperature average and differential will be studied further.

The purple color factor in excessively heated tile batches was found to remain on the insoluble filler when the organic binder was dissolved in methyl ethyl ketone. HCl treatment dissolved the limestone leaving a pink-purple colored asbestos residue. Further efforts to dissolve the color factor are underway.

Fluxing tests were run with tile mixes in an open Baker-Perkins mixer type as used by some Armstrong Cork Co. plants. Use of pre-compacted asbestos,

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ACL Doc 17986 · Page 10 of 31 asbestosclaims.law/library/17986/10

incorporation of trim scrap, and substitution of dioctyl phthalate for the Santicizer 160 plasticizer used by Armstrong all appeared to produce shorter fluxing cycles. The normally-used period of 30 minutes appears sufficient for fluxing. Incorporation of these mixes into tiles and measurement of their properties is scheduled for the near future.

Other Mill Products

McBurney 1-minute indentation hardness values on tiles made with comparable percentages (22%) of UCN asbestos lift No. 1 and Bauer separator products were essentially the same, i.e., 9.4 mils for L-1 fully opened and 9.2 mils for Bauer fully opened. Studies of other physical properties with Bauer product mixes and effects of formulation changes on them will continue.

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ACL Doc 17986 · Page 11 of 31 asbestosclaims.law/library/17986/11

ENGINEERING - J.A. Connors

Preliminary engineering studies for the asbestos project are continuing where practical in advance of a final definition of products and process.

The application and design of the various types of pneumatic conveying systems have been investigated in the published literature and with people experienced in the field. The Canadian asbestos industry appears to use only the high velocity-low density type of conveying, but the low velocity-high density type and the fluidizing gravity plan type may have some applications in a plant for our material. Design methods for all three types of pneumatic conveying systems are still largely empirical, however, and tests by a reputable vendor probably will be necessary to prove applications. A proposal has been obtained from the Fuller Company for testing 10-cubic foot quantities of our material in its various physical forms at their laboratory in Cataraugua, Pennsylvania. Notes on the literature search are being prepared for distribution to all parties concerned.

In cooperation with Sales and Research, revised estimates have been prepared for installing an asbestos pilot plant in leased space at Coalinga under two plans. The first plan would entail essentially a relocation of the existing equipment at Tuxedo. On the basis of current capacities and yields, six 400-pound ore samples could be processed per 8-hour shift with this equipment. Under 3-shift operation, the annual fiber production would be 360 tons. The estimated new investment for this plan is $50,000.

The second plan would involve a utilization of the same equipment from Tuxedo, and also the addition of a suitable drier and other equipment for continuous operations and a larger fiber opener for the higher production. Here, the annual fiber production under a 3-shift operation would be about 2000 tons. The estimated new investment for this second plan is $170,000.

Attached is a tabulation of the estimated costs for the two pilot plant plans.

Participation with Research in various equipment tests is planned. The testing of a Raymond mill as an alternate fiber opener is to be witnessed in Johnson, Vermont, during the week of May 9th.

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ACL Doc 17986 · Page 12 of 31 asbestosclaims.law/library/17986/12

ASBESTOS PILOT PLANTS AT COALINGA
PRELIMINARY ESTIMATES OF INVESTMENTS

	Manual Handling Batch Processing	Machine Handling Cont. Processing
Design Feed Rate, Basis	Six 400 lb.samples/8-hr.shift	1 Ton of ore/hr.
, Lbs/24-hr.day	7200	40,000(83% Eff.)
, Tons/200-day yr.	720	4,000
Design Product Yield	50%	50%
Design Product Rate, Tons/200-day yr.	360	2,000
New Investments:		
Land, Land Improvements and Building	(Leased Space) ✓	(Leased Space) ✓
Machinery and Equipment		
Front End Loader	-	$4,000
Crusher	$1,000	5,000
Bucket Elevator to Feed Bin	-	2,000
Dryer	4,000 (tray)	26,000(rotary)
Blower, Cyclone and Bag Filter for Dryer	-	7,000
Bucket Elevator to Hammer Mill	-	2,000
Hammer Mill (Jeffrey)	(SF)	(SF)
Screen (Rotex)	(SF)	(SF)
Cleaner (Bauer)	(SF)	(SF)
Opener	3,000	8,000
Bins for Feed, Product, Floats and Tailings	-	9,500
Cyclone Collectors with Rotary Valves	(SF)	(SF)
Dust Collector (Mikro-Pulsaire)	(SF)	(SF)
Blower (Am. Std.)	(SF)	(SF)
Air Compressor	1,000	1,000
Platform Scale	1,000	1,000
Instruments, and Misc. Lab. and Shop Equipment	3,000	3,000
Quebec Std.Testing Apparatus	(SF)	(SF)
Duct Work and Misc. Piping	1,000	5,000
Misc. Platforms, Equip.Supports and Foundations	6,000	6,000
Misc. Erection of New Equipment	2,000	7,000
Relocation of Existing Equipment	7,000	7,000
Substation and Power Wiring	1,000	3,000
Furniture and Fixtures	-	1,000
Transportation Equipment, 1 Pick-up Truck	-	2,500
Sub Total Installed Cost	$30,000	$100,000
Const.Engn.and Administration	3,000	10,000
Design Engn.	2,000	20,000
Contingency	15,000	40,000
TOTAL NEW INVESTMENT	$50,000	$170,000

NOTE: (SF) denotes re-use from Sterling Forest

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ACL Doc 17986 · Page 13 of 31 asbestosclaims.law/library/17986/13

SALES - J.T. Hall

Reception has been good from the following potential customers: Mastic Tile Co., Armstrong Cork Co., and Kentile Co. All of these flocr covering manufacturers are interested in our material with respect to both vinyl and asphalt tile. Flintkote Co. appears to be interested in our material for use in asphalt tile only. The total consumption of these four manufacturers is in the order of 30,000-40,000 tons of fiber per year.

Manufacturers of other types of commodities have also been contacted. We have received encouragment on use of our material in the following applications:

1) Asbestos in cement for stucco house siding.
2) Use in joint cements.
3) As an additive to vermiculate.

Many of the above manufacturers are ready for tests with one-ton quantities of fiber. These quantities are to be supplied from the pilot plant program starting late this month.

In general, the Sales Department is quite optimistic and still feels that it should be possible to meet the schedule outlined in Dr. Pufahl's report of April 12, 1960. In that report it was stated that we are probably aiming at an August 1st target date for having enough letters of intent from customers to request construction of a plant facility.

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ACL Doc 17986 · Page 14 of 31 asbestosclaims.law/library/17986/14

BISHOP - L.E. Wright

Drill Site Visit

A visit to the drill site to observe the drilling technique and sampling procedure was rendered impossible due to heavy rains. This will be done during more favorable weather. We also wished to observe another alternate access road along San Benito River to the Los Gatos Canyon road.

Mining Operation Studies

Tentative calculations have been made for a ripper-scraper mining system to determine optimum road grades between the drill site and a possible mill site located on claims Jim 6, 13, and 14. The calculations were based upon common earthmoving equipment tables and balanced against the speed and rim-pull rating of a PR619 unit.

Dry Grinding Tests

The Bishop laboratory completed one dry grinding test on a drill hole sample and additional test work using magnetic separation on different size fractions is in process. (Memo from Mr. George Brewer to Mr. L.E.Sausa, dated May 2, 1960).

The plus 60 mesh material, by visual inspection, is of comparable grade with the L-1 and L-2 products from the Tuxedo pilot plant. This test suggests the feasibility of a primary separation of the coarse gangue and the fine material (-60 mesh) for potential up-grading.

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ACL Doc 17986 · Page 15 of 31 asbestosclaims.law/library/17986/15

MINUTES OF MEETING (May 4 and 5, 1960, at Tuxedo.

Those Attending

Grand Junction	- T.S. Ary W.H. Kohler J.L. Lake J.A. Tavelli
Bishop	- L.E. Sausa L.E. Wright
Engineering	- J.A. Connors S.J. Cromer
Sales	- T.J. Hall
Research and Development	-J.C. Brantley G.S. Jordan M.A. Kurlander H.F. Reichard F.S. Smith E.H. Spreen C.O. Strother L.P. Twichell R.G. Woolery

The agenda for the meeting was previously shown in the Summary section of this report. The material presented in the general information session are covered by the preceding written reports from each group.

The following were the items covered and action taken or recommended during the discussion session:

Plant Design Information

A review was made of the attached tabulation (Attachment A) which shows the information required for plant design purposes as applied to process design only. During the meeting assignment of responsibility was made to the various groups for collection of the specific information itemized. It was decided that J.A. Connors would act as the central clearing point for all design information as it was collected. Attachment A shows the items discussed and the assignment of responsibility.

Test Program on Mining and Ore Handling Equipment

J.A. Tavelli presented cost estimates of production mining on the Condor site.

An additional study was made of the cost of a one-week experimental mining program which was estimated to cost approximately $3500. Attachment B shows the details of Mr. Tavelli's studies.

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ACL Doc 17986 · Page 16 of 31 asbestosclaims.law/library/17986/16

Title Acquisition

T.S. Ary reviewed the situation with respect to asbestos property in the Coalinga area not under our control.

Pilot Plant at Coalinga

A review was made of Mr. Connors' estimates for a pilot plant installation at Coalinga.

Recommendations

After discussion of the last three items above, it was decided to make recommendations on each of these subjects to the Company officers and members of the Project Evaluation Committee. Attachment C is a copy of the letter requesting consideration of these three items. It should be noted that approval has already been given to proceed with the experimental mining and materials handling program.

Miscellaneous

Attachment D is a map of the portion of the Condor property that is being drilled for the mine development program.

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ACL Doc 17986 · Page 17 of 31 **asbestosclaims.law/library/17986/17**

Union Carbide trial exhibit UC-3150: L. P. Twichell to T. S. Ary and Others: Asbestos Project Status Report for Apri...
ACL Doc 17986 · Page 18 of 31

INFORMATION FOR DESIGN
(Process Only)

ITEM	SOURCE OF INFORMATION	INFORMATION KNOWN OR SPECIFICATIONS	INFORMATION TO BE GATHERED
Mine Equipment and Method of Delivery to Mill	Bishop, G.J. AT BAJ-WTC	Underway	Suitability of Ripper-Scraper operations
Size and Type of wet stockpile	Bishop, Engr. G.J.	BAJ-Bagar-WTC	Determine stocking angle, stockpile size with respect to necessity for campaign mining.
Method of conveying from wet pile to coarse bin	Bishop, Engr.	GJH [illegible]	Test feeders and conveyors at Bishop
Primary Crusher	Bishop, G.J. WTC BAJ-WTC		Determine or estimate range of moisture.
	Bishop		Test ability to crush at various moisture contents.
	Bishop, Engr.		Test types of equipment, select and specify proper unit including auxiliary grizzly and/or primary coarse screen.
	Tuxedo	Crush to 100% minus 3/4" Max.moisture encountered in sample is 32%. Max.equilibrium moisture is 35%.	

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ATTACHMENT A
Page 1

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ITEM	SOURCE OF INFORMATION	INFORMATION KNOWN OR SPECIFICATIONS	INFORMATION TO BE GATHERED
Drier	Tuxedo	100% minus 3/4" feed Discharge 15% minus 20 mesh, Max. (ave.) Discharge 1% moisture, Max.	Acceptability of direct firing with oil with respect to product contamination. Measure max. allowable temperature. Determine drying rate curves.
	Bishop, G.J.		Determine or estimate range of moisture content over year's period.
	Bishop, Engr.		Tests of various types of driers.
	Engr.		Selection of type of equipment. Determine use of dual units for peak moisture periods.

UCC 000176

ATTACHMENT A
Page 2

Union Carbide trial exhibit UC-3150: L. P. Twichell to T. S. Ary and Others: Asbestos Project Status Report for Apri...
ACL Doc 17986 · Page 19 of 31
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ITEM	SOURCE OF INFORMATION	INFORMATION KNOWN OR SPECIFICATIONS	INFORMATION TO BE GATHERED
Hammer Mill	Tuxedo	Tip speed 9,800 ft/min, Min. 1/2" grate opening. Manganese steel wear plates and WC hammer tips. Dust-tight construction. Discharge must be <50% minus 20 mesh. Present unit: 15"x8" Jeffrey Jr. mill, 10 hp, Capacity >3 ton/hr. Largest Jeffry unit: 36"x36", 10-15 times capacity of 15"x8", 75-125 hp.	Determine max. capacity of 15"x8" mill. Get data on particle size distribution on hammer mill discharge

Union Carbide trial exhibit UC-3150: L. P. Twichell to T. S. Ary and Others: Asbestos Project Status Report for Apri... Published by AsbestosClaims.Law
ACL Doc 17986 · Page 20 of 31 **asbestosclaims.law/library/17986/20**

ITEM	SOURCE OF INFORMATION	INFORMATION KNOWN OR SPECIFICATION	INFORMATION TO BE GATHERED
20 Mesh Screen	Tuxedo	Present unit: Rotex Model 12, screening capacity 1 ton/hr (400 lb/hr/ft²), air lift capacity 1000 lb/hr under air lift (1 ton/hr/ft² of hood cross-section) 50% thru 20 mesh 50% on 20 mesh Max. 50% of +20 mesh air lifted. Air flow 600-700 cfm (1200-1400 ft/min across hood face) Hood adjustable from 0-4" above screen, with adjustable hinged flaps. Largest recommended unit: Model 81, 8 times the capacity of Model 12.	

Union Carbide trial exhibit UC-3150: L. P. Twichell to T. S. Ary and Others: Asbestos Project Status Report for Apri...
ACL Doc 17986 · Page 21 of 31
Published by AsbestosClaims.Law
asbestosclaims.law/library/17986/21

ITEM	SOURCE OF INFORMATION	INFORMATION KNOWN OR SPECIFICATIONS	INFORMATION TO BE GATHERED
Bauer Separator	Tuxedo	Present unit: Model 208, capacity 2 tons/hr feed gives 60% recovery (see curve), recommended air volume 3000 cfm.	Determine air velocity requirements. Determine ultimate capacity as function of yield.
		Largest unit: Model 308, 2 times the capacity of Model 208.	Determine yield from Bauer tails by 2nd pass through Bauer at various feed rates and various first pass recoveries. Compare with one pass operation.
	Engr.		Determine optimum arrangement with respect to investment and yield.

Union Carbide trial exhibit UC-3150: L. P. Twichell to T. S. Ary and Others: Asbestos Project Status Report for Apri...
ACL Doc 17986 · Page 22 of 31
Published by AsbestosClaims.Law
asbestosclaims.law/library/17986/22

ITEM	SOURCE OF INFORMATION	INFORMATION KNOWN OR SPECIFICATIONS	INFORMATION TO BE GATHERED
Cyclones	Engr.		Design to achieve air velocities as specified for 20 mesh screens and Bauer separators.
Fans	Engr.		
Air Ducts	Engr.		
	Tuxedo		Determine min. linear velocity to keep fiber suspended in horizontal duct. Get abrasion number.
Dust Collector	Engr.		
	Tuxedo		Determine % floats from air lifts. Determine particle size distribution of floats.
	Bishop, Engr.		Estimate % dust from drier.

UCC 000180

ATTACHMENT A
Page 6

Union Carbide trial exhibit UC-3150: L. P. Twichell to T. S. Ary and Others: Asbestos Project Status Report for Apri...
ACL Doc 17986 · Page 23 of 31
Published by AsbestosClaims.Law
asbestosclaims.law/library/17986/23

ITEM	SOURCE OF INFORMATION	INFORMATION KNOWN OR SPECIFICATIONS	INFORMATION TO BE GATHERED
Openers	Tuxedo	Present unit: Mikro-Pulverizer, Model 1SH, 0.029" grate, capacity 92 lb/hr, 5 hp.	Test performance of product from larger grate openings. Test Bauer Hurricane.
		Largest unit: Model 4TH, 100 hp, capacity 1840 lb/hr.	Test Raymond Mill.
	Tuxedo, Engr.		Select and specify opening equipment.

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ACL Doc 17986 · Page 24 of 31 asbestosclaims.law/library/17986/24

ITEM	SOURCE OF INFORMATION	INFORMATION KNOWN OR SPECIFICATIONS	INFORMATION TO BE GATHERED
Pressure Packer	Sales		Determine whether economic necessity to pressure pack.
	Tuxedo, Engr.		Conduct test on screen pre-packer. Conduct test with standard equipment.
Indoor Conveyors	Engr.	Indoor conveyors should be air conveyors or totally enclosed mechanical conveyors.	Possible testing of specific equipment.
Tailing Conveyor	Engr.		

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ACL Doc 17986 · Page 25 of 31
Published by AsbestosClaims.Law
asbestosclaims.law/library/17986/25

Ex

ESTIMATE OF MINING COSTS WHICH MAY BE ANTICIPATED FOR THE CONDOR ASBESTOS PROPERTY

J. A. Tavelli
4-29-60

The Union Carbide Nuclear Company Grand Junction Operations has been engaged for several years in the operation of open pit mining properties. We are currently active both at Maybell, Colorado and at the Gass Hills, Wyoming in open pit stripping and mining. Our experience includes both contract and Company operated activities in materials which range from relatively soft common excavation to rock areas which require drilling and blasting. Drawing on this Company experience, a review of machine rate capabilities and cost records, should provide data applicable to the proposed open pit mining at the Condor Asbestos property.

Certain differences exist in the comparison of our present activity with that projected for the Condor property. First, in the uranium areas we are producing ore which require selective mining after stripping of waste, whereas the Condor operation will probably require only grubbing and clearing followed by production of essentially the total underlying material with only minor waste removal, if any. Second, the Plateau Area operations experience a rigorous climate with freezing temperatures prevalent throughout several months of each year, whereas the Coalinga Area can be expected to present no problems of frozen ground and only a short period of high precipitation. Third, the physical nature of the material to be excavated at Maybell and at the Gas Hills is predominantly soft sandstone of low moisture content, whereas the material at the Condor property will probably be wet cohesive and slippery, creating a handling problem. With due consideration given to these differences, some worthwhile application of data should be possible.

Experience data from Colorado open pit operations are as follows:

Hourly Owning and Operating Costs - Includes Maintenance

Tractors:	D-9 Ripper, caterpillar	$19.25 per hour
	D-8 Pusher, caterpillar	14.10
	D-6 Dozer, caterpillar	* 8.65
Road Graders:	12 Caterpillar	$ 8.19 per hour
Scrapers:	S-18 18 yard, Euclid	$15.66 per hour
Shovels:	80-D Northwest 2-1/2 yard	*$32.50 per hour
	22-B Bucyrus-Erie, 3/4 yard	* 11.95
	Insley, 1/2 yard	* 9.45
Trucks:	Single axle, 5 yard	*$ 5.00 per hour
	Tandem axle, 10 yard	* 8.00
	Off-highway Euclid, 12 yard	* 9.60
	Off-highway Euclid, 17 yard	10.12

UCC 000183

Yards per hour = $\frac{195,952}{2595}$ = 75.5 yards

Cost per yard (shovels) = $0.140
Cost per yard (auxiliary) = $0.254
Cost per yard (all equipment) = $0.394

Where drilling and blasting is required for open pit excavation our experience at Maybell has been as follows:

Holes drilled on 10 foot centers:

(a)	Yards of burden per vertical foot of hole:	3.7 yard
(b)	Explosive used per yard broken:	0.38 lb.
(c)	Shot hole cost per yard broken, 4-1/2" D:	$0.0518
(d)	Explosive cost with primer per yard:	$0.0306
	Total cost per yard:	$0.0824

APPLICATION OF DATA TO CONDOR MINING ESTIMATE

The proposal for mine production anticipated at the Condor property must be developed from information now on hand relating to mill requirements. It has been proposed that the finished product fibre output desired is 150,000 tons per year. Recent analyses further indicate that it may be possible to recover 50 percent of the original ore feed as marketable fibre. Another assumption which must be made in estimating mine production is the moisture content. It will be considered that the average moisture content of the ore in place is 20 percent by weight. From these assumed values the requirements of mine production can be estimated.

Finished fibre: 150,000 tons per year
Material grade: Range of from 30% to 50%
Dry raw tons required: Range of from 300,000 to 500,000 tons/year
Moisture content (raw ore): 20%
Wet tons required: 360,000 to 600,000 tons per year
Mine operation: 8 hour day, 5 day week
48 weeks per year = 240 shifts per year

Wet tons per shift: Range $\frac{360,000}{240}$ = 1500 tons per day

$\frac{600,000}{240}$ = 2500 tons per day

Average value of required feed: 2000 tons per day
Unit weight raw ore: 22 cubic feet per ton; 1.2 tons per yard

Average yards of feed required: $\frac{2000}{1.2}$ = 1660 yards per day

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ACL Doc 17986 · Page 27 of 31 asbestosclaims.law/library/17986/27

Scraper Operation

Scraper cycle from Maybell Experience:

Loading time with pushcat:	1.2 minutes
Tram time (one mile - 4% grade):	4.6 minutes
Dumping and spreading time:	0.7 minutes
Return tram time (one mile):	6.5 minutes
Round Trip Total:	13.0 minutes

Scraper availability: 50 minutes per hour

Scraper trips per 8 hour shift: $\frac{50 \times 8}{13}$ = 30 trips

Scraper capacity per day: 30 x 18 = 540 yards per shift

Number of scrapers required: $\frac{1660}{540}$ = 3

Auxiliary equipment required: 1 - pushcat ripper, D-9
1 - road grader - Cat - 12

Cost of total equipment:

3 scrapers at $15.66 per hour	=	$46.98 per hour
1 pushcat at $19.25 per hour	=	19.25
1 blade at $ 8.19 per hour	=	8.19
		$74.42 per hour

Cost per yard moved:

$\frac{\$74.42 \times 8}{1620}$ = $0.367 per yard

Breakdown:		
	Scrapers	$0.231
	Pushcat	0.095
	Blade	0.041
		$0.367 total per yard
		$0.306 per ton

Shovel Operation

Shovel Capacities:		
	1/2 yard	60 yards per hour
	3/4 yard	80 yards per hour
	1 yard	120 yards per hour
	2-1/2 yard	260 yards per hour
	3-1/2 yard	340 yards per hour

Condor Job Requirements:

$\frac{1660}{8}$ = 207 yards per hour. The 2-1/2 yard shovel is indicated but should be operated at capacity of 260 yards per hour for maximum economy. Trucks best suited to this shovel would be 17 yard off-highway type.

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ACL Doc 17986 · Page 28 of 31 asbestosclaims.law/library/17986/28

Loading time, 2-1/2 yard shovel, 17 yard truck: 3.5 minutes
Truck transport time (one mile and return): 13.0 minutes
Round trip cycle time: 16.5 minutes

Round trips per truck shift: $\frac{8 \times 50}{16.5} = 24$

Number of trucks required: $\frac{2070 \text{ yards}}{24 \times 17} = 5$

Auxiliary equipment required: 1 - Road grader, Cat-12
1 - Dozer, Cat D-6

Cost estimate for shovel operation:

	Total	Per Yard
1 - shovel at $32.50 per hour	$32.50	0.125
5 - trucks at $10.12 per hour	50.60	0.195
1 - Grader at $ 8.19 per hour	8.19	0.032
1 - Dozer at $ 8.65 per hour	8.65	0.033
Total	$99.94 per hour	

Cost per yard: $\frac{99.94 \times 8}{2070} = \$0.387$

Cost per ton: $\frac{0.387}{1.2} = \$0.322$

Other Considerations in Selection of Mining Methods

The choice of method depends on physical character of material, most particularly the moisture content.

Questions which need to be answered are:

1. How sticky is ore - will it dump clean and load properly?

2. How slick is the surface in the pit: Can wheel vehicles traverse pit bottom readily?

3. How does material stack on a stockpile? What is repose angle and what are characteristics for drawing through a grizzly?

Material could be partially air dried by using scrapers over a broad area, first ripping the ground to allow air circulation, then picking up the top one foot with scrapers. Each day's production would require ore from an area that is in areal extent: 1500 x 27 = 40,500 square feet or approximately 200 feet by 200 feet. Eight or ten such areas could be selected and worked in rotation allowing each a week or ten days to dry after ripping.

Use of shovels requires high (15 foot) berms for greatest efficiency. Ore would have to be taken at its natural moisture content.

Surge capacity and dumping requirements at the mill site are an important consideration. Assuming that mine production goes to a stockpile, it will cost about $0.15 per yard to re-handle from stockpile to grizzly if a front-end loader is used.

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ACL Doc 17986 · Page 29 of 31 asbestosclaims.law/library/17986/29

It would be desirable to maintain a stockpile of 3 to 4 weeks minimum feed to allow for weather contingencies in mining. This amount is from 27,000 tons to 36,000 tons.

If adequate grade control can be maintained it will be economically desirable to feed the mill directly from current daily production during the mining week. If scrapers are used this would require a bridge structure over an unloading surge bin which would feed through a grizzly to a conveyor. By a direct mine to process feed system the raw material cost can be reduced by about $0.12 per ton.

The use of end-dump trucks would simplify the unloading direct to process at the mill, but would not allow for field drying of material.

The value of drying is estimated as follows:

20% moisture by weight = 400 pounds per ton
400 pounds H_2O, specific heat, calories per gram = 1.0
Latent heat of vaporization: 596 calories per gram
Specific heat of ore (estimated): 0.2 calories per gram
Heat required to drive off 75% of contained water with assumed ore temperature of 300°C; ΔT = 100-30 = 70°C:

Total water: (400 lbs) (454) = 182,000 grams per ton
Water to be removed (75%): (182,000)(.75) = 136,200 grams per ton
Dry weight of ore: 2000 lbs - 400 lbs = 1600 pounds
(1600)(454) = 727,000 grams per ton
Heat requirement:
(182,000)(1)(70) + (136,200)(596) + (727,000)
(0.2)(70) = 1,275,000 + 81,000,000 + 1,015,000 =
83,290,000 gram calories per ton, or;
$\frac{83,290,000}{252}$ = 331,000 BTU per ton

Natural gas fuel estimate: 1000 BTU per cubic foot -- heat content
$0.00042 per cubic foot -- cost of fuel

Gas required per ton: $\frac{331,000}{1000}$ = 331 cubic feet

Cost of gas per ton: (331)(.00042) = $0.14 per ton

Conclusions

From the above figures it would appear that a scraper operation provides the most favorable economics, provided that the physical character of the material is such that it can be handled by this method. Total mill feed costs would be expected to be approximately as follows:

1. Mining and transporting to mill stockpile:	$0.31 per ton
2. Supervision and Engineering (10%):	0.03 per ton
3. Rehandling of stockpile (2/3 of total feed):	0.08 per ton
Total	$0.42 per ton
4. Possible mine credit for air drying ore:	0.07 per ton
	$0.35 per ton

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ACL Doc 17986 · Page 30 of 31 asbestosclaims.law/library/17986/30

An experimental program of excavation using EW-21 scraper and a D-9 dozer for a period of one week should provide the answers needed relating to material handling. On a short term basis this might be expected to cost:

Mobilization of equipment:		$425.00
Equipment rental:		
	DW-21 at $26.50 per hour	1,060.00
	D-9 at $20.50 per hour	820.00
		800.00
Engineering and supervision:		300.00
Contingencies:		
	Total	$3,405.00

This equipment might be expected to move 5,000 yards of material.

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ACL Doc 17986 · Page 31 of 31 **asbestosclaims.law/library/17986/31**