PRELIMINARY REPORT
TREATMENT OF ASBESTOS FOR
USE IN HAVEG MFG.

Introduction

Ever since the beginning of our operations in this country, our raw asbestos has been digested and purified by the General Chemical Company, Marcus Hook, Pa. The material purified by them has been satisfactory in general quality, and has required very little attention on our part.

The cost involved in these operations has always been considerable, however, and about two years ago, the writer began a laboratory study of possible digestion processes with the idea that we might be able to reduce costs by treating the asbestos ourselves. Very little progress was made at that time because of the more pressing importance of other problems.

Early in the Spring of 1937, however, our HAVEG production increased to the point where General Chemical was unable to meet our demands for asbestos for several weeks. While the production rate was later stepped up, and has since permitted the accumulation of a satisfactory reserve, we were at one time actually within 100 lb. of having no asbestos at all.

This condition, on our basic raw material, was of course dangerous in the extreme, and we again started our own study of asbestos treatment, as intensively as conditions permitted.

This year a further complication has arisen. The General Chemical Company has found it necessary to increase our treatment cost to 6-1/4¢ a pound, which brings our net cost, including raw asbestos and losses, to almost 10¢. This increase was caused by the need for expensive new equipment, together with the stated fact that they had lost money at the old price. The General Chemical Company's representatives told us that they would be very glad to assist us should we wish to treat our own asbestos. It was obvious from the discussions that they would welcome the opportunity to give up the operation completely.

Our own asbestos study has, therefore, been intensified. A process has been worked out on a small scale which appears to offer promise. Further study on a larger scale will be required, however, before the possibilities of the process on production can be evaluated.

German Process

The asbestos treatment in Germany, which the writer inspected, consisted of the following steps:

a - asbestos digested 24 hours with HCl in open tank, heated by blowing in steam

PLAINTIFF'S EXHIBIT
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HAV-33

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b - acid washed out partly by decantation and partly on a gravity filter screen
c - wet asbestos removed by hand to a centrifuge where much of the water was removed
d - asbestos dried on glass trays in a long drynouse at a moderate temperature only. Turned over frequently by hand.

General Chemical Process

At Marcus Hook the process is basically the same as the German one with minor variations. After the digestion, the asbestos is washed by gravity on a large shallow screen some 20 ft. square. This is a very slow process. Then the asbestos is dried on a hot plate of about the same size.

Considerations on which our process is based

In considering a digestion process for our own use, we rejected the above after very brief consideration, because in our opinion, it has some very serious defects.

1 - excessive HCl fumes from open digestion tank would be out of the question in a settled community like Marshallton
2 - The acid is continually diluted by the direct addition of steam. This results in long digestion time and makes acid recovery impossible. Resulting costs are high. Also, serious problem of river pollution; many pounds per day of spent acid must be disposed of
3 - Gravity filtration and low temperature drying both seem very slow.

Any process, to be practical and economical for our use, must avoid a serious fume nuisance and a serious river contamination hazard. It must recover a large part of the hydrochloric acid and it must be capable of reasonably rapid manipulation.

A few attempts were made to digest the asbestos with HCl in a glass vessel, by blowing in steam and agitating mechanically. This process was not suitable, first because the acid could not be recovered in sufficient quantity and second because the fibres were badly broken up by the stirrer.

Next, we set up two liter flasks and boiled under reflux in the laboratory. The flasks were charged with asbestos and hydrochloric acid of 15% concentration. There was no agitation except that provided by the boiling itself. Two concentrations were used; one involved 12 cc of the 15% HCl per gram asbestos, the other used 6.5.

The products so obtained were washed clean, then dried and analyzed.

A summary of the results follows:

Run No.	Digestion Time	Acid Ratio	Yield	Asbestos Analyses	
9	1/2	13-1	97.5%	1.57%	)
7	1	13-1	95.1	1.43	) Domestic asbest
4	3	13-1	96.9	0.85	) (Powhatan 10-A)
11	8	13-1	97.1	0.60	)
10	1/2	65-1	96.9	1.46	)
8	1	65-1	95.2	1.27	) Domestic
5	3	65-1	96.9	0.85	) Asbestos
12	8	65-1	95.6	0.99	)
13	1/2	65-1	93.2	1.78	)
14	1	65-1	91.7	1.46	) Imported
15	3	65-1	93.2	1.21	) Asbestos
16	7	65-1	91.7	1.04	)

These experiments permitted the following conclusions:

Simple boiling under reflux with 15% hydrochloric acid will remov the soluble matter from either domestic or foreign asbestos without complications.

About three hours digestion is required to reduce soluble matter our specification of 1.2% or less.

The more concentrated slurry of 6.5 to 1 is capable of entirely satisfactory results.

Since the HCl concentration is not greatly changed in this proces recovery by filtration becomes a possibility.

From these experiments we felt that if a commercial means could b secured of boiling the asbestos slurry under reflux, the basis of a practical process would be secured. There were two difficulties in this. The first was to find a satisfactory material to use in heating coils for HCl and the second was to obtain a satisfactory means of agitation which would not break up the fibres.

A small digester, 8" diameter x 14" deep, with a tight cover was constructed, using HAVEG. In the top of this digester, extending through it into the liquid, was mounted a Tantalum Cascle Heater, loaned to us by the Fansteel Metallurgical Corporation. For agitation we blew small quantities of compressed air in at the bottom. In order to prevent loss of HCl vapor we added a small water-cooled condenser, constructed of HAVEG with Pyrex glass tubes.

Several runs were made using the digester described above, treating imported asbestos. All runs were made with a charge of 3 lb. raw asbestos and 21 lb. of 15% hydrochloric acid, which is comparable to the 6.5-1 acid ratio used in the laboratory. After the digestion the charge was dumped into a small HAVEG filter and suction was applied. The filtered acid was saved and used in the next batch. Then the

asbestos was washed several times until clean, and finally dried and analyzed.

Three typical runs resulted as follows:

Run no.	Digestion Time	S.G.	% HCl recovery	Muriatic re'd.per pound asbestos	Air rate cu.ft. per min.	Asbestos Yield	Asbestos analysi
17	1	1.074	67.5	1.060	0.105	91.7	1.21%
18	2	1.086	64.5	1.201	0.105	89.7	1.43%
19	2	1.092	61.2	1.325	0.105	91.7	1.40%

In general, the process proved satisfactory. The Tantalum heater worked perfectly, and the air agitation seemed to keep the mass thoroughly worked up. There was no serious degradation of the fibres. We were able to recover 61 to 64% of the hydrochloric acid for re-use in the next batch, and the yields averaged slightly better than 90% of the raw asbestos. All of this looked very promising.

There remained, however, two or three points on which we were not satisfied. First, our digester was equipped with a dump valve, which consistently plugged with asbestos fibre. The use of such a valve on production was out of the question and a satisfactory dumping arrangement had to be worked out on the whole process was useless. Second, our digestions were for a period too short to yield material meeting our 1.30% specification. Third, we recognized the certainty that as the acid was used over again and again, it would gradually increase in impurity until an equilibrium was established. We felt the need to run a much larger number of batches to find out whether the impure acid would affect the quality of the asbestos.

The digester was rebuilt, including a rubber-gasketed plug valve in place of the one mentioned above. This operated entirely without difficulty, and appears to have solved the dumping problem, at least on this small size equipment.

With the rebuilt digester we ran 10 batches for various lengths of time, saving the recovered acid from batch to batch. In this series we improved the recovery of acid greatly by recovering, not only the first filtrate, but also the first wash water. Both imported and domestic asbestos was treated and gave satisfactory results.

After these 10 runs the impurity in the acid was still increasing slowly and was some distance from reaching equilibrium. There was, however, no progressive decrease in purity of the asbestos. It was felt that the expense and time consumed in running a large number of further batches was not justified. We feel that the possibility of obtaining pure asbestos with dirty acid has been substantially shown; although not conclusively proven. In any case, should it be necessary to discard the acid after 10-15 or 20 runs, the "amortization" of that acid is so low as hardly to affect the results.

In detail, the results of this series of runs are as follows:

Batch No.	S.G. of charge	% NH3 anal. charge	Dig. time	% Hal recov.	lbs. muriatic per lb. product	Air rate	Yield %	% Anal. Prod.
24	1.087	17.52	4	85.3	0.565	.092	93.9	0.74
25	1.095	16.68	4	90.3	0.723	.092	91.6	1.29
26	1.105	16.30	4	84.8	0.733	.092	91.6	1.16
27	1.111	16.30	6	81.2	0.869	.152	91.6	0.81(incert
28	1.124	16.12	6	81.3	0.902	.152	93.7	0.74 accept
29	1.134	16.50	3	81.8	0.370	.152	91.6	0.56
30	1.140	16.30	3	81.0	0.648	.152	93.4	1.20
31	1.142	15.36	3	82.2	0.765	.152	95.9	0.37
32	1.150	16.20	3	82.5	0.818	.152	93.9	0.78(incric
33	1.151	17.00	4	76.5-	1.069	.152	93.9	0.67 accept
34	1.156	16.49	"	"	"	"	"	"

These runs prove to our own satisfaction the practicability of the process outlined and the small scale equipment developed to carry it on. To design from this information a full scale plant, however, would seem to be an exceedingly risky proposition. The process and the equipment are so entirely different from the previous method that our design information is very limited. We believe, therefore, that an intermediate size plant should be built, of about 30 lb. daily capacity. This plant could be operated on the basis of regular production, with close technical control. It would prove more definitely the correctness of our design and method, and would yield more precise design and cost data.

Accordingly, we have drawn up completely a so-called pilot plant for an estimated capacity of 30 lb. per day. We have calculated as closely as possible the sales price and out-of-pocket expenditures and present them in the following table. Several items of equipment consist of HAVEC tanks already built and the only cost on these items is a small sum to adapt them for the purpose. The actual immediate out-of-pocket expenditure is practically speaking the cost to us of the pilot plant:

Item	Description	Drawing	Supplier	New or Old	Sales Price	Nominal out-of-pocket	Actual present expendit
1	Digester	H-2535	HAVEC	New	$224.20	$104.64	$104.64
2	Tan.heater	P-20453	Fanesteel	"	208.00	208.00	208.00
3	Condenser	1-2531	HAVEC	"	325.90	188.70	188.70
4	Suction filter	H-2536	"	Old	171.55	61.00	34.00
5	Vacuum receiver	H-2536	"	New	170.15	76.35	76.35
6	" pump	4R(4222)	G.E.	"	22.68	22.68	22.68
7	Mixing tank	H-2537	HAVEC	Old	86.55	34.60	7.60
8	Neutralizing Tank	H-2803-7	"	"	183.24	73.30	2.13
9	Drier & trays	H-2534	"	New	132.45	59.49	59.49
10	Pipe	H-2538	"	"	149.26	62.65	62.65
11	Valves	H-2538	"	"	107.20	59.88	59.88
12	Iron pipe & instali.			"	140.00	140.00	140.00
13	Wood structure			"	70.00	70.00	70.00
14	Water meter			"	20.00	20.00	20.00
					2009.78	1181.29	1057.02

The cost to us of the Pilot plant will, therefore, run in the vicinity of $1100.00. Not all of this cost represents material which we must purchase; perhaps 40% represents expenditure for labor of our own present employees.

This Pilot plant design and cost estimate takes account of the probable necessity of neutralizing the waste acid with lime to prevent stream polution. The actual amount of acid put into the stream by our process will probably be small enough to cause no damage; but we feel that it would be best to take whatever steps are open to us towards minimizing the polution. This will strengthen our position in the event of activity on the part of the state at some future date.

In order to determine whether the rather sizable Pilot plant expenditure is justified, it was felt desirable to attempt to calculate the possible eventual cost of a final full scale plant, together with its operating cost. If such a plant can show a reasonably sizable saving, based on present or future consumption of asbestos, then the Pilot plant expenditure is justifiable.

The following calculations were, therefore, made. The estimated plant cost is exceedingly rough and may be 25% from the eventual figure The material and labor figures were based on the small scale study given above and are also subject to considerable revision.

The cost of the eventual plant includes the cost of the Pilot plan indicated above.

Cost Calculation

HAVEG Material

1 - digester	$ 1,500.00
1 - condenser	650.00
1 - vacuum filter	700.00
1 - receiver.	550.00
1 - mixing tank	550.00
1 - storage tank	1,800.00
1 - neutralizing tank	1,650.00
1 - set HAVEG pipe & valves	2,000.00
1 - HAVEG eductor (Haveg parts)	50.00
1 - HAVEG obnoxious vap. cond.	100.00
1 - HAVEG fume hoods (sheet)	400.00
	$ 9,950 Sales Price

— 2.5 - out-of-pocket - $3,820

Outside Material

1 - eductor (Schutte-Koerting's part)	360.00
1 - obnoxious vap.cond. (S.K.part)	200.00
4 - tantalum heaters (Fansteel)	1,500.00
1 - set traps, valves, pipe	700.00
installation cost	1,100.00
1 - home-made drier	1,000.00
	4,860.00

4,860

1 - Pilot plant complete	1,000.00
Total —	$9,840.00

Plant Productivity

On 1 - 10 hr. shift, 923 lb. per day,
260 working days - 240,000 lb. per year
On 2 - 10 hr. shifts - 480,000 " " "

Recent Consumption

During 1937 total asbestos used was 185,651 lb. per year
During first 5 months of 1938, rate - 98,800 lb. per year

Proposed plant would, therefore, take care of 1937 rate of production with some to spare, leaving a whole extra shift for possible expension.

Cost of Plant

As detailed separately, roughly $9,840.00

Estimated life of plant - 5 years. Therefore, amortization per year - $1,968.00

Estimated maintenance per year - $200.00

Plant charges per year - $2,168.00 which constitutes a fixed charge, to be distributed over the production.

Fixed Plant Charges per lb. of Product

This will depend entirely on the rate of production. Will be given three ways.

(a) Based on present 1938 rate
(b) Based on actual consumption during 1937
(c) Possible eventual maximum plant capacity, working two shifts

Fixed charges for depreciation and maintenance at these three production rates will be:

(a) $2,168.00 ÷ 98,800.00 - $0.0219 per lb.
(b) 2,168.00 ÷ 185,651.00 - 0.0117 " "
(c) 2,168.00 ÷ 480,000.00 - 0.0045 per lb.

Direct Charges - Manufacturing Costs - Labor & Material

These are based on daily charge of 1000 lb. raw asbestos, which, at 92.3% average yield - 923 lb. per day of treated asbestos.

Direct Labor

1 man - 10 hrs. @ 70¢	- $ 7.00
1 " 3 " 50¢	- 1.50
Supervision	- 3.50
	$12.00 ÷ 923 - $0.0130 per lb.

Material

1000 lb. raw asbestos @ 3.03¢	=	$ 30.31
Muriatic acid, 787 lb.@ 0.75¢	=	5.91
Lime, 252 lb. @ 0.425¢	=	.99
Steam, 10,450 lb. @ 35¢ per 1000	=	3.66
Water, 24,100 gal. @ 4¢ " "	=	.97
Air, 10,500 cu.ft. @ 1¢ " "	=	.11

41.95÷923 = $0.0454 per lb

Total direct labor & Material 0.0534 per lb

Total Cost of Product & Comparison with Present Price

Our present treated asbestos, laid down at Marshalliton, based on figures furnished to me by Mr. Sinclair, but adjusted for the recent price increase is $0.09959 per lb. This is not governed by quantity used. Our own production costs vary with quantity and would be:

Production rate / year	Fixed Charges	Mfg. Cost	Total Cost	Potential Saving per lb.	Potential Saving per year
93,800 lb.	$0.0219	0.0534	0.0803	0.0194	1,916.00
185,851 "	0.0117	0.0534	0.0701	0.0296	5,500.00
460,000 "	0.0095	0.0534	0.0629	0.0368	17,690.00

The figure given of potential saving per year includes overhead items not possible to evaluate definitely with the incomplete information now available. These include power, light, heat, space rental, taxes, insurance, etc. They do not include maintenance, supervision or depreciation, as these have been included in the table above.

While I cannot gauge with exactitude what these figures would be, it is my opinion that a figure of $100.00 per month would amply cover them. On this basis the actual savings per year would be:

Production Per year	Potential yearly saving	Estimated actual yearly saving
93,800 lb.	$ 1,916.00	$ 716.00
185,851 "	5,500.00	4,300.00
460,000 "	17,690.00	16,490.00

These figures indicate that the installation is justified even on the basis of present production and would yield a substantial saving at the production rate of 1937 or better.

This takes no account, of course, of the greatly improved certain of supply on our basic raw material which our own plant would give us

and which probably would be worth paying something extra for.

Our general conclusion, therefore, is that the expense of a Pilot plant is well justified by the eventual possibilities, and we request that an appropriation be made in the sum of $1100.00 for this project.

When the General Chemical Company's representatives talked with us some months ago about the proposed price increase, it was stated that they were faced with an expenditure of $40,000.00 to $50,000.00 for equipment to carry on this work. We took exception to this figure.

Later on some of their engineers visited our office and the writer described to them in full detail our proposed process for treating asbestos. We told them that an expenditure of perhaps $10,000.00 to $15,000.00 should cover the equipment. It was also explained that a Pilot plant would be necessary before the process could be installed and we offered to give them the Pilot plant equipment at part price.

Somewhat later a letter was received with a revised estimate of their expenditure cut down to $10,000.00 to $12,000.00; but re-affirming their increased quotation. Nothing was said then or since about whether they wished to use our process.

We believe, however, that all the evidence indicates that they will either not use our process, or if they do use it, charge us the same price previously contemplated.

We believe we should continue to purchase partial requirements through them for probably some time to come, and in the meantime, develop ourselves as a second source of supply as rapidly as practicable. This belief is strengthened by the fact that tentative overtures on the part of our purchasing department to other chemical companies has met with any cordial response.

The chemical work on which this report is based was performed largely by Mr. E. F. Hampe and the Pilot plant designs were made by Mr. G. H. Chase.

The writer wishes also to acknowledge with thanks the advice and assistance of Mr. C. F. Sinclair in preparing the cost estimates and in studying the probable eventual justification of the process.

Respectfully submitted.

June 30, 1938.

Mampe Ex 2
7/19/94
EDM

STATE OF DELAWARE:
:SS
NEW CASTLE COUNTY:

AFFIDAVIT

APPEARED BEFORE ME, a Notary Public for the state and county aforesaid, Edwin Paul Mampe, who being duly sworn on the 28th day of March, 1994, did depose and, based on his personal knowledge, state as follows:

1. He is a resident of the State of Delaware.

2. He was employed at the Haveg plant in Marshallton, DE in various positions from 1937 to 1977. During the years 1937 to 1941 he was employed as a draftsman, a pilot plant operator, and then was in charge of the order department. He has attached pages 5 and 6 from his deposition of July 5, 1985 to reflect this.

3. He recalls that Haveg was supplied with treated asbestos by General Chemical from the time he started at Haveg in 1937 until approximately 1941 when Haveg began to receive untreated asbestos from other sources. The treated asbestos received from General Chemical was used in the manufacture of Haveg material. The Haveg material was sanded and manipulated in various ways which created large amounts of visible dust throughout the plant.

4. He has reviewed a copy of a document entitled, "Preliminary Report Treatment Of Asbestos For Use In Haveg Mfg." He has attached a copy of this document. He believes it was written by William H. Adams, Jr., Technical Director at Haveg. This document accurately represents the supply of treated asbestos to Haveg by General Chemical and the plan for Haveg's own treatment of raw asbestos.

5. The manufacture of Haveg material at the Marshallton plant began in approximately 1932.

E.P.M. 6. He is competent to testify about the facts set forth in this affidavit.

Edwin Paul Mampe
Edwin Paul Mampe

SWORN TO AND SUBSCRIBED before me, a Notary Public, on ths date and year aforesaid.

Brenda A. Olin
Notary Public