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TCL-446

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Authors

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Problem Number

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Title

Evaluation of a Thickener in Removal of Asbestos
Fibers from the Chlorine Cathode Washing System

CORP. RES. AND DEV.

LAB. NO.

Informative summary with conclusions

PATENT DISCLOSURE NO.

DISCLOSURE
PLANNED?

The purpose of this study was to evaluate the use of a thickener to concentrate the effluent from a chlorine cell cathode washer. The area necessary to concentrate 1500 gpm of 0.1% by weight asbestos in water slurry to a concentrate of 0.5% solids was found to be: 3720 square feet if acidizing is used in the washing process, 2800 square feet if no acidizing is used. In either case a flocculant, Purifloc A-23, should be used.

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I. PURPOSE

The purpose of this study was to evaluate the use of a thickener in removal of asbestos fibers from the chlorine cathode washing system used by Dow Industrial Service.

II. SUMMARY

The area of a continuous thickener to concentrate a dilute slurry of asbestos from a chlorine cathode washer was determined.

III. CONCLUSIONS

To concentrate 1500 gpm of a 0.1 percent by weight asbestos in water slurry to a concentration of 0.5% solids:

1. A flocculant, Purifloc A-23, should be used in the concentration of 2 - 3 ppm.
2. An area of 2800 square feet is adequate if the cathodes are not acidized.
3. If the cathodes are acidized, 3720 square feet will be necessary.

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IV. INTRODUCTION

The object of this study was to determine the diameter of a continuous thickener operating on an asbestos-water slurry of approximately 0.1% by weight concentration of solids.

The cathode washing operation performed by Dow Industrial Service generates a flow of approximately 1500 gpm of 0.1% asbestos slurry. These fibers must not be allowed to enter any waste water discharge for ecological reasons, making landfill the most practical method of disposal. It is desirable to transport the asbestos fibers to the landfill area in as concentrated form as possible.

An experimental rotary drum vacuum filter was tried by L. Little, a D.I.S. employee and a Konline-Sanderson representative on the asbestos slurry at D.I.S. They found that the feed slurry must be at least 0.5% by weight solids for the solids to be discharged from the filter. They also report a flow rate of approximately 25 - 30 gph per square foot of filter area. This data was confirmed by Bird Machine Company on a sample sent to their lab.

The problem of thickening the dilute slurry to a concentration suitable for filtration was thought to be best solved using a continuous thickener of the "Dorr Pond" type. Three methods of sizing a thickener using settling tests in graduated cylinders were used; Coe and Clevenger², Talmage and Fitch³, and Faust⁴. The results of the methods resulted in the respective diameters of: 42.8', 34.4', and 19.3'.

In an article published by Chemical Engineering and written by Bryant Fitch, he states, "However, if underflow concentration is of critical importance, you should not rely too heavily on the batch procedure particularly where

- . Indicated underflow concentrations are low. Say less than 25% by volume.
- . Indicated compression times are long. Say over 24 hours.
- . There is no clearly defined "compression point."
- . Strong channeling is not evident in "compression" regime.

"In such cases, continuous piloting or the semi continuous procedure to be described later should be used."

A continuous experiment thickener was devised and used to try and determine which if any of the diameters would be correct. The apparatus consisted of a 4" Plexiglas tube six feet long with a cone and discharge nozzle in the bottom. A fifteen-gallon sample of the slurry was pumped to the tube and the overflow and underflow collected and recycled to the feed pipe.

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Data⁵ from this test indicated a diameter of 30 feet would be suitable for the problem. It was felt, however, that further study was needed in a larger test apparatus that contained a solids removal system.

A three-foot diameter "laboratory thickener" was bought from the Denver Equipment Company and installed at the D.I.S. facilities. The results of this study are reported here.

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¹Letter from Bird Machine Company to Dow Chemical Company dated November 14, 1972 -- See appendix.

²Coe, H. S., Clevenger, G. H., "Methods for Determining the Capacities of Slime-Settling Tanks," trans. AIME, 55, 356 (1916)

³Talmage, W. P., Fitch, E. B., "Determining Thickener Unit Area," Industrial and Engineering Chemistry, Volume 4M, No.1, p.38 (1955)

⁴Faust, A. S. et al, "Principles of Unit Operation" page 467.

⁵Chlor-Alkali Status Summary, January-March, 1972. See Appendix.

V. EXPERIMENTAL

A. Materials

1. Asbestos slurry.

The asbestos slurry used was obtained directly from the cathode washer in use at the Dow Industrial Services facilities.

2. Flocculant

Purifloc A-23 was used as a flocculant.

3. Apparatus

The thickener was a 3'0" diameter Denver Equipment Company Laboratory thickener complete with rake assembly and underflow pump. The feed slurry was directly from the cathode washer sump pump through a two-inch rubber hose and a one-inch ball valve and feed pipe. The Purifloc was injected into the feed piping with a controlled volume pump and mixed in a series of 90° ells before entering the thickener.

Two 55-gallon drums served as check tanks to measure the volume of the overflow and a smaller 15-gallon drum was used to collect the underflow for measuring and sampling.

A variable speed transmission was added to the rake drive train to allow various rake and underflow pump speeds. It was determined during the runs that the pump would plug when running at very slow rates and a recycle line was added allowing the underflow to continuously recycle through the sump in the bottom of the thickener.

B. Procedure

The dilute slurry was flow-controlled to the thickener at a maximum rate that produced a clear overflow while a measured amount of Purifloc was being added. The overflow was collected in one of the two check tanks and timed. When this tank was filled, the overflow was diverted to the other tank and the first tank emptied. This switching of tanks continued throughout the entire run. The underflow was continuously recycled through the collection sump of the thickener and periodically diverted to the small holding tank where the volume was measured.

Samples were taken of the feed and underflow and analyzed for solids concentration.

This procedure was repeated using various amounts of Purifloc to determine the optimum amount to be used.

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VI. RESULTS

The data from the experimental runs on the Denver Lab thickener calculated to the area needed to process 1500 gpm are shown in Table I.

TABLE I

<u>Purifloc</u> <u>ppm</u>	<u>Feed Concen.</u> <u>Wt. %</u>	<u>Underflow Concen.</u> <u>Wt. %</u>	<u>Area for 1500 gpm</u> <u>Sq.Ft.</u>
0.6	0.05	0.41	4140
1.0	0.14	0.54	2390
1.9	0.15	0.52	2140
2.3	0.03	0.97	2100
2.4	0.07	1.56	2410
2.9	0.05	0.34	2060
3.1	0.07	0.81	2800
4.6	0.14	0.46	2600
6.4*	0.12	1.06	3060
7.7*	0.08	0.89	2550
9.1*	0.19	1.27	2860
13.7*	0.09	0.69	2650
17.0*	0.10	0.38	3420
17.1*	0.04	0.57	3720

*Runs made when D.I.S. was acidizing every cathode.

Graph I is a plot of Purifloc A-23 addition versus area required for 1500 gpm. Graph II is a plot of Purifloc A-23 addition versus the weight percent solids in the underflow.

Table II is the results of settling test performed in a graduated cylinder using various flocculating agents. Included is the settling test using Purifloc A-23 of 3 and 15 ppm concentrations in the slurry from the cathode washer when every cathode was acidized.

Table III is the results of settling test performed in a graduated cylinder on the raw unthickened asbestos slurry with the pH adjusted to various levels. The slurry sample was taken at the time every cathode was being acidized.

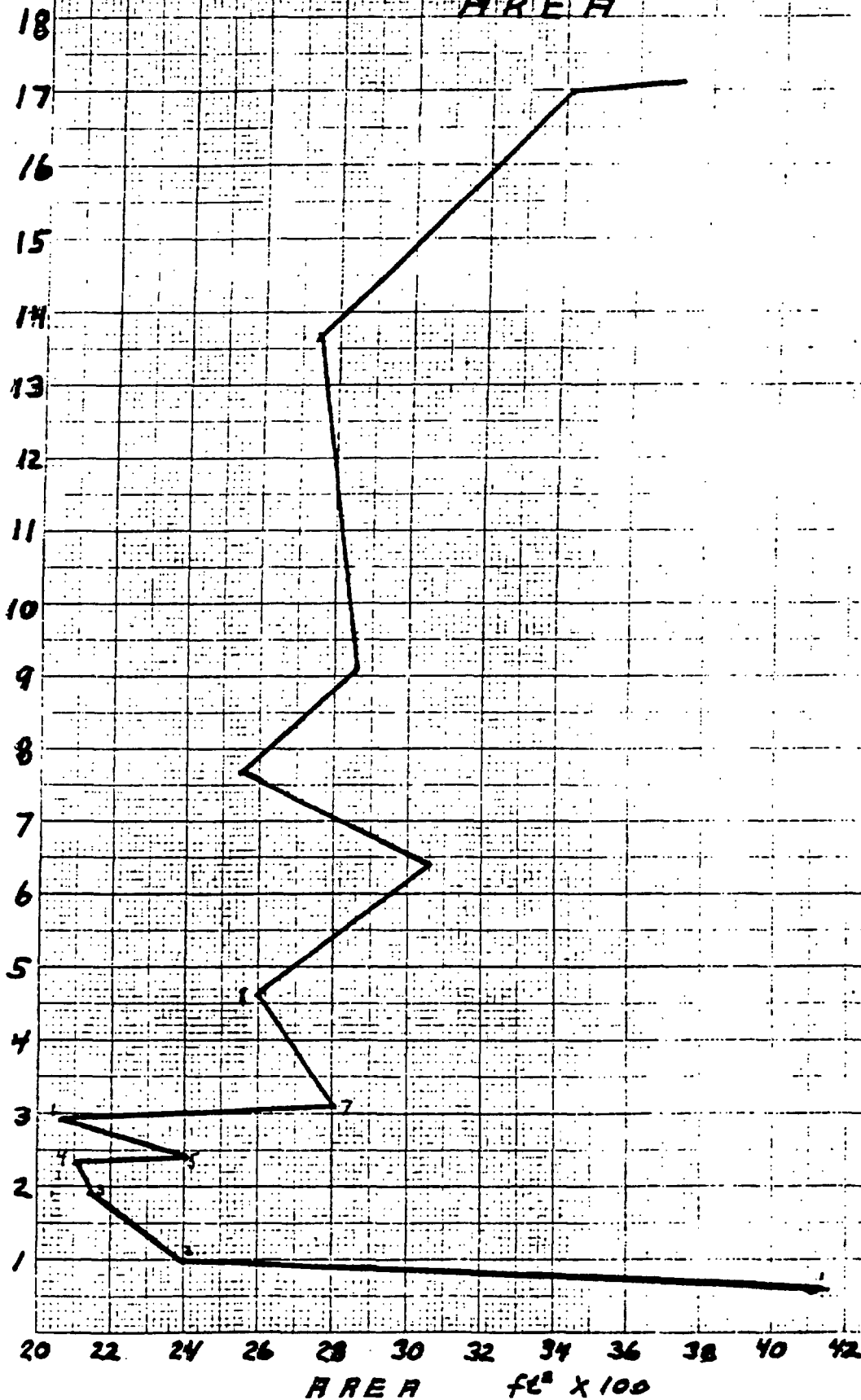
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GRAPH I

PURIFLOC

AREA

PURIFLOC PPM



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GRAPH II
PURIFLOC
vs
UNDERFLOW CONC.

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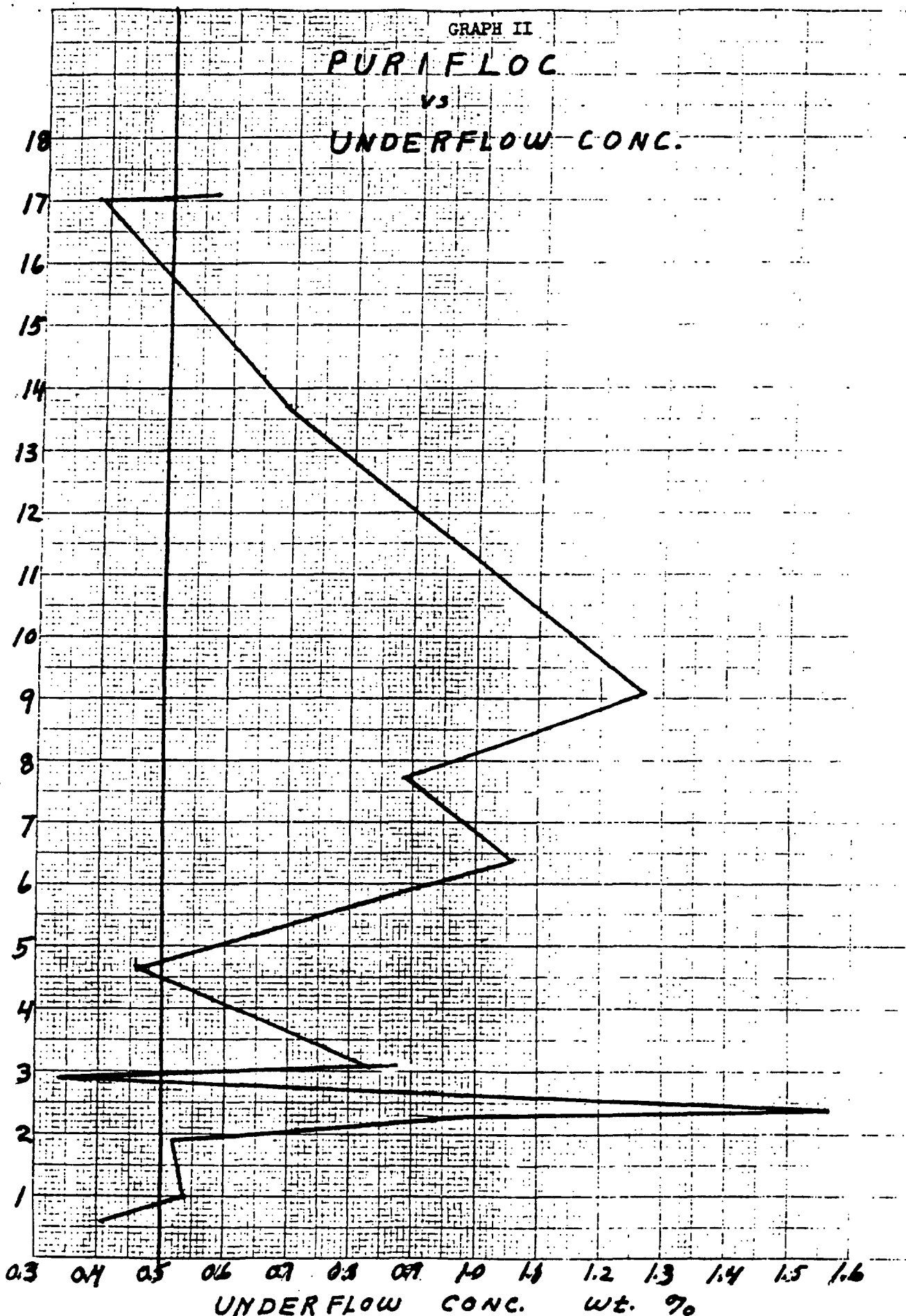


TABLE II
SETTLING RATES OF ASBESTOS SLURRIES
Time in Minutes

Flocculant (Conc.)

Inches Settled	None	Polyhall 402 (5 ppm)	Polyhall 295 (5 ppm)	Polymer JB (8 ppm)	Jaguar + (5 ppm)	A-23 2ppm	A-23* 3 ppm	A-23* 15ppm
0.71	.22	.12	.09	.11	.15			
1.42	.46	.27		.29	.38			
2.12	.70	.42	.25	.35	.49			
2.83	.85	.56		.56	.57			
3.54	.97	.68	.38	.65	.65			
4.25	1.10	.75		.79	.80			
4.96	1.28	.84	.55	.91	.92			
5.66	1.46	.92		1.10	1.10			
6.37	1.65	1.02		1.15	1.20			
7.08	1.80	1.15	.81	1.28	1.30			
7.79	2.00	1.25		1.40	1.50			
8.50	2.10	1.36		1.50	1.70			
9.20	2.20	1.40		1.65				
9.91	2.35	1.52	1.10					
10.62								
11.33						0.30	0.50	0.50

TABLE III

SETTLING RATES OF ASBESTOS AT VARIOUS ADJUSTED pH

pH	Rate of Settling (Interface) In./Min.
2.1	4.72
3.9*	4.22
7.2	1.91
10.0	1.79
12.0	1.30

*Raw, unthickened slurry without pH adjusted.

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VII. DISCUSSION OF RESULTS

A. Flocculant

The flocculant, Purifloc A-23, was recommended by the Organic Product Research Department to Dow Industrial Services. This recommendation was determined valid after a series of tests was made comparing A-23 to several flocculants produced by Stein, Hall and Company.

The area necessary for 1500 gpm when up to 1.0 ppm Purifloc was added was over 4000 square feet. When the concentration was increased above the 1 ppm range up to 3 ppm, the area decreased to 2800 square feet. Above the 3 ppm addition little benefit was realized. The data appears that the larger addition of Purifloc hindered the settling. It must be noted, however, that the last six runs were performed three months after the first eight and D.I.S. had changed their wash procedure to acidizing every cathode. The acidizing apparently has some effect on the settling rate. The settling test in a graduate was repeated using the slurry that had been acidized and a 3 and 15 ppm Purifloc addition. No difference was found between the two, however, the rate is different than the test done before acidizing was begun.

B. Thickener Area with Minimum Acidizing

The first eight runs of this study were made prior to June, 1972, when D.I.S. was using a minimum of cathode acidizing in the wash procedure. The first set of data was taken with a low Purifloc addition, 0.6 ppm, and resulted in poor settling. If this run is ignored because of the low flocculant level, the largest area of the remaining seven is 2800 square feet. The thickener diameter for this area would be 60 feet to handle 1500 gpm of unthickened slurry.

C. Thickener Area with Maximum Acidizing

The last six runs were made after D.I.S. had started acidizing every cathode. From these six runs, 3720 square feet was found to be the largest area needed for 1500 gpm of unthickened slurry. The diameter of a thickener of this area would be 69 feet.

D. Settling Rates at Various pH's

It was anticipated that by increasing the pH of the slurry, the ferric chloride in the slurry would form a flocculant and make the addition of Purifloc unnecessary. This was not the case as the settling rate actually decreased as the pH was increased. The supernatant liquid was less turbid at a pH above 7.0 than below. The problem of this study is removing asbestos fibers and not clarification, so it is concluded that pH adjustment has no value in settling of asbestos.

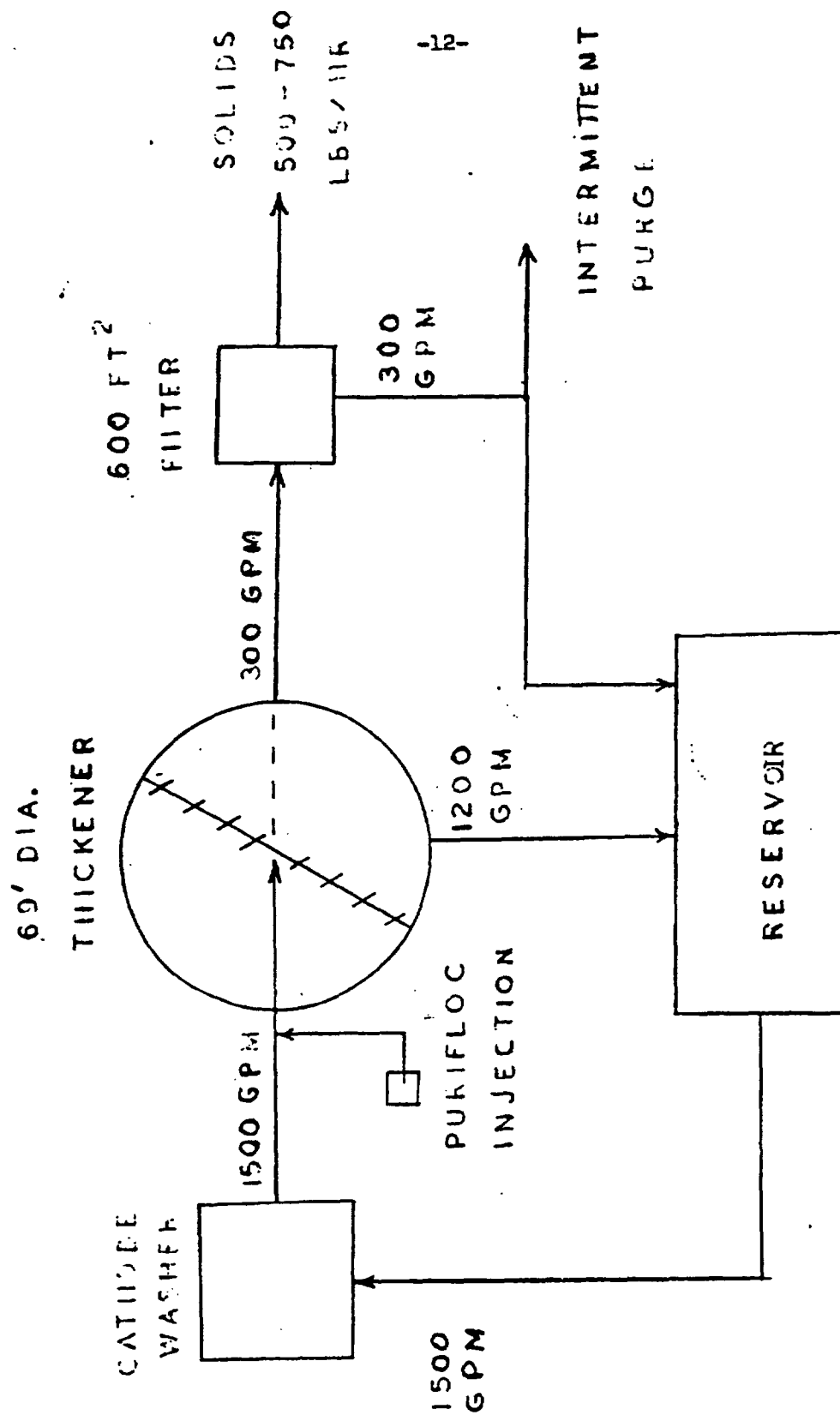
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D. Proposed Process

The 0.5 percent thickened slurry will have to be further dewatered for disposal. A rotary drum vacuum filter seems to be suitable for this service. There has been no actual study done on the use of such equipment by this department. A preliminary study was performed by D.I.S. personnel in conjunction with the Komline-Sanderson Co. They found that a feed slurry of 0.5% solids would produce a filtrate rate of 30 gph per square foot of filter area. Based on this, a filter of 600 square feet would be necessary. The solids removed by calculation should be 750 pounds per hour, however, in actual practice, it is closer to 500 pounds per hour. The difference could be the time necessary to place and remove the cathodes in the washer. Figure 1 is a flow sheet of the proposed process.

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PROPOSED PROCESS



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VIII. APPENDICES

- Appendix A Results of Tests Done by Bird Machine Company
 on Sample of Asbestos Slurry
- Appendix B Methods of Determining Thickener Areas
- B-1 Talmage and Fitch
 B-2 Fitch, Batch Test
- Appendix C Chlor-Alkali Status Summary
 January-March, 1972

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