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TITLE: ASBESTOS REMOVAL, PART 3: FILTRATION OF EVAPORATOR FEED CELL EFFLUENT

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CENTRAL REPORT INDEX

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This report is: ☒ INTERIM ☐ FINAL and mainly: ☒ REVIEW

DESCRIPTIVE SUMMARY WITH CONCLUSIONS: (Include in this space references to data books, and to earlier related reports, patents and publications.)

SUMMARY

Data obtained using a 550 ft^2 pressure leaf filter on evaporator feed cell effluent showed that the asbestos levels were reduced from ~ 1.8 ppm (~ 46,000 M FPL) avg. to ~ 0.02 ppm (~ 180 M FPL) avg. Iron removal was to ~ 50% of the inlet concentration for the majority of the filter aids tested including the cellulosics. A Perlite filter aid (DIC 476 or 436) would be recommended for use as the precoat and body feed to minimize costs with equivalent iron removal obtained in comparison to using a cellulosic precoat. The inlet Fe concentration at the Louisiana Division Caustic Plant averaged ~ 2.3 ppm, and this would require the use of MgO to remain in spec or the use of iron cells. MgO added to the body feed tank to give 2 to 5 ppm MgO as body feed to the filter gave improved iron removal without blinding the filter or reducing cycle lengths. Cycle times of ~ 6 hours were obtained at a 0.75 gpm/ft^2 feed rate using DIC 476 as the precoat and body feed at a 3 to 1 body feed ratio for an inlet turbidity of ~ 15 FTU. At the same conditions as above except at a 0.5 gpm/ft^2 filtration rate, cycle times of 10 to 12 hours were obtained. Sluicing with brine would be recommended.

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CONCLUSIONS

1) 99% Asbestos removal was obtained to levels of 0.02 ppm (avg.) in the filtrate.
2) Iron removal using various types and combinations of filter aids was normally to ~50% of inlet concentration. To obtain outlet Fe concentrations in spec for 50% NaOH (≤ 0.8 ppm as measured in ~8% NaOH), the following conditions were necessary
   a) inlet Fe concentrations ≤ 1.5 ppm Fe
   b) for inlet Fe concentrations > 1.5 ppm, MgO must be added to either the precoat (10% of the precoat weight) or body feed (~2 to 5 ppm in feed to filter)
3) A Perlite filter aid (Dicalite 476 or 436) would be recommended as the precoat and body feed to minimize the filter aid costs and still obtain ~ equivalent iron removal and an outlet silica concentration low enough to be in spec.

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CONCLUSIONS cont'd

4) For filtration of cell effluent with the inlet turbidity range of 10 to 20 FTU using Dicalite 476 as the precoat and body feed with a 3 to 1 body feed ratio, cycle times of 10 to 12 hours were obtained at 0.5 gpm/ft^2 and of 6 hours at 0.75 gpm/ft^2.
5) Sluice disposal could be accomplished in several ways, but sluicing with brine and pumping the sluice at a continuous rate of 65 gpm to the brine treating sludge disposal system would be preferred for the Louisiana Division.

INTRODUCTION

The purpose of this testing was to confirm the pilot scale testing done by the Midland Division (report EMR-LR-120) on plant scale equipment and to optimize the filtration system. Asbestos removal and iron removal are both desired for the evaporator feed cell effluent filtration.

This testing was also compared to flocculation, settling, and filtration (Part 4) to determine which method was more economical and was used to recommend the best system for the Louisiana Division (Part 5).

EXPERIMENTAL PROCEDURES AND EQUIPMENT

The same equipment, sampling, data taking, and analytical procedures were used in this testing as were described in Part 2. However, there was an equipment problem that affected the data evaluation and testing. The problem was with the sluice arm in the sparkler filter being used. During testing, the sluice arm dropped down and caught on the filter leaves knocking some of them over until the arm pulled loose and fell to the bottom of the filter. Several of the filter bags were torn and the filter leaves were damaged. This required replacement of the filter bags and filter leaves. The sluice arm was repaired as well as possible, but a weld separated. This allowed a large quantity of high pressure sluice to be directed at one spot on the new filter bags. This resulted in holes being worn in the polypropylene bags and required them to be replaced again. Rick Wittman of the Caustic Plant worked with representatives for the sparkler filters and modifications were made to eliminate the problem with the sluice arm on the existing filter. Sparkler Company also changed their design to prevent future problems on new filters.

DISCUSSION OF RESULTS

The testing was conducted using a production scale 550 ft^2 pressure leaf filter as constant rate filtration. A variety of different filter aids were tested and the flow rate was varied from 0.2 to 0.75 gpm/ft^2.

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1) Effect of Inlet Fe Concentration and Type of Filter Aid Used - The inlet Fe concentration averaged 2.32 ppm during this testing and the outlet Fe concentration averaged ~1.25 ppm (without MgO addition). Below 1.5 ppm inlet Fe concentration, the outlet Fe concentration was normally in spec. This agrees with Midland Division testing and was true for cellulosic or Perlite filter aids. Above 1.5 ppm inlet Fe level, the outlet Fe level was seldom in spec. These results are shown by Table 2 for using DIC 476 as the precoat and body feed or in Tables 1, 3, and 4 for using cellulosic filter aids as the precoat and body feed or combinations of cellulosics and Perlites. In general, iron removal was to levels ~50% of the inlet concentration for any filter aid tested.

It has been suggested that the cellulosic filter aids (JM BH 40) have an absorptive property based on lab testing by the Midland Division.[4] Lab testing using a buchner funnel was conducted to duplicate the results using the cellulosics with Fe levels as low as 0.2 ppm obtained in the filtrate. The results are shown by Table 5. However, by the same testing method, but using DIC 436, the Fe concentration was 0.26 ppm in the filtrate. Testing using the lab "bomb" filter also showed similar iron removal for DIC 436 as for JM BH 40. These results are shown by Table 6. From these results and the plant scale testing, it appeared that a certain particle size removal by filtration was occurring rather than absorption. Representatives of the Brown Company (Solka Floc BW 40) and Johns Manville Company (JM BH 40) were consulted about any possible absorptive or adsorptive property of the cellulosics for iron removal. The Brown Company representatives indicated that iron removal by the cellulosics should be by filtration rather than by adsorption because the cellulose fibers do not carry a surface charge.[5] However, the Johns Manville Company indicated that cellulosics did carry a negative charge and could have chemi-adsorptive properties.[6] They felt, however, that the bulk of the iron removal was by filtration to a certain particle size. Tests performed by the Dicalite Company using uniform particle size test slurries have shown that (1.) DIC 476 would remove particles down to ~0.65 microns, (2.) DIC 436 would remove to ~0.5 micron size particles, and (3.) DIC 416 would remove to ~0.2 micron size particles.[7] Such data was not available for the cellulosics.

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2) Use of MgO - Due to the high (>1.5 ppm) inlet Fe concentration for the Louisiana Division Caustic Plant, using MgO would be required to keep the outlet iron concentration in spec. Pilot scale testing done by the Midland Division adding MgO as ~6 to 12% of the precoat weight had been effective using a diatomite.[8] These results, however, indicated shorter cycles or possible blinding. The plant scale testing was done using the Perlites (DIC 476 and 436) and the amount of MgO added to the precoat was varied. The MgO was also added to the body feed. Several cycles were also run to determine if blinding was occurring. The results obtained are shown in Tables 7 - 12. The data showed that adding 10 to 20% of precoat weight as MgO would reduce the outlet iron levels to well within spec even with inlet iron concentrations of ≯3 ppm. This is shown by Tables 10 and 11.

Adding 2 to 3 ppm MgO as body feed also reduced the outlet iron concentration low enough to be in spec as shown by Tables 7, 8, and 9. The combination of using ~10% of the precoat as MgO with 2 to 3 ppm MgO in the body feed also reduced the outlet iron concentration as shown by Table 10. The outlet iron in the testing using the combination should have been in spec anyway. The total quantity of MgO added to the body feed tank was approximately the same amount added to the precoat for an effective dosage in both cases.

The possibility of decreased cycle times or blinding was investigated using MgO in a total of 34 runs. The results obtained showed that blinding was not a significant problem when MgO was added in the body feed at the low concentrations specified. This is shown by Tables 7, 8, and 9. It would seem that adding MgO as part of the body feed would probably protect against blinding better than adding it in the precoat. The data obtained adding MgO in the precoat using DIC 476 in 10 runs did not show any significant reduction in cycle time, however, data obtained adding MgO in the precoat using DIC 436 indicated some possible blinding. These results are shown by Tables 10 and 11. The outlet asbestos, silica, Ca, and Mg concentrations using MgO showed no significant difference from data without using MgO.

C) Outlet Silica Concentration - The outlet silica concentration was normally in spec (100 ppm Si in 50% NaOH or ≦ 16 ppm in 8% NaOH). Using cellulosic filter aids as the precoat and body feed gave the best results. This was because they contained no silica for the cell effluent to leach out. The use of a cellulosic precoat with a Perlite body feed gave good results but showed a slight silica pick-up, and the outlet concentrations were normally in spec although on the high end of the range. These results are shown by Table 1.

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D) Turbidity - The inlet turbidity varied from ~5 FTU to ~65 FTU depending on the quality of the cell effluent coming into the Caustic Plant and the tank levels. The inlet turbidity averaged 15 FTU which would represent ~24 ppm total suspended solids. The outlet turbidity averaged 0.5 FTU for the majority of the filter aids tested. The outlet turbidity obtained is also dependent on the body feed ratio as shown by Graph 1.

E) Ca and Mg Concentrations - The inlet Ca concentrations averaged 7 ppm with ~3 ppm Ca obtained in the filtrate. The Mg concentration in the filtrate was always <1 ppm. These results are also shown by Table 1. The Ca removal may possibly result in a reduction in evaporator fouling.

II. Cycle Times - The cycle times were found to depend on the same variables as discussed in Part 2 which were the following:

A) Body Feed Ratio - The optimum body feed ratio for cycle lengths was 3 or 4 to 1 as shown by Tables 13, 14, 16, 17, and 18, and graphs 2 and 4. This was determined in lab testing and plant testing. The results agreed with the testing done on trench liquor as shown by graph 5. Again it should be noted that a higher body feed ratio would be required at 0.75 gpm/ft^2 to obtain 8 hour cycles than for 0.5 gpm/ft^2 flow rate. This also depends on the inlet turbidity, but the use of less body feed at lower flow rates to obtain the same throughput as at higher feed rates is reported in literautre.[9]

B) Inlet Turbidity - The inlet turbidity as a measure of the total suspended solids concentration has a significant effect on the cycle times obtained with all other variables held constant. The effect of turbidity on the cycle times is shown by graph 6 for DIC 476 used as the precoat and body feed. The general trend obtained agreed well with the Midland Division testing and testing done on trench liquor. However, the cycle times obtained for any given inlet turbidity were shorter for the evaporator feed testing than for the trench liquor testing. The difference could be due to the characteristics of the solids being different in the two streams or to some other variable. The cycle lengths obtained after replacing the filter bags the first time agreed well with the trench liquor testing. However, after replacing the filter bags a second time, the somewhat shorter cycles were obtained than were expected for the turbidity range of the feed. Perhaps the filter cloth used the second time was somewhat different. There was no noticeable change in the analysis of the filter feed that could have caused the difference.

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C) Filter Aid - The type of filter aid used has a significant effect on the cycle times obtained just as it has a significant effect on the clarity obtained. These effects have been explained in previous reports and literature.[10] Lab testing was conducted to determine the relative flow rate, or cycle length at a given flow rate, that could be obtained using various filter aids. The results obtained agreed well with earlier testing by Midland Division in the relative flow comparison for the different filter aids.[11] This is shown by Tables 19 and 20 and graphs 7 - 10. The same trends held true in the plant testing as shown by Tables 21 - 23. Slightly longer cycles were obtained for DIC 476 than for DIC 436 or DIC 416. Also, slightly longer cycles were obtained for Solka Floc BW 40, a cellulosic, than for any of the Perlites.

D) Filtration Rate - Data were obtained at 0.75, 0.5, and 0.2 gpm/ft^2 feed rates as shown by Tables 13 - 15. At 0.75 gpm/ft^2 flow rates cycle lengths of ~6 hours were obtained at 3 to 1 body feed ratios, inlet turbidities of ~15 FTU, using DIC 476 as the precoat and body feed. At the same conditions, but at ~6 FTU inlet turbidity, cycle lengths of 10 hours were obtained. At the same conditions as above, except for using a 0.5 gpm/ft^2 flow rate, cycle lengths of 10 to 12 hours were obtained depending on the inlet turbidity. Operating at a 0.5 gpm/ft^2 seemed to guarantee longer cycles with less dependence on the inlet turbidity than for 0.75 gpm/ft^2. However, when the feed turbidity was low (~8 FTU), there was no advantage to operating at 0.5 gpm/ft^2. The cycle lengths obtained at 0.2 gpm/ft^2 were not significantly longer and there would be no advantage to operating below 0.5 gpm/ft^2 feed rates.

The choice of the design flow rate must consider the additional filter area required for operating at 0.5 gpm/ft^2 versus 0.75 gpm/ft^2, the filter aid costs, and the cycle lengths obtained. Since the feed turbidity averaged 15 FTU, cycle times of ~6 hours at 0.75 gpm/ft^2 must be considered. In doing so, the filter aid costs for operating at 0-5 gpm/ft^2 are somewhat cheaper despite the additional area and precoat required. The filter aid costs to obtain 8 hour cycles would also be cheaper at 0.5 gpm/ft^2 than at 0.75 gpm/ft^2 due to the difference in body feed ratios needed to obtain 8 hour cycles at the two flow rates. Although the data are not as clear cut for the evaporator feed filtration as for the trench liquor filtration, 0.5 gpm/ft^2 feed rates would be recommended for both.

III. Filter Aid Selection - A Perlite filter aid, Dicalite 476 or 436, would be recommended as the precoat and body feed to minimize filter aid costs. The Perlites also demonstrated acceptable or equivalent outlet clarity to that obtained using a cellulosic precoat with a Perlite or diatomite body feed. MgO addition to the precoat or body would be required to keep the outlet iron concentration in spec when the inlet iron concentration is >1.5 ppm. For plants with existing iron cells, the use of MgO would be optional.

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IV. Filter Aid Costs - By using the Perlite filter aids as the precoat in place of cellulosic filter aids, the costs can be significantly reduced. The filter aid costs for filtering the evaporator feed cell effluent stream was estimated to be ~$90,000/year. These costs were based on the following: (1) using Perlites (DIC 476 or 436) as the precoat and body feed at 5¢ /pound cost, (2) using a 3 to 1 body feed ratio, (3) an average inlet turbidity of 15 FTU (~24 ppm total suspended solids), (4) 3000 gpm flow rate of evaporator feed cell effluent, (5) using four 1600 ft^2 filters with a feed rate of 0.5 gpm/ft^2, and (6) obtaining 8 hours as the minimum cycle length. These calculations are given in the Appendix.

V. Sluice Disposal - Three possible methods for handling the sluice disposal were considered depending on the liquid used to sluice the filters. The data obtained were preliminary for indicating major problems. The results and descriptions of the methods are presented by the following:

A) Cell Effluent Sluice - This system is shown by Figure 1. In this method, the filter volume and sluice would be sent to a small settler with the overflow returned to the filter feed tank. The concentrated sludge from the bottom of the settler would be filtered using a rotary drum vacuum filter to obtain a dry cake discharge. The filtrate would be returned to the settler. Settling rate data were obtained to determine the approximate residence time required. The data are shown by graph 11 which indicates that a settling rate of ~ 0.6 inches/minute was obtained. The solids would begin compaction after ~ 20 minutes. The clarity of the clear liquid was not good after 30 minutes settling time. This data was obtained for a 3% wt. slurry. The solids concentration from the sparkler filters, based on 2560 gallon sluice and ~3000 gallon filter volume, would be ~ 1% wt. Preliminary data were obtained for filtering the concentrated solids from the settler by simulating a rotary drum vacuum filter with the lab vacuum leaf filter. Filtering a ~3 to 5% solids by weight slurry gave filtration rates of ~ 0.4 gpm/ft^2 at a 3 minute/revolution drum speed. The cake thickness was only ~1/64" however. The data was obtained using DIC 476 as a precoat. The filtrate turbidity was ~5 FTU. These results are shown by Table 24.

B) H_2O Sluice - This scheme is shown by Figure 2. In this method, the filter volume would be displaced using an air blowback with the liquid returned to the feed tank. The sluice liquid, containing ~1% wt. solids, would then be sent to a settler to concentrate the solids. The sludge would again be handled by a rotary drum filter. The overflow H_2O would be used to slurry the solid salt sent back to the brine treating saturator. The settling rate data obtained was slightly better than for cell effluent as shown by graph 11. The turbidity of the overflow after 30 minutes was

still not as good as desired (33 FTU). The preliminary data for rotary drum vacuum filtration is shown by Table 25. Filtering 5 to 7% by weight solids at a 3 minute/revolution drum speed using DIC 476 as the precoat gave flow rates of ~0.4 gpm/ft^2. The cake thickness was~3/16" with 60% wt. dry solids in the cake. The filtrate clarity was ~ 6 FTU.

C. Brine Sluice - Again, an air blowback system would be used to displace the filter volume sending it back to the feed tank. Then, the filters would be sluiced with brine. Handling the brine sluice gives two methods for disposal as described below:

1) The first alternative is similar to sluicing with water or cell effluent as shown by Figure 3. The major difference is that the overflow from the settler would again be used to slurry the solid salt returned to the brine treating saturator. The settling rate data with brine is shown by graph 11. The settling rate in brine was slower than in water or cell effluent at~0.35" /minute, however, the clarity after 30 minutes settling time was better (9 FTU). The preliminary filtration data handling a sludge concentration of~10% wt. solids showed ~0.15 gpm/ft^2 filtration rate using DIC 476 as the precoat at a 3 minute/revolution drum speed. The cake thickness obtained was 1/8" with~60% dry solids in the cake. The filtrate clarity was~6 FTU. The data obtained are shown in Table 26.

2) A second alternative is the same as the first except that the sluice would be collected in a tank and pumped at a continuous rate (~65 gpm) for the Caustic Plant to be mixed with the brine treating sludge from the Chlorine Plant and the Chlor-Alkali II Plant. The sludge would then be sent to the secondary settler at the Chlor-Alkali I Plant. The clears from the settler would be recycled back to brine treating. The sludge from the settler would be filtered using a plate and frame filter and the dry cake would be hauled to the brine wells for disposal. This system is shown by Figure 4. This method would make use of some existing equipment. The amount of solids from the cell effluent filter sluices from the Caustic and the Chlor-Alkali II Plants would not be appreciable in comparison to the brine treating sludge (~5 to 10 tons/day sluice solids vs. ~75 tons/day brine treating sludge). The settling rate data obtained for combining brine treating sludge and cell effluent filter sluice is shown by graph 12.

The data obtained showed that the settling rate would be mainly controlled by the brine treating sludge. The overflow clarity after 30 minutes was good (~9.5 FTU) in comparison to the clarity of the brine treating sludge only (28 FTU). Data was obtained for brine treating sludge using a plate and frame filter by Flash Howard of the Chlor-Alkali II Plant.[12] This data included filtration rate data and clarity data. The clarity data showed asbestos removal from ~20 ppm to 0.01 ppm

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or 99+% removal. The asbestos data are shown by Table 27, and filtration rate data in the Appendix.

Of the possible sluice disposal methods, method no. 3 (brine sluice) would be preferred. The use of the second alternative of method no. 3 would make use of an existing clarifier and combine the asbestos solids with the brine treating sludge needed to cause the asbestos to settle when injected in the brine wells.

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ECOLOGICAL CONSIDERATIONS

The techniques advocated in this report will eliminate asbestos from the cell effluent stream and 50% NaOH. The sluice system recommended would be a closed liquid loop with the solids disposal by injecting into the brine wells. Both of these methods are ecologically suitable methods.

ACKNOWLEDGEMENTS

Rick Wittman and other Caustic Plant personnel operated the filter system and were very helpful in obtaining the data presented in this report. Dave Naessens of the Midland Division was helpful in comparing the data with the pilot scale testing.

REFERENCES

[1] Dicalite Industrial Filtration Manual, p. 14

[2] EMR-LR-120

[3] EMR-LR-120

[4] EMR-LR-121

[5] Reed, Clyde, District Sales Manager for SOLKA FLOC, personal communication.

[6] Douthit, Duane, Sales Engineer for Johns-Manville, personal communication.

[7] Dicalite Industrial Filtration Manual, p. 14.

[8] EMR-LR-120

[9] Johns-Manville Celite Filter Aid Filtration, p. 12.

[10] EMR-LR-120

[11] EMR-LR-116

[12] Flash Howard, personal communication (Letter and data presented in Appendix.)

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FIGURE # 1

CELL EFFLUENT SLUICE

ALTERNATIVE

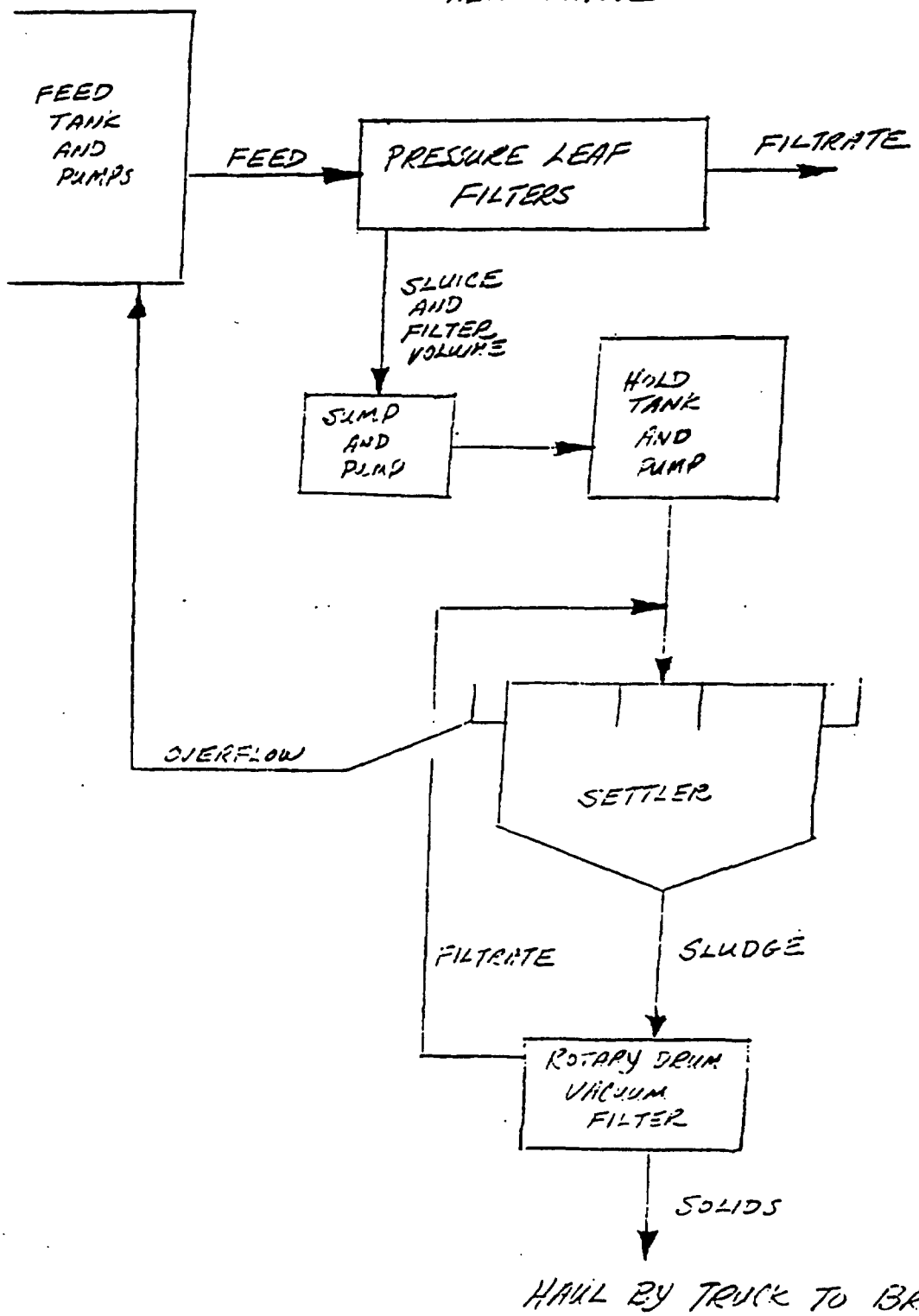

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FIGURE #2

H_2O SLUICE ALTERNATIVE

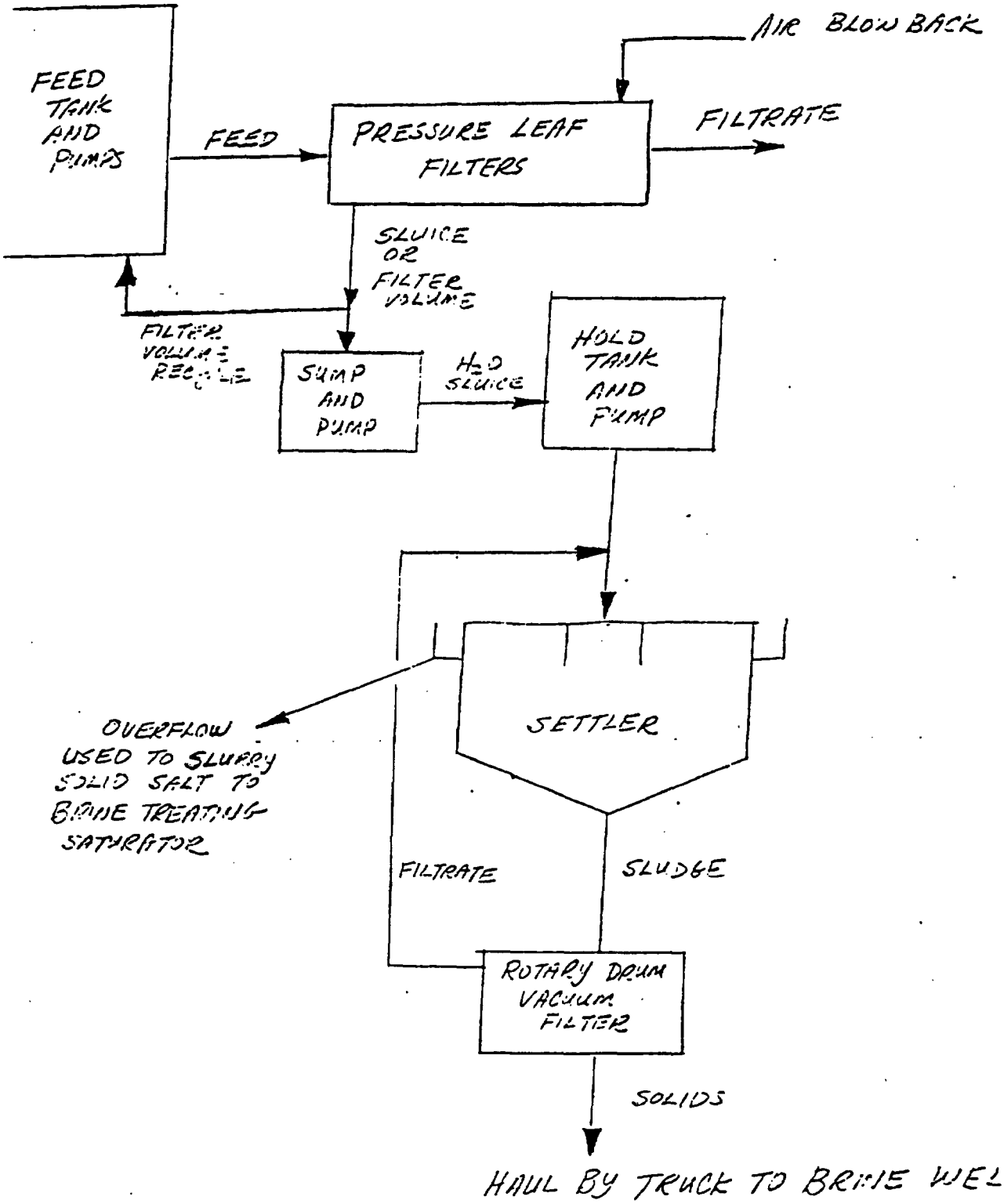

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FIGURE #3

BRINE SLUICE

RECOMMENDED

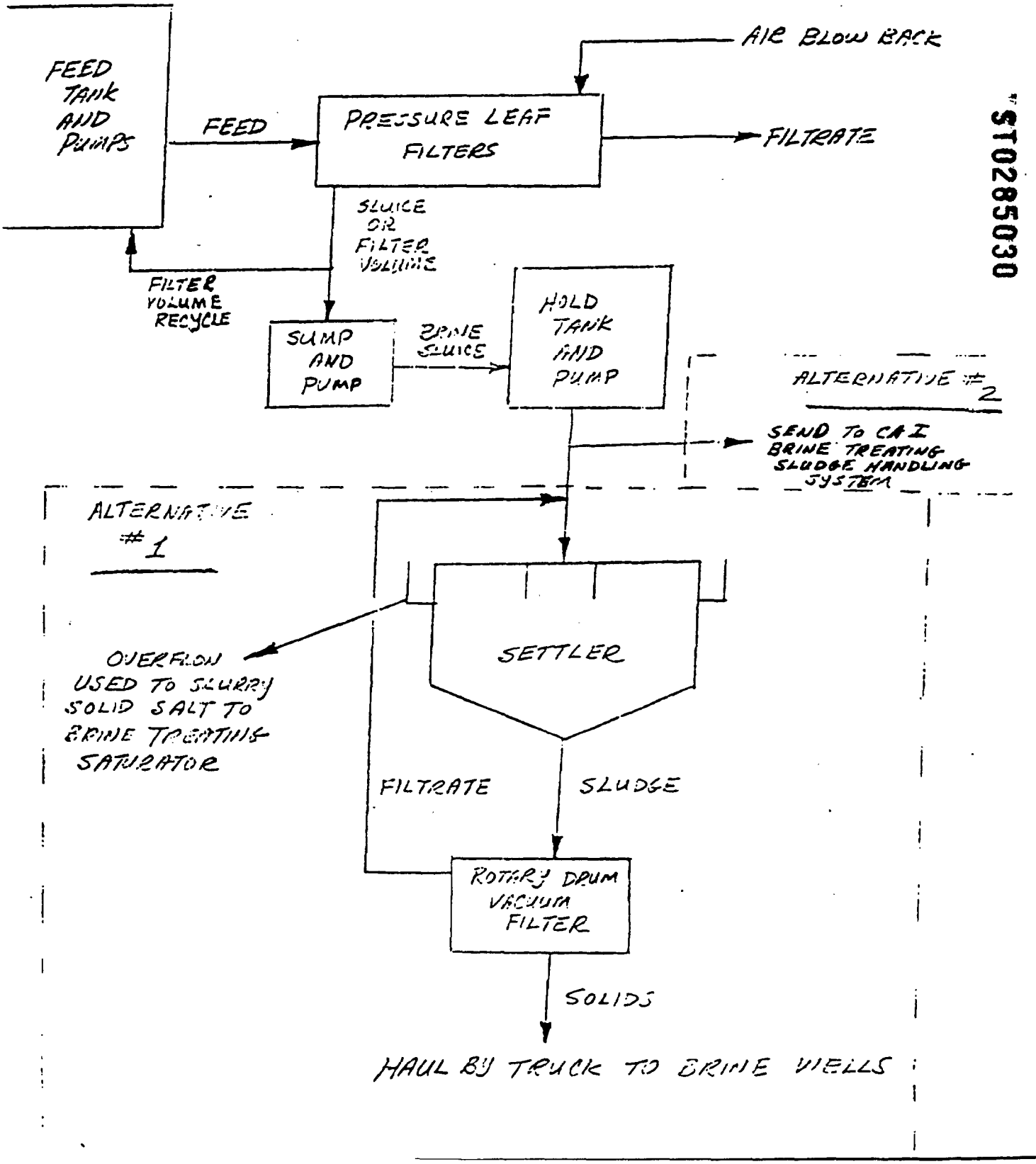

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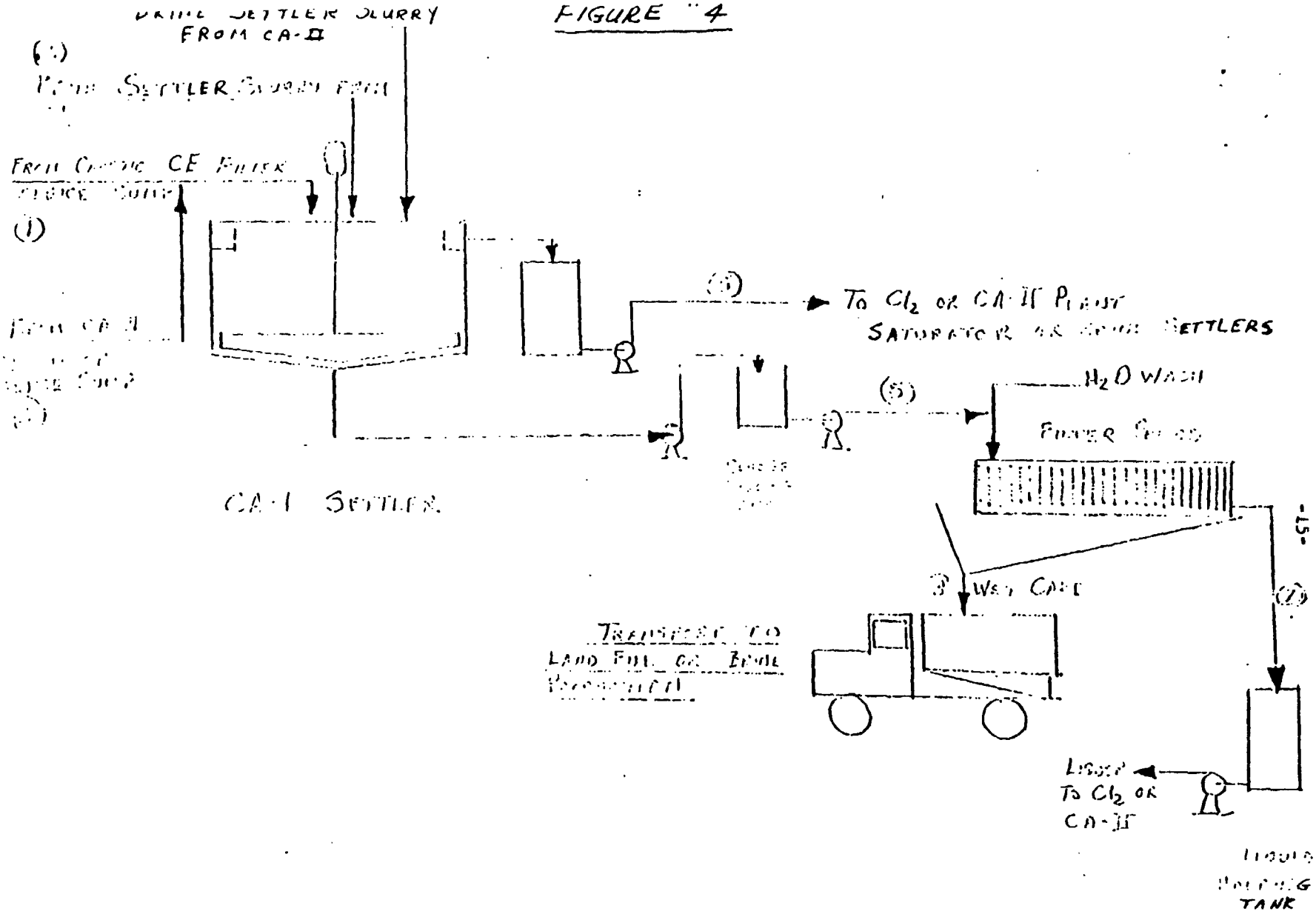
FIGURE 4



DISPOSAL

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LOUISIANA DIVISION
DATA SHEET

TABLE # 1 EVAPORATOR FEED FILTRATION

OUTLET CLARITY VERSUS FILTER AID TYPE

	PRECOAT TYPE	BODY FEED TYPE	AVERAGE ppm ASBESTOS IN	AVERAGE ppm ASBESTOS OUT	AVERAGE ppm Silica IN	AVERAGE ppm Silica OUT	AVERAGE ppm Fe IN	AVERAGE ppm Fe OUT	AVERAGE % Fe REMOVAL	AVERAGE ppm Ca IN / OUT	AVERAGE ppm Mg IN / OUT
PERLITES	DIC476	DIC476	1.52	0.02	7	14	2.1	1.1	46	9 / 3	2 / <1
	DIC436	DIC436	–	0.04	8	16	3.2	1.6	50	—	—
CELLULOSIC PRECOAT AND PERLITE BODY FEED	JMBH40	DIC476	2.5	0.05	7	11	2.1	1.7	20	11 / 3	4 / <1
	"	DIC436	1.05	0.03	8	10	2.7	1.6	40	9 / 3	2 / <1
	"	DIC416	2.4	0.01	6	16	1.9	0.7	63	10 / 3	2 / <1
	SOLKA FLOC BW40	DIC476	1.2	0.01	5	11	1.2	0.9	25	4 / 2	1 / <1
	"	DIC436	1.8	0.02	7	11	2.6	1.3	50	—	—
CELLULOSIC PRECOAT AND DIATOMITE BODY FEED	JMBH40	JM HYRO SUPERCEL	2.5	0.04	8	17	3.1	2.0	37	7 / 2	3 / <1
	"	DIC215	3.2	0.03	7	21	3.2	2.1	35	—	—
	SOLKA FLOC BW40	JM HYRO SUPERCEL	1.4	0.02	5	11	3.2	1.0	68	—	—
CELLULOSIC	JMBH40	JMBH40	2.5	0.04	6	5	1.7	1.0	45	—	—
	SOLKA FLOC BW40	SOLKA FLOC BW40	2.9	0.04	7	6	1.8	0.9	51	7 / 4	3 / <1
10 to 20% OF PRECOAT WAS MgO	DIC476	DIC476	1.64	0.04	7	15	2.55	0.57	77	12 / 2	4 / <1
2 to 3 ppm MgO AS BODY FEED	DIC476	DIC476	1.22	0.01	7	14	1.5	0.42	72	4 / 3	1 / <1

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DATA SHEET EVAPORATOR FEED FILTRATION

TABLE # 2

IRON REMOVAL USING DIC 476 PRECOAT AND BODY FEED

RUN #	BODY FEED RATIO	ppm Fe IN	ppm Fe OUT	% IRON REMOVAL	REMARKS
149	5.9	0.3	0.3	0	
151	5.5	0.4	0.4	0	
148	3.1	0.6	0.3	50	
131	3.7	0.67	0.29	57	
154	2.5	0.70	0.50	30	
150	0	0.97	0.70	28	
138	8.8	1.39	0.60	57	
135	5.5	1.39	1.15	20	
137	3.4	1.48	0.59	60	
125	3.0	1.50	0.89	40	
130	2.7	1.55	0.44	61	← ≤ 1.5 ppm Fe IN THE OUTLET ppm Fe WAS NORMALLY IN SPEC
153	3	1.60	1.0	38	
128	4.5	1.70	0.59	65	
155	2.2	1.70	1.30	25	
134	4.0	1.88	1.24	35	
136	3.4	2.07	1.06	49	
132	4.6	2.2	1.3	41	
139	8.8	2.7	1.6	41	
133	2.3	3.08	1.7	45	
79	3.5	3.7	2.1	43	
78	1.4	3.9	2.3	42	
AVG	3.8	1.73	0.96	44.5%	

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TABLE # 2A DATA SHEET TRENCH LIQUOR FILTRATION

IRON REMOVAL USING DIC 476 PRECOAT AND BODY FEED

RUN #	BODY FEED RATIO	PPM Fe IN	PPM Fe OUT	% IRON REMOVAL								ST0285034
40	6.6	0.9	0.8	12								
29	3.5	1.2	1.1	10								
28	6.1	1.6	0.2	88								
26	9.2	1.9	0.9	53								
27	12.2	2.1	0.7	67								
29A	3.3	2.1	1.1	48								
34A	1.4	2.8	0.9	64								
24	9.5	3.2	1.4	56								
25	20.0	3.9	1.6	59								
23	5.8	4.0	1.6	60								
33	7.4	4.2	2.1	50								
34	2.7	4.9	1.0	80								
AVG	7.5	2.73	1.12	59								

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TABLE #3

DATA SHEET EVAPORATOR FEED FILTRATION

IRON REMOVAL USING SOLKAFLOC BW40 AS PRECOAT · VARIOUS BODY FEED TYPES

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RUN #	BODY FEED MATERIAL	BODY FEED RATIO	PPM Fe IN	PPM Fe OUT	% IRON REMOVAL	REMARKS
84	DIC 476	2.5	1.1	1.0	9	BODY FEED
85	DIC 476	6.3	1.2	0.9	25	PERLITE FILTER AID
89A	DIC 436	2.4	1.43	0.7	51	
141	DIC 436	3.0	2.5	1.2	52	BODY FEED
142	DIC 436	2.7	2.9	1.5	48	PERLITE FILTER AID
140	DIC 436	2.3	3.5	2.0	43	
AVG	DIC 436	2.6	2.6	1.35	47	
86	JM HYDRO SUPERFL	1.8	1.63	1.0	38	BODY FEED
87	JM HYDRO SUPERCEL	2.5	4.9	1.07	88	DIATOMITE FILTER AID
121	SOLKA FLOC BW40	1.9	1.19	0.83	30	
122B	SOLKA FLOC BW40	5.6	1.4	0.58	59	
83	SOLKA FLOC BW40	4.8	1.43	0.71	50	BODY FEED
82	SOLKA FLOC BW40	2.1	1.87	1.6	9	CELLULOSIC FILTER AID
122A	SOLKA FLOC BW40	4.1	3.2	0.84	74	
AVG	SOLKA FLOC BW40	3.7	1.8	0.9	50	

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LOUISIANA DIVISION
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TABLE # 4 EVAPORATOR FEED FILTRATION

IRON REMOVAL USING JMBH40 PRECOAT WITH VARIOUS BODY FEED TYPES

RUN #	BODY FEED MATERIAL	BODY FEED RATIO	PPM Fe IN	PPM Fe OUT	% IRON REMOVAL	REMARKS
125	DIC476	3	1.5	0.89	41	BODY FEED
77	DIC476	2.3	2.6	1.76	33	PERLITE FILTER AID
76	DIC476	1.3	2.97	1.9	36	
124	DIC436	4.5	1.4	0.9	36	BODY FEED
143	DIC436	2.4	2.3	1.2	48	PERLITE FILTER AID
144	DIC436	1.9	4.5	2.8	38	
126B	JM HYFLO SUPER CEL	2.2	2.4	1.4	42	
80	JM HYFLO SUPER CEL	1.2	3.3	2.4	37	BODY FEED
126A	JM HYFLO SUPER CEL	0.8	3.5	1.2	66	DIATOMITE FILTER AID
81	JM HYFLO SUPER CEL	4.6	4.3	2.0	53	
75	JM BH40	4.2	1.18	1.17	1	BODY FEED
74	JM BH40	2.3	1.58	0.92	42	CELLULOSIC FILTER AID
123	JM BH40	2.5	2.4	0.75	68	

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TABLE #5 EVAPORATOR FEED FILTRATION

IRON REMOVAL

LAB FILTRATION USING 10cm BUCHNER FUNNEL AND GLASS WARE

ST0285037

RUN #	FILTER SEPTUM	FILTER AID MATERIAL	grams FILTER AID USED	VOLUME FILTERED, ml	TEMP °C	ppm Fe FEED	ppm Fe FILTRATE	REMARKS
1	NO 32 FILTER PAPER	0	0	600	65	2.8	0.69	
2	"	JMBH40	1.6	"	"	"	0.17	CELLULOSIC
3	"	JMBH40	0.6	"	"	"	0.25	
4	"	DIC436	1.25	"	"	"	0.27	PERLITE
5	"	DIC 436	0.6	"	"	"	0.31	
6	POLYPROP.* SCREEN	JMBH40	3.6+	"	"	"	0.24	CELLULOSIC

+ 3.6 grams = 0.1 #/ft² precoat

*SAME TYPE USED ON PLANT SCALE FILTER
~82 CFM AIR PERMEABILITY

THE DOW CHEMICAL COMPANY
LOUISIANA DIVISION

TABLE #6 DATA SHEET EVAPORATOR FEED FILTRATION IRON REMOVAL

3 FILTRATION USING "BOMB" (PRESSURE LEAF) FILTER

RUN #	FILTER AID MATERIAL	BODY FEED RATIO	TIME, MIN	TOTAL FILTRATE VOLUME, * ml	CAKE THICKNESS AT END	FEED TURBIDITY, FTU	FILTRATE TURBIDITY, FTU	FEED ppm Fe	FILTRATE ppm Fe	REMARKS
105	JM8HA	3.7	3	380	1/16"	10	1.1	0.75	0.20	CELLULOSIC
			6	500						
			9	590						
			12	670						
			15	740						
			18	805						
			21	850						
106	SOLKA FLOCBW4	3.7	3	620	1/16"	10	1.4	0.75	0.45	CELLULOSIC
			6	760						
			9	870						
			12	960						
			15	1030						
			18	1100						
			21	1170						
107	DIC476	3.7	3	480	1/16"	10	0.5	0.75	0.12	PERLITE
			6	600						
			9	710						
			12	810						
			15	890						
			18	970						
			21	1050						

* DATA FOR CONSTANT PRESSURE OF 10 PSIG, 0.5" LEAF DIAMETER, 45°C TEMP

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LOUISIANA DIVISION

ST0285039

TABLE # 7 DATA SHEET IRON REMOVAL

• DIC 476 PRECOAT AND BODY FEED

USING MgO IN THE BODY FEED . @ 0.75 gpm/ft²

RUN #	lbs MgO ADDED TO PRECOAT	lbs MgO ADDED TO BODY FEED TANK	CYCLE TIME hr, min	ppm Fe IN / ppm Fe OUT	ppm Asbestos IN / ppm Asbestos OUT	MFL Asbestos IN / MFL Asbestos OUT	ppm Si IN / ppm Si OUT	ppm TSS IN / ppm TSS OUT	FTU TURBIDITY IN / FTU TURBIDITY OUT	ppm BODY FEED DIC 476 / ppm MgO IN BODY FEED	BODY FEED RATIO	% NaOH / % NaCl
133	0	0	5hr 25min	3.08 / 1.7	—	—	—	28 /	19 / 0.5	65 / 0	2.3	—
130	"	0	4hr 30min	1.55 / 0.44	1.82 / 0.02	/ 180	6 / 14	20 /	14 / 0.4	55 / 0	2.7	—
110A	"	2.5	4hr	—	—	—	—	— / —	— / —	— / —	—	— / —
110B	"	2.5	4hr 15min	2.8 / 1.4	—	—	—	24 /	16 / 1	58 / 1	2.4	7.6 / 14
116	"	5	4hr 30min	2.0 / 0.76	—	—	—	24 /	16 / 1	50 / 1.7	2.1	7.9 / 15
117	"	10	10hr	1.6 / 0.36	1.22 / 0.01	/ 80	9 / 17	15 /	10 / 0.6	45 / 3	3.0	— / —
112	"	10	4hr 20min	—	—	—	—	— / —	— / —	— / —	—	— / —

TABLE # 8

SAME CONDITIONS AS ABOVE @ 0.5 gpm/ft²

151	0	0	11hr 35min	0.4 / 0.4	0.57 / —	/ —	5 / 15	11 /	7 / 0.7	/ 0	5.5	7.99 / 14.6
152	"	0	10hr 5min	—	—	—	—	12 / —	8 / —	— / 0	4.4	—
159	"	5	8hr 45min	—	—	—	—	12 /	8 / —	60 / 2	5	—
160	"	5	10hr 15min	1.41 / 0.48	1.47 / —	/ —	5 / 11	12 /	8 / 1.2	52 / 2	4.3	—

THE DOW CHEMICAL COMPANY
LOUISIANA DIVISION

ST0285040

TABLE # 9 DATA SHEET IRON REMOVAL

DIC 436 PRECOAT AND BODY FEED

SING MgO IN THE BODY FEED. @ 0.5 gpm/ft²

Run #	lbs MgO ADDED TO PRECOAT	lbs MgO ADDED TO BODY FEED TANK	CYCLE TIME hr, min	PPM Fe IN / PPM Fe OUT	PPM Asbestos IN / PPM Asbestos OUT	~MFPL Asbestos IN / ~MFPL Asbestos OUT	PPM Si IN / PPM Si OUT	PPM TSS IN / PPM TSS OUT	FTU TURBIDITY IN / FTU TURBIDITY OUT	PPM BODY FEED DIC 436 / PPM MgO IN BODY FEED	BODY FEED RATIO	% NaOH / % NaCl
164	0	5	5hr 5min	0.87 / 0.44	—	—	—	17	11 / 0.7	105 / 3.5	6.2	7.6 / 14.8
165	"	5	9hr	1.52 / 0.68	—	—	—	15	10 / 0.7	52 / 1.7	3.5	—
166	"	5	9hr 15min	0.63 / 0.59	—	—	—	8	5 / 0.8	35 / 1.2	4.4	—
167	"	5	10hr 5min	0.6 / 0.6	—	—	—	6	4 / 0.5	60 / 2	10	—
168	"	5	8hr 45min	0.95 / 0.63	—	—	—	17	11 / 1.3	68 / 2.2	4	—
169	"	5	9hr 50min	1.37 / 0.56	1.76 / 0.09		6 / 16	21	14 / 1.2	64 / 2	3	—
171	"	5	8hr 45min	1.51 / 0.9	—	—	—	18	12 / 1.1	53 / 1.7	2.9	—
177	"	5	9hr 15min	— / —	—	—	—	27	18 / —	68 / 2.2	2.5	—

THE DOW CHEMICAL COMPANY
LOUISIANA DIVISION
DATA SHEET

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TABLE # 10 IRON REMOVAL

• DIC 476 PRECOAT AND BODY FEED

USING MgO IN THE PRECOAT. @ 0.75 gpm/ft²

RUN #	lbs MgO ADDED TO PRECOAT	lbs MgO ADDED TO BODY FEED	CYCLE TIME hr, min	PPM Fe IN / PPM Fe OUT	PPM Asbestos IN / PPM Asbestos OUT	~MFPL Asbestos IN / ~MFPL Asbestos OUT	PPM Si IN / PPM Si OUT	PPM TSS IN / PPM TSS OUT	FTU TURBIDITY IN / FTU TURBIDITY OUT	PPM BODY FEED	BODY FEED RATIO	% NaOH / % NaCl
133	0	0	5hr 25min	3.08 / 1.7	—	—	—	28	19 / 0.5	65	2.3	—
130	0	"	4hr 30min	1.55 / 0.44	1.82 / 0.02	/ 180	6 / 14	20	14 / 0.4	55	2.7	—
115	2½	"	3hr 45min	2.9 / 1.2	—	—	—	30	20 / 0.2	55	1.8	—
113	5	"	3hr 15min	31 / 0.59	1.64 / 0.04		8 / 19	37	25 / 0.3	90	2.4	7.7 / 19.5
156	5	"	3hr 20min	1.57 / 0.79	—	—	—	12	8 / 1.2	40	3.3	—
114	10	"	1hr 15min	4.4 / 0.25	—	—	—	44	30 / 0.2	100	2.3	—
157	10	"	5hr 10min	1.13 / 0.76	1.05 / 0.06		6 / 11	12	8 / 0.4	40	3.3	—

TABLE # 11

SAME AS ABOVE EXCEPT USING DIC 436 @ 0.5 gpm/ft²

172	5	0	1hr 45min	2.83 / 0.5	—	—	—	36	24 / 1.9	93	2.6	—
173	5	"	2hr	—	—	—	—	30	20 / —	80	2.7	—
174	5	"	1hr	2.9 / 0.76	—	—	—	27	18 / 2.3	60	2.2	—
175	5	"	2hr	1.61 / 0.48	—	—	—	18	12 / 1.5	50	2.8	—
176	5	"	3hr 35min	—	—	—	—	27	18 / —	60	3.3	—

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TABLE # 12 DATA SHEET IRON REMOVAL

DIC 476 PRECOAT AND BODY FEED

USING MgO IN PRECOAT AND BODY FEED. @ 0.75 gpm/ft²

Run #	lbs MgO added to precoat	lbs MgO added to body feed	Cycle time hr, min	ppm Fe IN / ppm Fe OUT	ppm Al IN / ppm Al OUT	ppm Mn IN / ppm Mn OUT	ppm Si IN / ppm Si OUT	ppm TDS IN / ppm TDS OUT	FTU Turbidity IN / FTU Turbidity OUT	ppm Body Feed DIC 476 / ppm MgO in Body Feed	Body Feed ratio	% KOH / % NaOH
132	0	0	11hr 30min	2.2 / 1.3	0.77 / 0.02	180	8 / 14	12	8 / 0.5	0	4.6	.25 / 12.6
135	0	0	10hr 15min	1.39 / 1.15	—	—	—	10	6 / 0.8	55 / 0	5.5	8.1 / 11.2
145	5	2.5	9hr 50min	1.03 / 0.54	—	—	—	11	7 / 0.5	43 / 1	3.9	—
146	5	5	8hr 45min	1.17 / 0.62	—	—	—	12	8 / 0.8	38 / 1	3.2	—
123	5	5	11hr 5min	1.09 / 0.53	—	—	—	11	7 / 0.5	30 / 1	2.7	—
158	5	5	7hr 45min	0.96 / 0.8	—	—	—	8	5 / 0.3	35 / 1	4.4	7.9 / 15.5
147	5	10	8hr 30min	1.1 / 0.42	1.13 / 0.06		5 / 13	12	8 / 0.8	47 / 3	3.9	—

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LOUISIANA DIVISION

TABLE # 13 DATA SHEET @0.75gpm/ft² FEED RATE TO ΔP = 50psig

DIC 476 PRECOAT AND BODY FEED. @0.1 #/ft² PRECOAT

RUN #	BODY FEED RATIO	CYCLE TIME hrs, min	ppm ASBESTOS IN	ppm ASBESTOS OUT	ppm Fe IN	ppm Fe OUT	ppm Si IN	ppm Si OUT	TURBIDITY IN	TURBIDITY OUT	ppm TSS IN	% NaOH
78	1.4	10hr 40min	1.63	<0.01	3.85	2.31	9	13	29	0.8	43	6.4/14.6
133	2.3	5hr 25min	—	—	3.08	1.7	—	—	19	0.5	28	—
130	2.7	4hr 30min	1.82	0.02	1.55	0.44	6	14	14	0.4	20	—
79	3.5	10hr 40min	—	—	3.7	2.1	—	—	23	2.5	34	6.8/16
131	3.7	5hr 35min	—	—	0.67	0.29	—	—	10	0.3	15	6.7/12.3
134	4.0	6hr 35min	—	—	1.88	1.24	—	—	10	0.4	15	7.8/13
128	4.5	4hr	—	—	1.7	0.59	—	—	13	0.3	18	—
132	4.6	11hr 30min	0.77	0.02	2.2	1.3	8	14	8	0.5	12	7.5/12.6
135	5.5	10hr 15min	—	—	1.39	1.15	—	—	6	0.8	10	8.1/11.9

ST0285044

TABLE # 14 DATA SHEET @ 0.5 gpm/ft² FEED RATE TO ΔP = 50 PSIG

DIC 476 PRECOAT AND BODY FEED . @ 0.1 #/ft² PRECOAT

RUN #	BODY FEED RATIO	CYCLE TIME hrs, min	ppm ASBESTOS IN	ppm ASBESTOS OUT	ppm Fe IN	ppm Fe OUT	ppm Si IN	ppm Si OUT	TURBIDITY IN	TURBIDITY OUT	ppm TSS IN	% ALUM IN / % ALUM OUT
150	0	7hr 45min	0.74	0.03	0.97	0.7	5	11	5	1.0	7	—
155	2.2	3hr 45min	—	—	1.7	1.3	—	—	10	1.5	15	—
154	2.5	10hr 10min	—	—	0.7	0.5	—	—	7	0.6	11	—
153	3.0	8hr	—	—	1.6	1.0	—	—	8	0.8	12	7.9 / 16.7
148	3.1	10hr 45min	—	—	0.6	0.3	4	12	11	0.2	17	7.8 / A.
156	3.4	13hr 30min	—	—	2.07	1.06	—	—	15	0.7	22	—
157	3.4	7hr 30min	1.12	0.03	1.48	0.59	5	13	15	0.3	22	7.7 / 12.9
152	4.4	10hr 5min	—	—	—	—	—	—	8	—	—	—
151	5.5	11hr 35min	—	—	0.4	0.4	5	15	7	0.7	11	7.99 / 14.2
149	5.9	12hr 5min	—	—	0.3	0.3	—	—	7	0.5	11	—

TABLE # 15

SAME AS ABOVE EXCEPT @ 0.2 gpm/ft² FEED RATE

158	8.9	10hr	—	—	1.39	0.6	—	—	13	0.8	19	—
159	8.8	13hr 15min	—	—	2.7	1.6	—	—	14	0.5	20	9.3 / 15.2

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN
DATA SHEET

FOR DIC 476

TABLE # 16 OPTIMUM BODY FEED RATIO

@ 10 PSIG CONSTANT PRESSURE

@ 0.5" LEAF DIAMETER

3B FILTRATION OF EVAPORATOR FEED.

RUN #	FILTER AID MATERIAL	PPM BODY FEED	BODY FEED RATIO	TOTAL FILTRATE VOLUME, ML AFTER 21 MIN	CAKE THICKNESS AT END INCHES	FEED TURBIDITY, FTU	FILTRATE TURBIDITY, FTU	FEED PPM Fe	FILTRATE PPM Fe
97	0	0	0	1685	1/32	10	9.5	2.39	2.39
98	DIC 476	28	1.9	245	1/32	"	1.5	"	1.49
102	"	42	2.8	340	1/16	"	1.0	"	1.42
99	"	56	3.7	635	1/16	"	0.6	"	1.35
100	"	111	7.4	335	1/16	"	0.8	"	1.8

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THE DOW CHEMICAL COMPANY
CHEMICAL DIVISION
DATA SHEET

FOR JM BH 40

TABLE # 17 OPTIMUM BODY FEED RATIO

@ 5 PSIG CONSTANT PRESSURE

LAB FILTRATION OF EVAPORATOR FEED @ 0.956" LEAF DIAMETER

ST0285046

RUN #	FILTER AID MATERIAL	PPM BODY FEED	BODY FEED RATIO	TOTAL FILTRATE VOLUME, ml AFTER 21 MIN	CAKE THICKNESS AT END, INCHES	FEED TURBIDITY, FTU	FILTRATE TURBIDITY, FTU	FEED PPM Fe	FILTRATE PPM Fe
59	0	0	0	1650	1/32	10	—	1.87	—
52	JM BH40	56	3.5	1730	1/16	"	—	"	—
53	"	112	6.9	2140	1/8	"	—	"	—
54	"	167	10.4	2170	3/16	"	2.0	"	1.37
55	"	222	13.8	2295	1/4	"	—	"	—
56	"	278	17.3	2265	3/8	"	1.9	"	1.27
57	"	556	34.8	2120	1/2	"	—	"	—
58	"	834	52	2160	5/8	"	—	"	—

TABLE # 17A

SAME AS ABOVE EXCEPT USING DIC 436

59	0	0	0	1650	1/32	10	—	1.87	—
61	DIC 436	139	8.7	2010	1/16	"	—	"	—
60	"	278	17.3	2180	3/16	"	2.0	"	1.09

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

DATA SHEET

FOR SOLKA FLOC BW40

TABLE # 18

OPTIMUM BODY FEED RATIO

- @ 10 PSIG CONSTANT PRESSURE
- @ 0.5" LEAF DIAMETER

18 FILTRATION OF EVAPORATOR FEED

ST0285047

RUN #	FILTER AID MATERIAL	ppm BODY FEED	BODY FEED RATIO	TOTAL FILTRATE VOLUME, ml AFTER 21 MIN	CAKE THICKNESS AT END, INCHES	FEED TURBIDITY, FTU	FILTRATE * TURBIDITY, FTU	FEED ppm Fe	FILTRATE * ppm Fe
97	0	0	0	1685	1/32	10	9.5	2.39	2.39
94	SOLKA FLOC BW40	28	1.9	1010	1/16	"	6.8	"	1.78
90	"	56	3.7	785	1/16	"	3.8	"	1.53
95	"	84	5.6	940	1/16	"	6.0	"	1.46
96	"	112	7.5	785	1/8	"	5.1	"	1.06
101	** "	42	2.8	335	1/16	"	0.9	"	1.73

* THE FIRST 200 ml OF FILTRATE WERE NOT DISCARDED AS THE PROCEDURE CALLED FOR MAKING THE CLARITY DATA INACCURATE

** THE FIRST 200 ml OF FILTRATE WERE DISCARDED FOR THIS RUN

THE DOW CHEMICAL COMPANY
LOUISIANA DIVISION

TABLE #19 DATA SHEET COMPARISON OF FILTER AIDS

• @ 10 PSIG CONSTANT PRESSURE
• @ 0.5" LEAF DIAMETER

1B FILTRATION OF EVAPORATOR FEED

RUN #	FILTER AID MATERIAL	PPM BODY FEED	BODY FEED RATIO	TOTAL FILTRATE VOLUME, ml AFTER 21 MIN	CAKE THICKNESS AT END INCHES	FEED TURBIDITY, FTU	FILTRATE * TURBIDITY, FTU	FEED ppm Fe	FILTRATE * ppm Fe			
72	0	0	0	1110	1/32	10	10	2.39	2.39			
63	JM BH 40	222	13.8	735	3/16	"	5.5	"	2.2			
65	DIC 436	"	"	745	1/8	"	3.0	"	2.39			
66	DIC 476	"	"	1155	3/16	"	2.5	"	2.1			
67	JM HYFLO SUPERCEL	"	"	990	1/8	"	3.5	"	1.2			
68	DIC 437	"	"	860	1/8	"	1.7	"	2.2			
69	DIC 416	"	"	485	1/8	"	2.9	"	1.9			
70	SOLKA FLOC BW100	"	"	480	1/8	"	3.5	"	1.0			
71	SOLKA FLOC BW200	"	"	630	1/8	"	4.5	"	1.9			

* THE FIRST 200 ml OF FILTRATE WERE NOT DISCARDED AS THE PROCEDURE CALLED FOR MAKING THE CLARITY DATA INACCURATE

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THE DOW CHEMICAL COMPANY
LOUISIANA DIVISION
DATA SHEET

TABLE # 20 COMPARISON OF FILTER AIDS @ 10 PSIG CONSTANT PRESSURE

B FILTRATION OF EVAPORATOR FEED . @ 0.5" LEAF DIAMETER

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RUN #	FILTER AID MATERIAL	PPM BODY FEED	BODY FEED RATIO	TOTAL FILTRATE VOLUME, ml AFTER 21 MIN	CAKE THICKNESS AT END, INCHES	FEED TURBIDITY	FILTRATE TURBIDITY *	FEED PPM Fe	FILTRATE PPM Fe *			
89	JM BH40	56	3.7	370	1/16	10	4.0	2.39	2.13			
90	SOLKA FLOC BW40	"	"	785	1/16	"	3.8	"	1.53			
91	SOLKA FLOC BNB40	"	"	665	1/16	"	3.6	"	2.39			
92	SOLKA FLOC BNB20	"	"	745	1/16	"	3.8	"	2.12			
93	SOLKA FLOC BNC COARSE	"	"	660	1/16	"	3.6	"	1.98			
99	DIC 476	"	"	635	1/16	"	0.6	"	1.35			

* THE FIRST 200 ml OF FILTRATE WERE NOT DISCARDED AS THE PROCEDURE CALLED FOR MAKING THE CLARITY DATA INACCURATE

ST0285050

LOUISIANA DIVISION

DATA SHEET

TABLE # 21 EVAPORATOR FEED FILTRATION

COMPARISON OF FILTER AIDS @ 0.75 gpm/ft² @ 0.1 #/ft² PRECOAT USING JMBH 40 AS THE PRECOAT

RUN #	PRECOAT MATERIAL	BODY FEED MATERIAL	CYCLE TIME hr, min	PPM Fe IN / PPM Fe OUT	PPM ASBESTOS IN / PPM ASBESTOS OUT	MFL ASBESTOS IN / MFL ASBESTOS OUT	PPM Si IN / PPM Si OUT	PPM TSS IN / PPM TSS OUT	FTU TURBIDITY IN / FTU TURBIDITY OUT	PPM BODY FEED	BODY FEED RATIO	% NaOH / % NaCl
125	JMBH40	DIC 476	1 hr	1.5 / 0.89	—	—	—	18	13 / 0.3	54	3	7.8 / 13.5
76	"	"	10 hr 20 min	2.97 / 1.9	2.45 / 0.05	65,000 / 560	7 / 11	52	35 / 0.6	68	1.3	6.4 / 14
77	"	"	8 hr 15 min	2.6 / 1.76	—	—	—	66	45 / 1.0	152	2.3	—
SITES												
143	JMBH40	DIC 436	8 hr	2.3 / 1.2	1.18 / 0.02	/ 180	10 / 13	19	13 / 0.3	46	2.4	—
144	"	"	6 hr 15 min	4.5 / 2.8	—	—	—	27	18 / 0.3	51	1.9	7.7 / 14
124	"	"	12 hr 15 min	1.4 / 0.91	0.91 / 0.05	/ 560	6 / 6	10	5 / 0.2	45	4.5	—
126A	JMBH40	JM HYFLO SUPERCEL	3 hr 30 min	3.5 / 1.2	—	—	—	47	33 / 0.3	38	0.8	8.1 / 13.5
126B	"	"	4 hr 15 min	2.4 / 1.4	1.84 / 0.04	/ 430	7 / 12	25	17 / 0.3	55	2.2	—
SITES 80	"	"	12 hr 50 min	3.3 / 2.4	—	—	—	42	28 / 0.9	50	1.2	—
81	"	"	10 hr 15 min	43 / 2.0	3.09 / 0.04	/ 430	8 / 22	34	23 / 0.9	156	4-6	7.5 / 14
74	JMBH40	JMBH40	27 hr 15 min	1.58 / 0.92	1.35 / 0.02	/ 180	6 / 5	20	14 / 0.6	46	2.3	—
DSIC 75	"	"	14 hr 52 min	1.18 / 1.17	—	—	—	18	12 / 0.8	76	4.2	6.9 / 13.4
123	"	"	1 hr	2.4 / 0.75	—	—	—	18	12 / 0.1	45	2.5	7.7 / 10.7

TABLE # 21A

SAME AS ABOVE EXCEPT @ 0.2 #/ft² PRECOAT

81A	JMBH40	JM HYFLO SUPERCEL	9 hr	2.2 / 1.6	2.01 / 0.06	/	7 / 21	42	28 / 2.2	105	2.5	—
90	"	DIC 436	8 hr 35 min	2.2 / 1.7	—	—	—	23	11 / 1.5	124	5.4	8.4 / 14
93	"	DIC 416	9 hr 20 min	1.93 / 0.72	2.35 / 0.01	/ 80	6 / 16	27	18 / 1.8	105	3.9	7.3 / 13
92	"	DIC 215	4 hr 30 min	3.0 / 0.2	—	—	—	27	18 / 0.8	100	3.7	—
92A	"	DIC 215	5 hr 45 min	3.4 / 2.1	3.23 / 0.03	/ 300	7 / 21	17	11 / 1.5	109	6.4	7.22 / 13

LOUISIANA DIVISION

DATA SHEET

ST0285051

TABLE # 22 EVAPORATOR FEED FILTRATION

@ 0.75 gpm/ft² USING SOLKA FLOC BW40

COMPARISON OF FILTER AIDS @ 0.1 #/ft² PRECOAT AS THE PRECOAT

RUN #	PRECOAT MATERIAL	BODY FEED MATERIAL	CYCLE TIME hr, min	PPM Fe IN / PPM Fe OUT	PPM Asbestos IN / PPM Asbestos OUT	MFFL Asbestos IN / MFFL Asbestos OUT	PPM Si IN / PPM Si OUT	PPM TSS IN / PPM TSS OUT	FTU TURBIDITY IN / FTU TURBIDITY OUT	PPM BODY FEED	BODY FEED RATIO	% NaOH / % NaOCl
84	SOLKA FLOC BW40	DIC 476	15hr 5min	1.1 / 1.0	1.19 / 0.01	28,000 / 80	5 / 11	18 /	12 / 0.5	45	2.5	8.3 / 13.6
85	"	"	13hr 31min	1.19 / 0.93	—	—	—	15 /	9 / 0.5	95	6.3	—
ITES 89A	SOLKA FLOC BW40	DIC 436	11hr 15min	1.43 / 0.7	2.02 / 0.07	/	5 / 13	19 /	13 / 0.3	45	2.4	—
140	"	"	2hr 40min	3.5 / 2.0	—	—	—	31 /	21 / 0.5	70	2.3	—
141	"	"	2hr	2.5 / 1.2	—	—	—	20 /	14 / 0.3	60	3.0	7.8 / 14.3
142	"	"	3hr 30min	2.9 / 1.5	1.53 / 0.02	/ 180	10 / 9	24 /	16 / 1.0	65	2.7	8.0 / 15
MITE 87	SOLKA FLOC BW40	JOHNS-MANVILLE SUPERCEL	6hr	4.9 / 1.07	—	—	—	63 /	43 / 2	160	2.5	8.1 / 14.4
86	"	"	13hr 15min	1.63 / 1.0	1.39 / 0.02	/ 180	5 / 11	27 /	18 / 1.1	48	1.8	8.4 / 14
82	SOLKA FLOC BW40	SOLKA FLOC BW40	26hr 10min	1.87 / 1.6	1.56 / 0.05	/ 560	7 / 6	21 /	15 / 0.9	45	2.1	8.5 / 14.1
83	"	"	17hr 20min	1.43 / 0.71	—	—	—	21 /	15 / 1.5	100	4.8	—
USSK 121	"	"	7hr	1.19 / 0.83	4.32 / 0.04	/ 430	6 / 5	26 /	18 / 0.3	50	1.9	7.7 / 12.9
122A	"	"	2hr	3.2 / 0.84	—	—	—	23 /	15 / 0.2	95	4.1	7.5 / 11.2
122B	"	"	5hr	1.4 / 0.58	—	—	—	12 /	7.5 / 0.2	75	5.6	—

TABLE # 22A

SAME AS ABOVE EXCEPT @ 0.2 #/ft² PRECOAT

88	SOLKA FLOC BW40	DIC 436	4hr 30min	7.9 / 2.7	11.7 / 0.27	/	15 / 32	71 /	48 / 1.6	175	2.5	—
88A	"	"	3hr 45min	4.84 / 3.18	—	—	—	46 /	31 / 2.1	350	7.6	13.4 / 15.
89	"	"	50min	—	—	—	—	120 /	63 / —	163	1.3	—

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TABLE #23 EVAPORATOR FEED FILTRATION

@ 0.75 gpm/ft² @ Δp = 50 psig

COMPARISON OF FILTER AIDS; @ 0.1 #/ft² PRECOAT (PERLITES)

RUN #	PRECOAT MATERIAL	BODY FEED MATERIAL	CYCLE TIME hr, min	PPM Fe IN / PPM Fe OUT	PPM ASBESTOS IN / PPM ASBESTOS OUT	MFA ASBESTOS IN / MFA ASBESTOS OUT	PPM Si IN / PPM Si OUT	PPM TSS IN / PPM TSS OUT	FTU TURBIDITY IN / FTU TURBIDITY OUT	PPM BODY FEED	BODY FEED RATIO	% NaOH / % NaCl
94	DIC436	DIC436	8hr 15min	48 / 2.06	— / —	— / —	— / —	46	31 / 2	152	3.3	6.7 / 13.7
129	DIC436	DIC436	3hr 20min	1.60 / 1.0	— / 0.04	— / 430	— / 16	18	12 / 0.2	59	3.3	—
127	DIC436	DIC215	2hr 15min	1.8 / 1.1	0.97 / 0.02	/ 180	5 / 11	18	12 / 0.4	79	4.4	7.8 / 13.5
130	DIC476	DIC476	4hr 30min	1.55 / 0.44	1.82 / 0.02	/ 180	6 / 14	20	14 / 0.4	54	2.7	— / —
79	DIC476	DIC476	10hr 40min	3.7 / 2.1	— / —	— / —	— / —	34	23 / 2.5	119	3.5	6.8 / 16.
131	DIC476	DIC476	5hr 35min	0.67 / 0.29	— / —	— / —	— / —	15	10 / 0.3	56	3.7	6.7 / 12.

THE DOW CHEMICAL COMPANY
LOUISIANA DIVISION
DATA SHEET

TABLE # 24 CELL EFFLUENT SLUICE

28 VACUUM LEAF FILTRATION TO SIMULATE A ROTARY DRUM VACUUM FILTER

RUN #	FILTER CLOTH NO.	% SOLIDS FEED	PRECOAT TYPE	FORM TIME, SEC	DRY TIME, SEC	FILTRATE FLOW RATE, GPM/FT²	FILTRATE TURBIDITY, FTU	CAKE THICKNESS INCHES	CAKE % SOLIDS	DRUM SPEED MIN/REV		
1	PO-801-HF*	3	DIC 476	67	95	0.5	19	1/64	—	3		
2	"	"	"	"	"	0.57	5	1/64	—	"		
3	"	"	"	"	"	0.4	5.4	1/64	—	"		
4	"	"	"	"	"	0.46	6.1	1/64	—	"		
		TABLE #25 → H_2O SLUICE										
1	PO-801-HF	5	DIC 476	67	95	0.44	9.9	5/16	66	3		
2	"	"	"	"	"	0.41	6.0	3/16	67	"		
3	"	"	"	"	"	0.41	5.2	3/16	67	"		
		TABLE #26 → BRINE SLUICE										
1	PO-801-HF	10	DIC 476	67	95	0.26	8	1/8	67	3		
2	"	"	"	"	"	0.17	6	1/8	66	"		
3	"	"	"	"	"	0.18	6	1/8	67	"		

* POLYETHYLENE CLOTH, MONOFILAMENT, PLAIN WEAVE, AIR FLOW 40 to 60 CFM

ST0285058

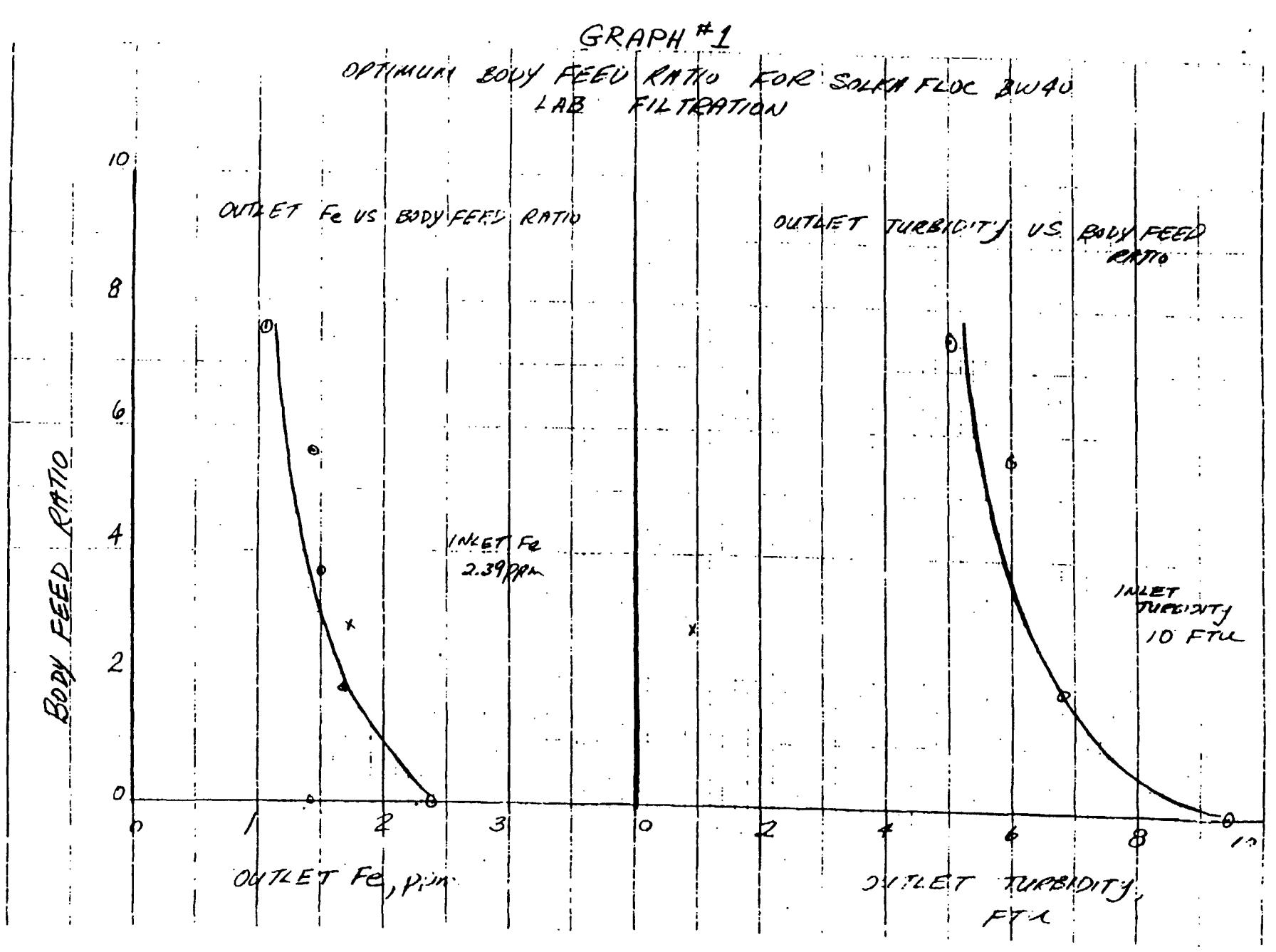
TABLE 27

ASBESTOS REMOVAL FROM BRINE TREATING SLUDGE

BY FILTRATION USING A PLATE AND FRAME FILTER

Run	ppm Asbestos In	ppm Asbestos Out
1	22	-
2	36	0.01
3	26	0.02
4	4	0.01
5	24	0.01
6	21	0.01
7	12	0.01
8	0.2	0.01
9	14	0.49
10	0.3	0.21
11	0.9	0.07
Wash Water	-	0.18

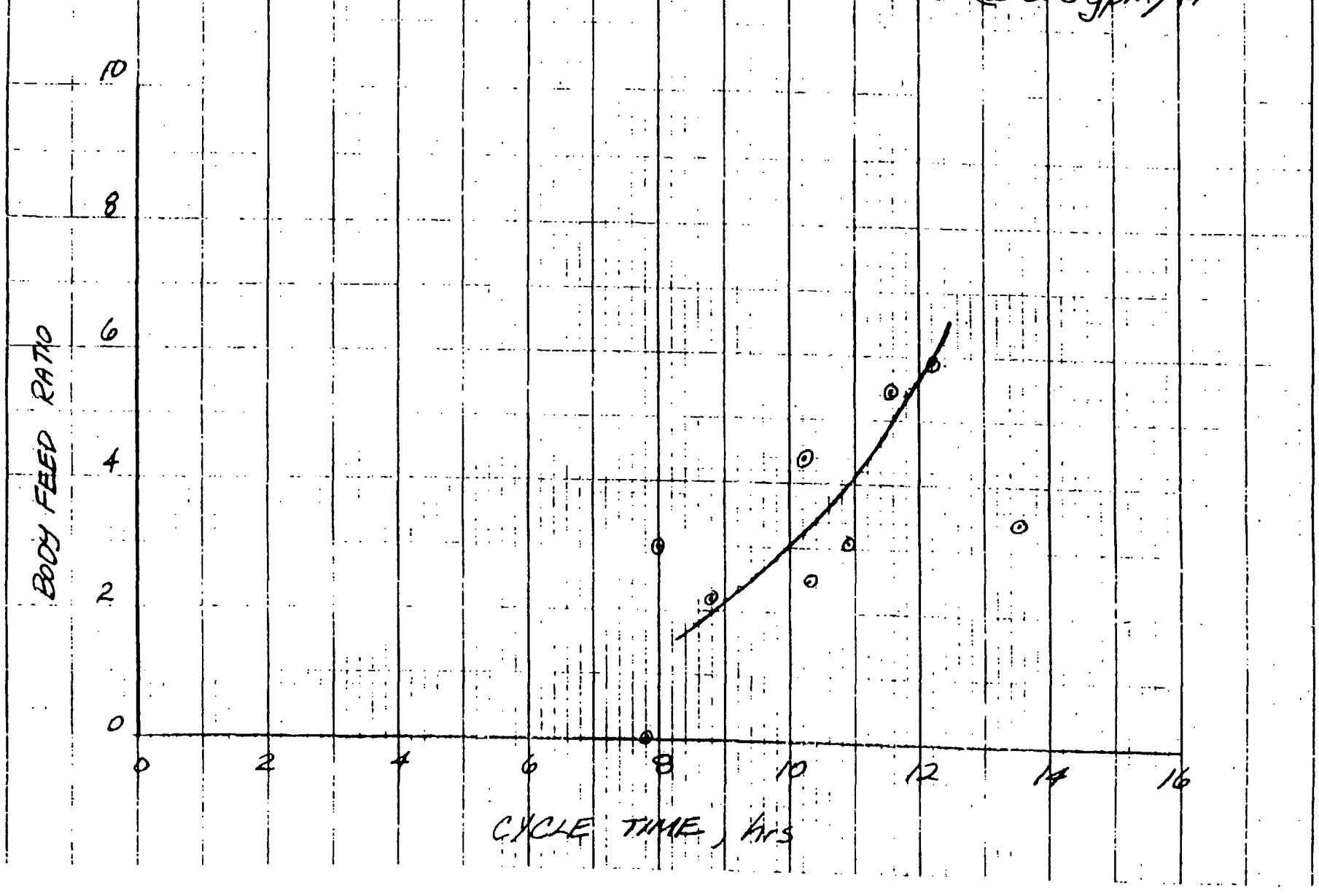
ST0285054


GRAPH #1
OPTIMUM BODY FEED RATIO FOR SOLKA FLOC BW40
LAB FILTRATION
OUTLET Fe VS BODY FEED RATIO
OUTLET TURBIDITY VS. BODY FEED RATIO
INLET Fe
2.39 PPM
INLET TURBIDITY
10 FTU
BODY FEED RATIO
OUTLET Fe, PPM
OUTLET TURBIDITY, FTU
0
2
4
6
8
10
0
1
2
3
0
2
4
6
8
10

ST0285055

GRAPH # 2

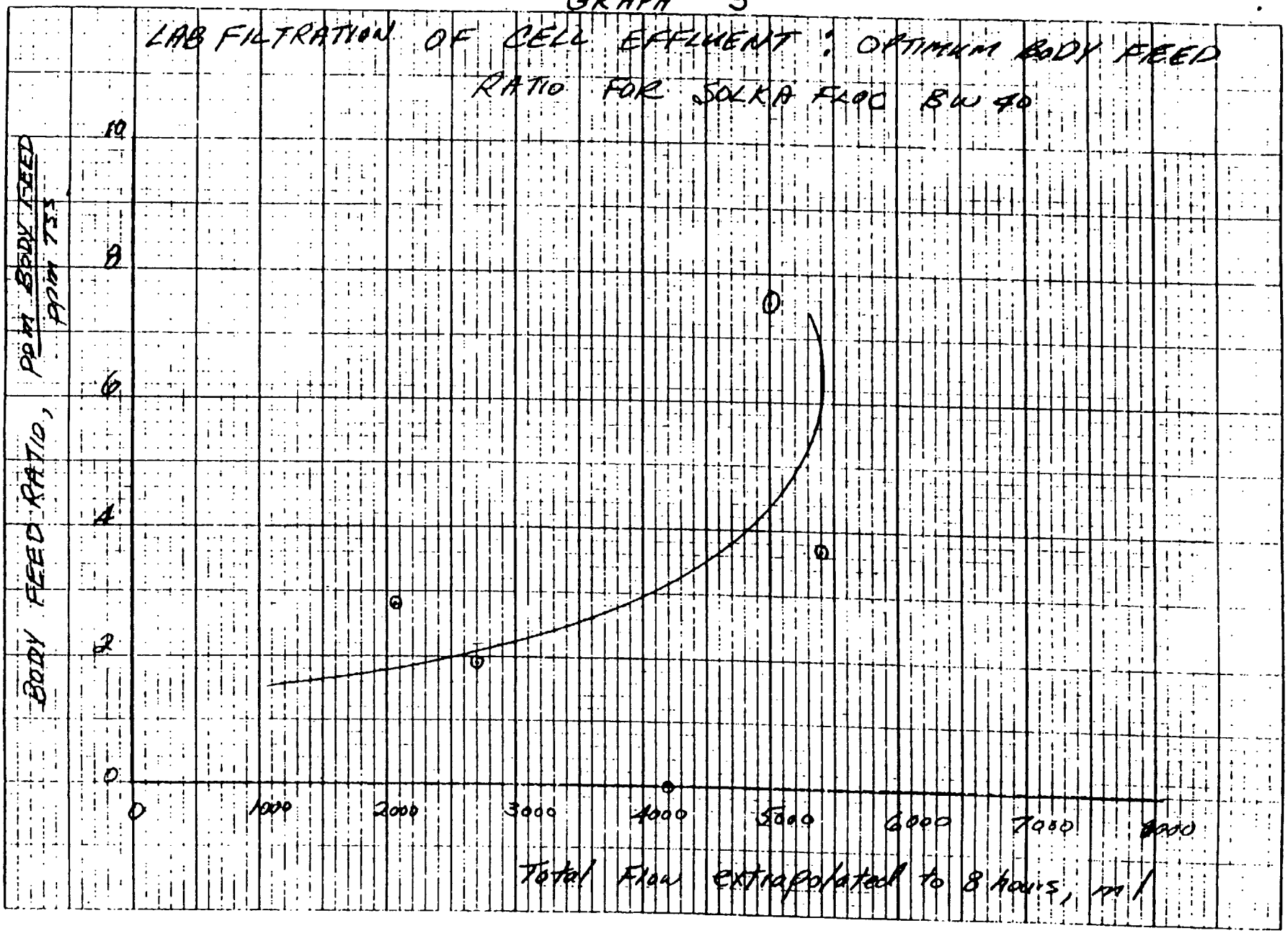
OPTIMUM BODY FEED RATIO FOR DIC 476 @ 0.5 gpm/ft²



ST0285056

GRAPH # 3

LAB FILTRATION OF CELL EFFLUENT : OPTIMUM BODY FEED RATIO FOR 50KA FLOW BW 40

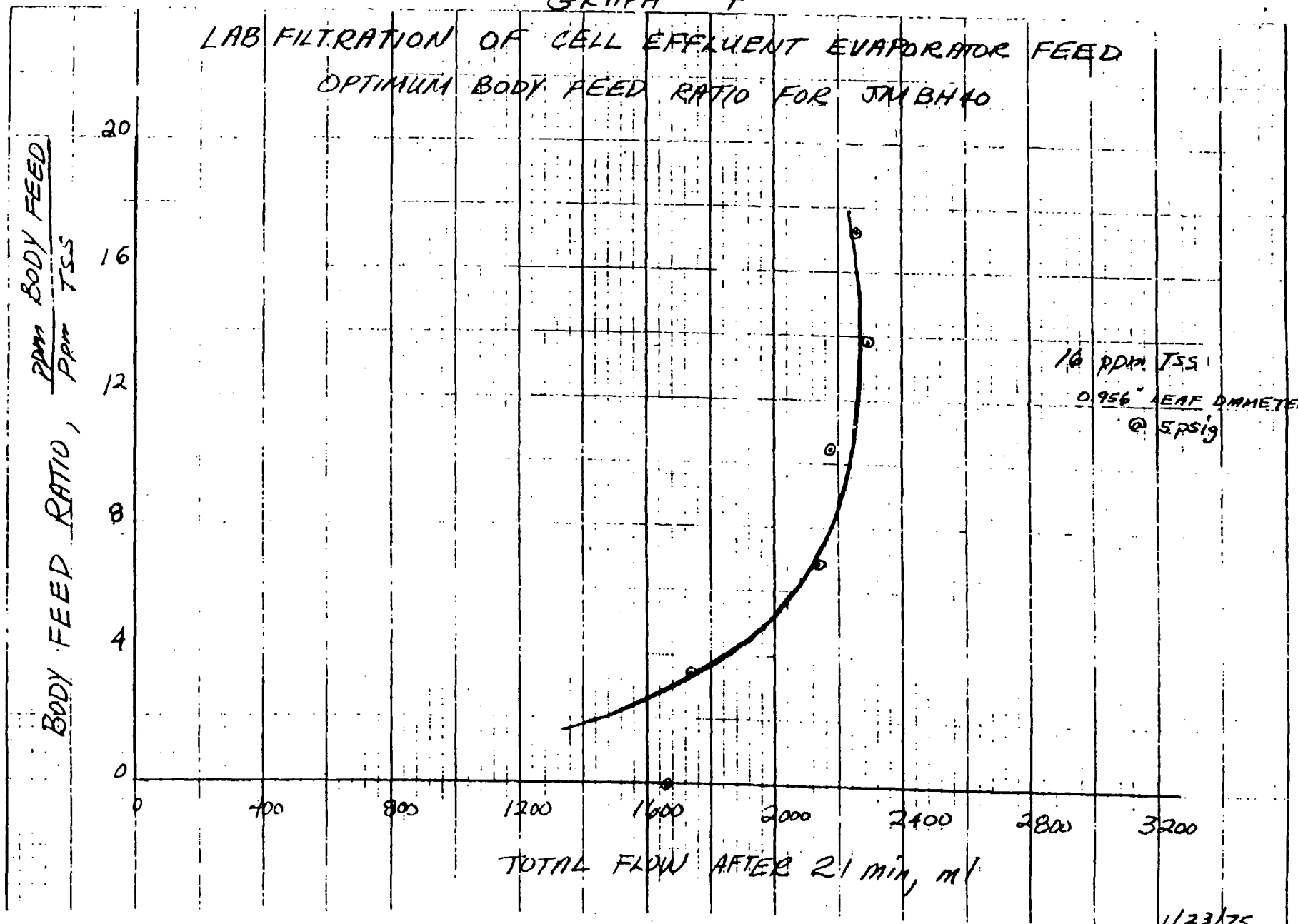


ST0285057

GRAPH # 4

LAB FILTRATION OF CELL EFFLUENT EVAPORATOR FEED

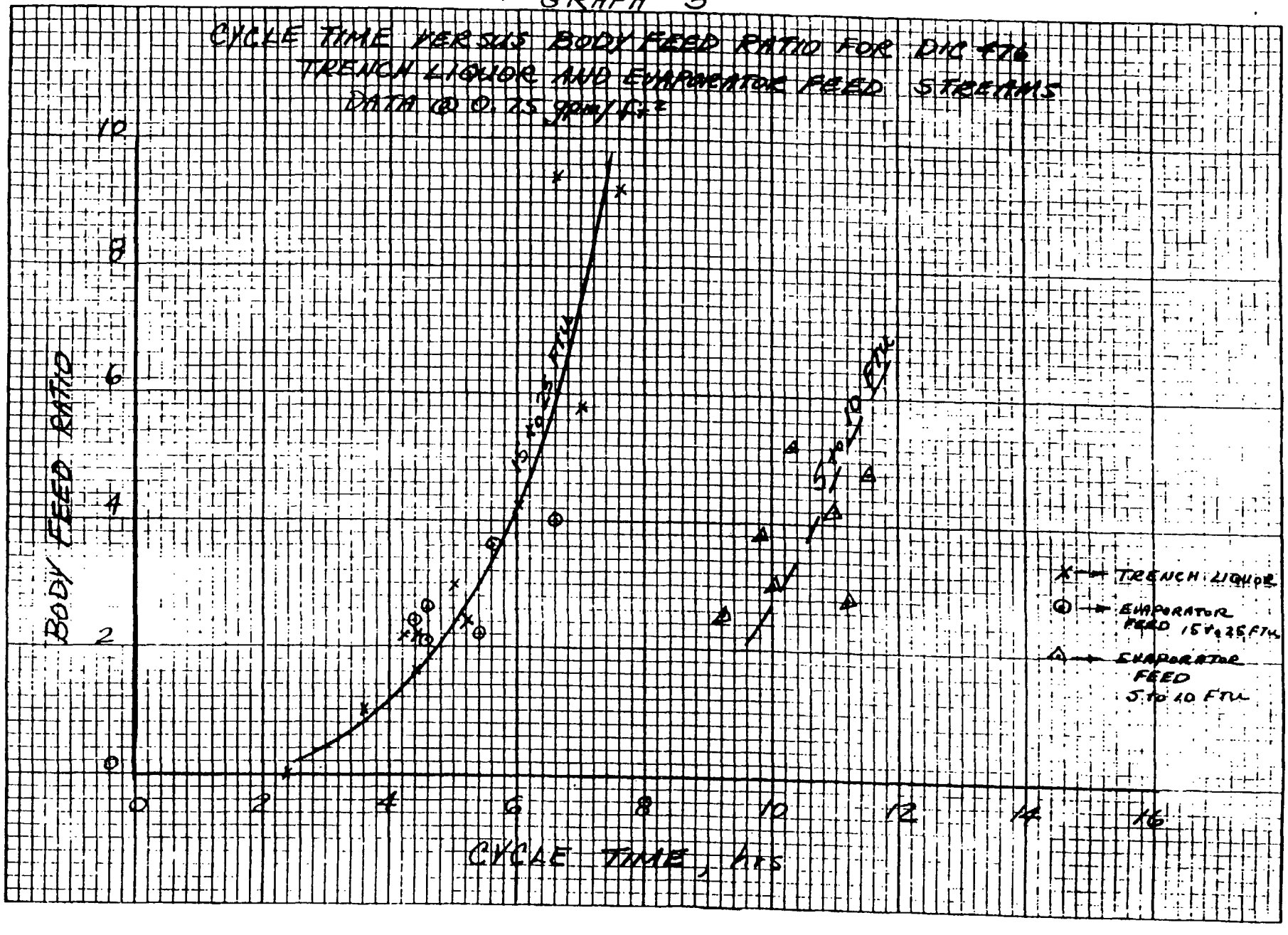
OPTIMUM BODY FEED RATIO FOR JM BH40



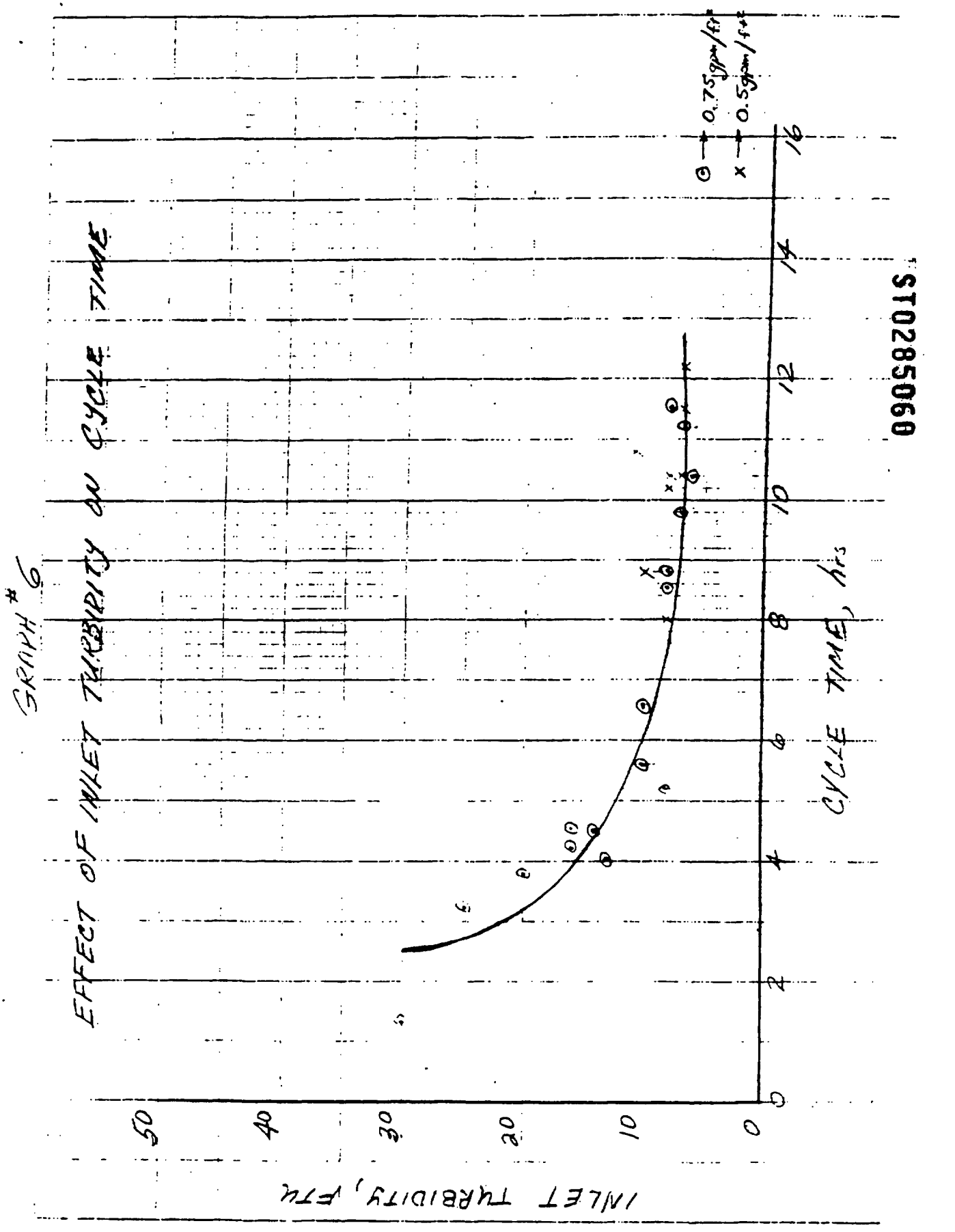
1/23/75
JWG

ST0285058

GRAPH #5



ST0285059


EFFECT OF INLET TURBIDITY ON CYCLE TIME
GRINN # 6
INLET TURBIDITY, FTU
CYCLE TIME, hrs
0.75 gpm/ft²
0.5 gpm/ft²
0
10
20
30
40
50
2
4
6
8
10
12
14
16

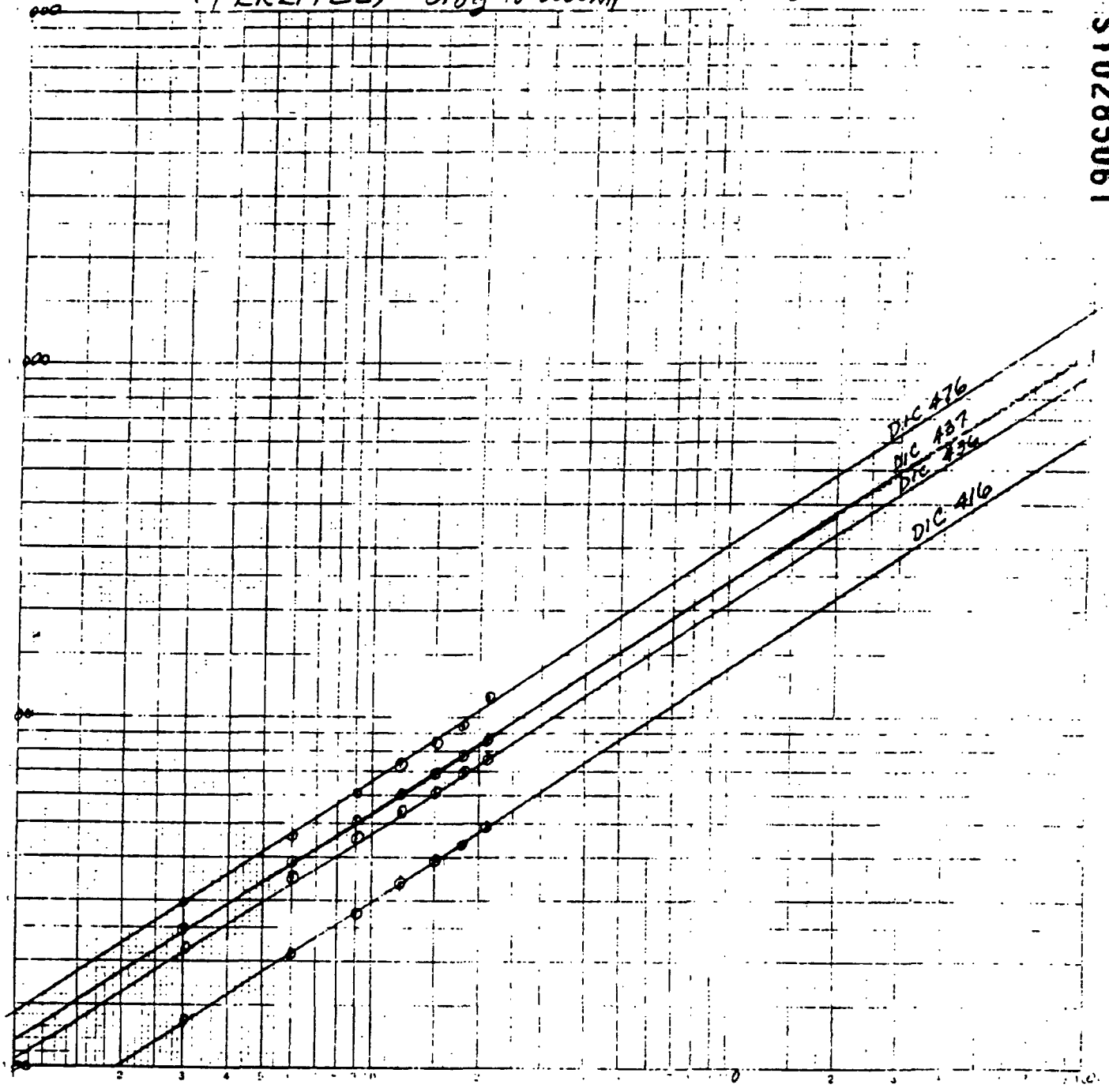
ST0285060

GRAPH #7

LAB FILTRATION OF CELL EFFLUENT

(EVAPORATOR FEED)

(PERLITES) 0.8g to 3000ml @ 10 psig



0.5" Diameter Leaf

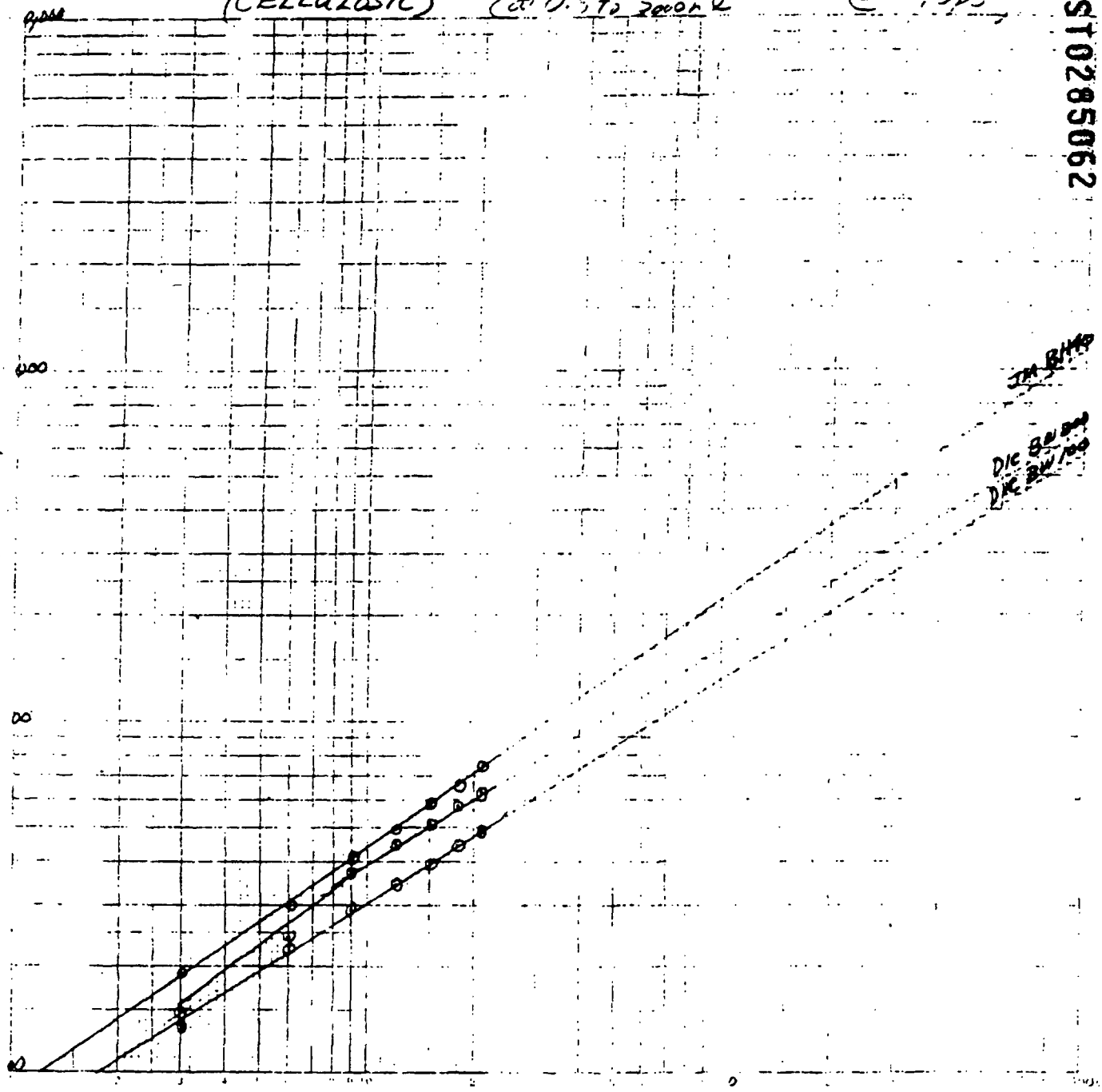
1/24/75
JWG

ST0285061

GRAPH #8

LAB FILTRATION OF CELL EFFLUENT (EVAPORATOR FEED)

(CELLULOSIC) @ 0.5 to 2000 ml @ 10 psig



1/24/75
JWG

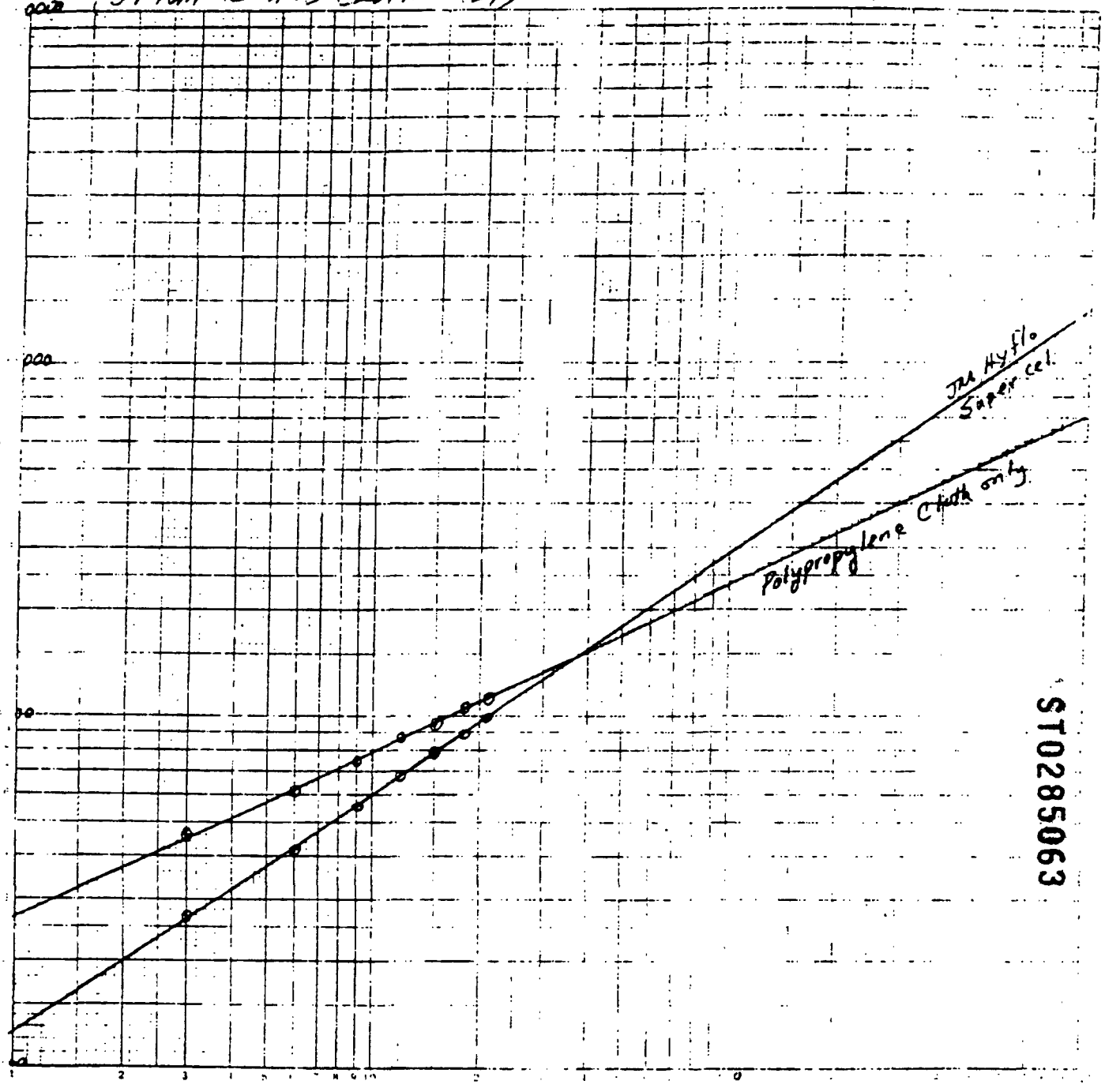
ST0285062

GRAPH #9

LAB FILTRATION OF CELL EFFLUENT

(EVAPORATOR FEED)

(DIATOMITE AND CLOTH ONLY) @ 10 psig



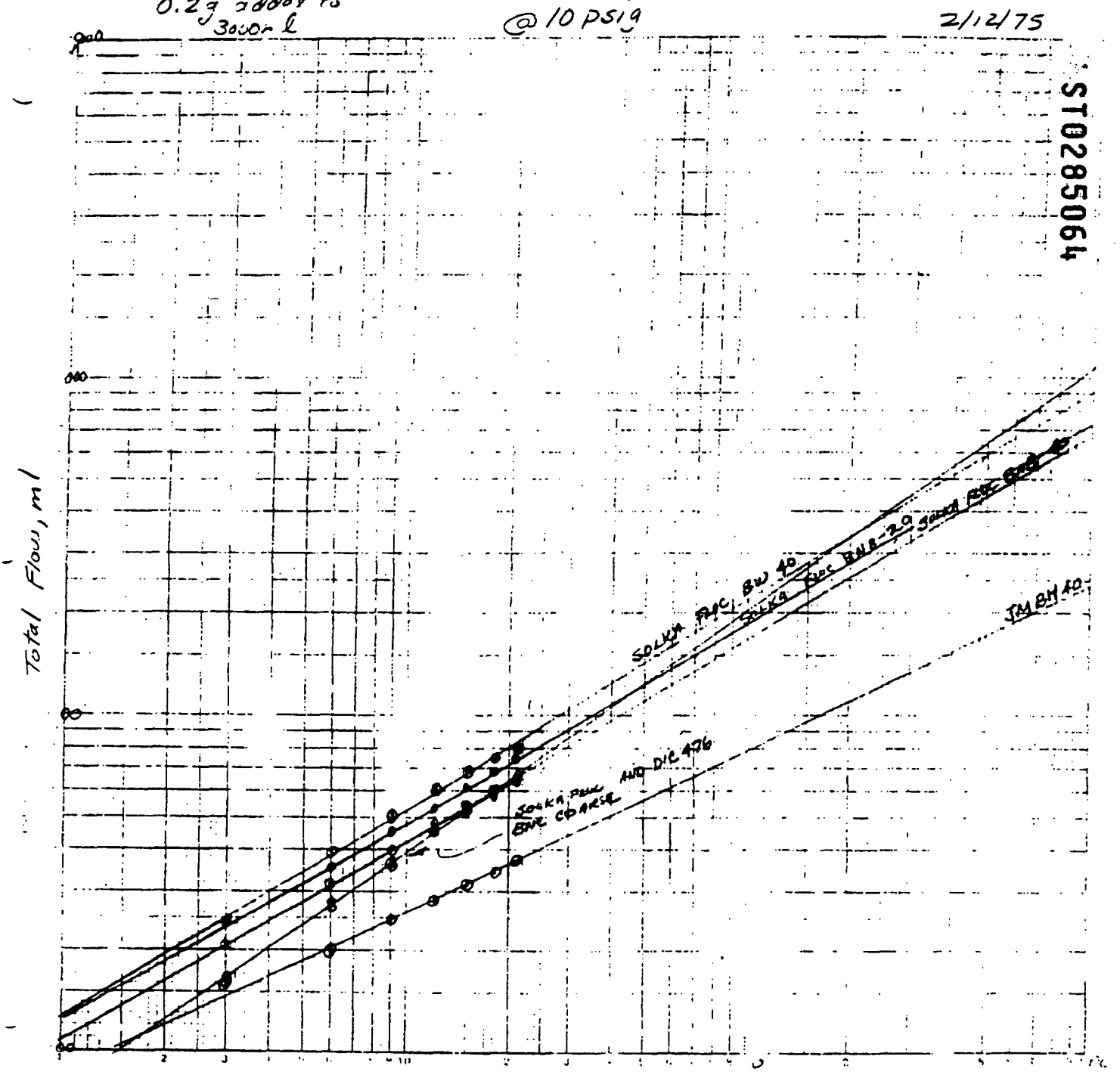
ST0285063

1/24/75
JVG

GRAPH #10

LAB FILTRATION OF CELL EFFLUENT (EVAPORATOR FEED)

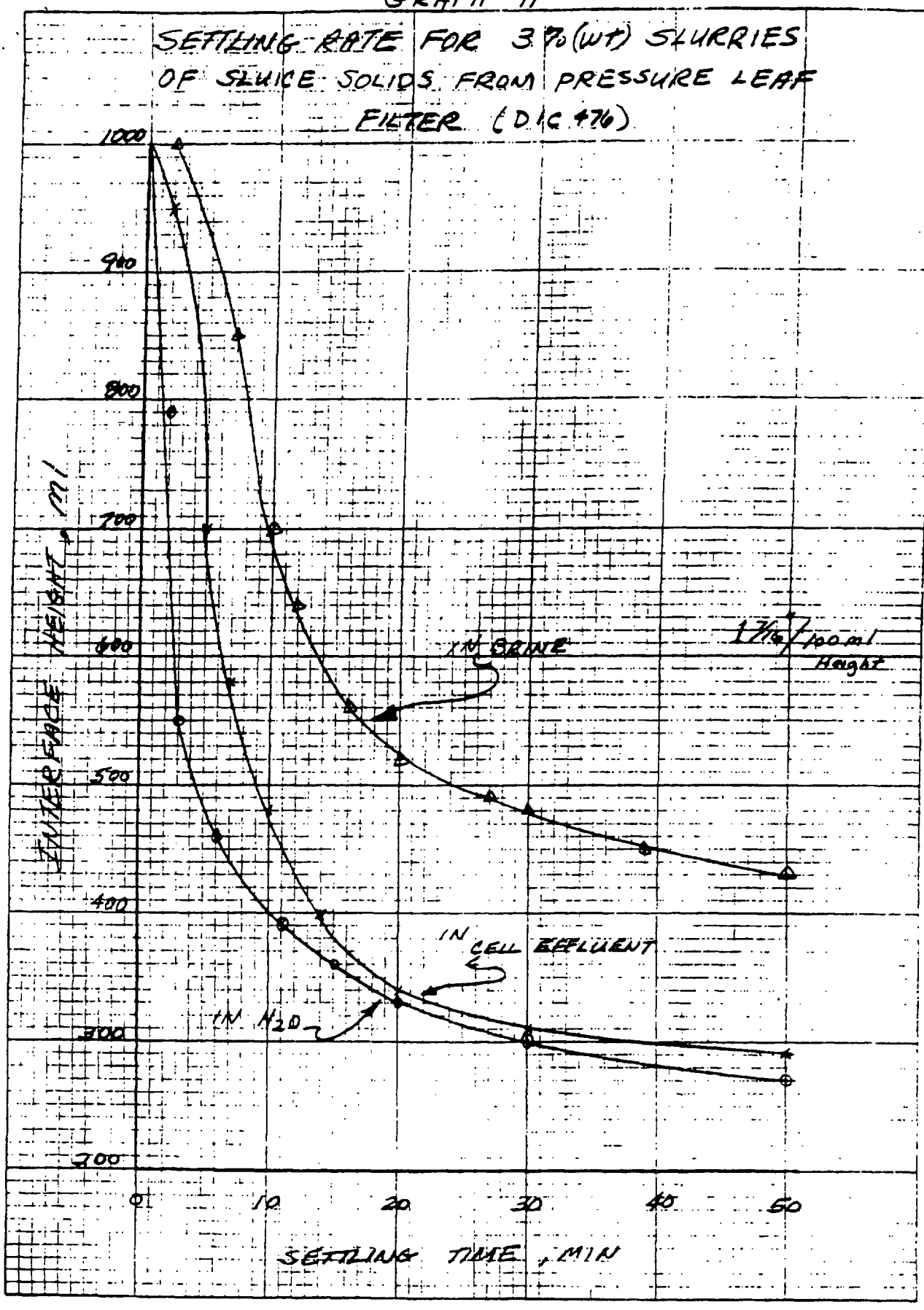
COMPARISON OF FILTER AIDS



0.5" LEAF DIAMETER
POLYPROPYLENE CLOTH

2/12/75
JWG

GRAPH # 11



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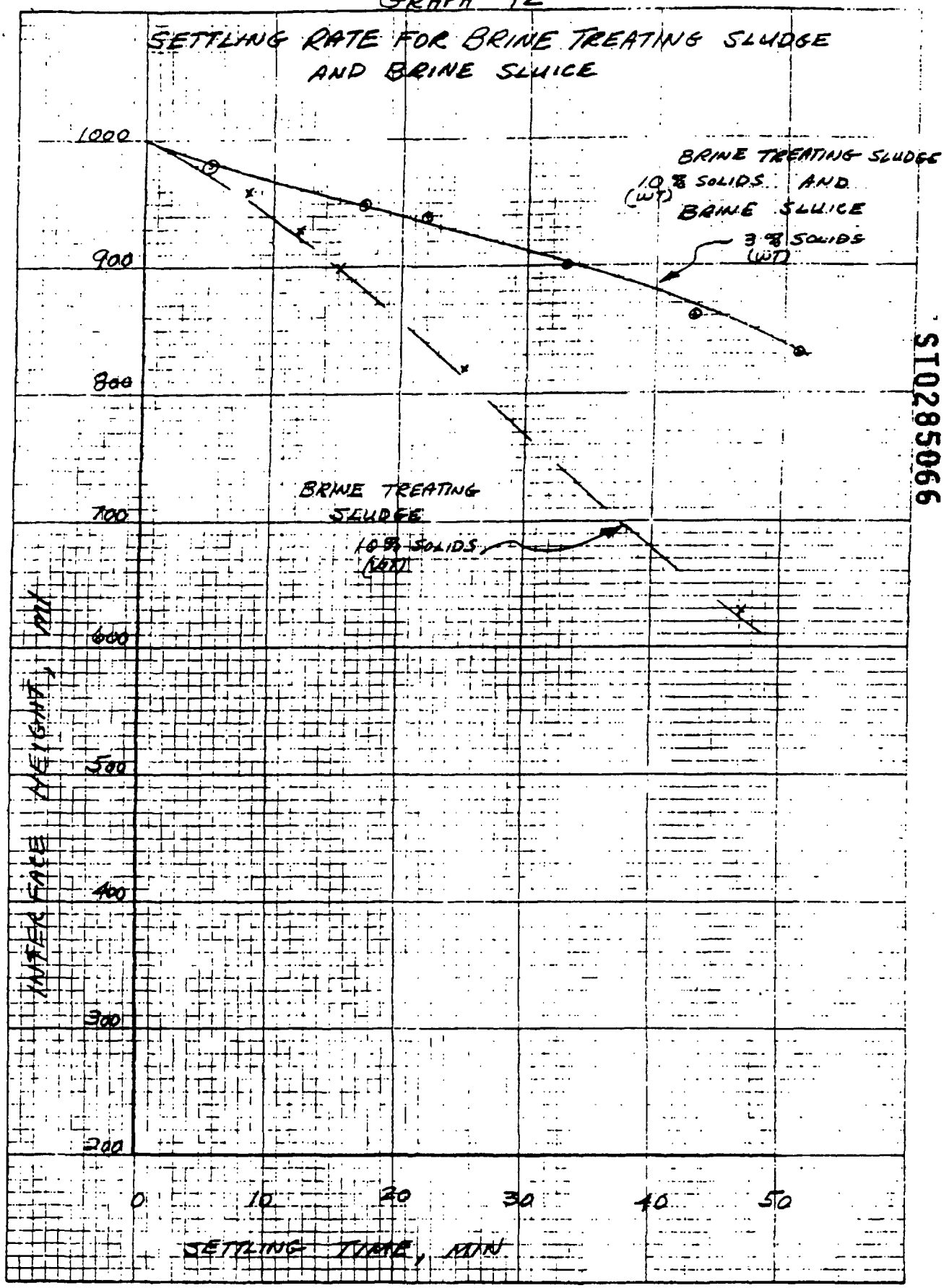
GRAPH # 12



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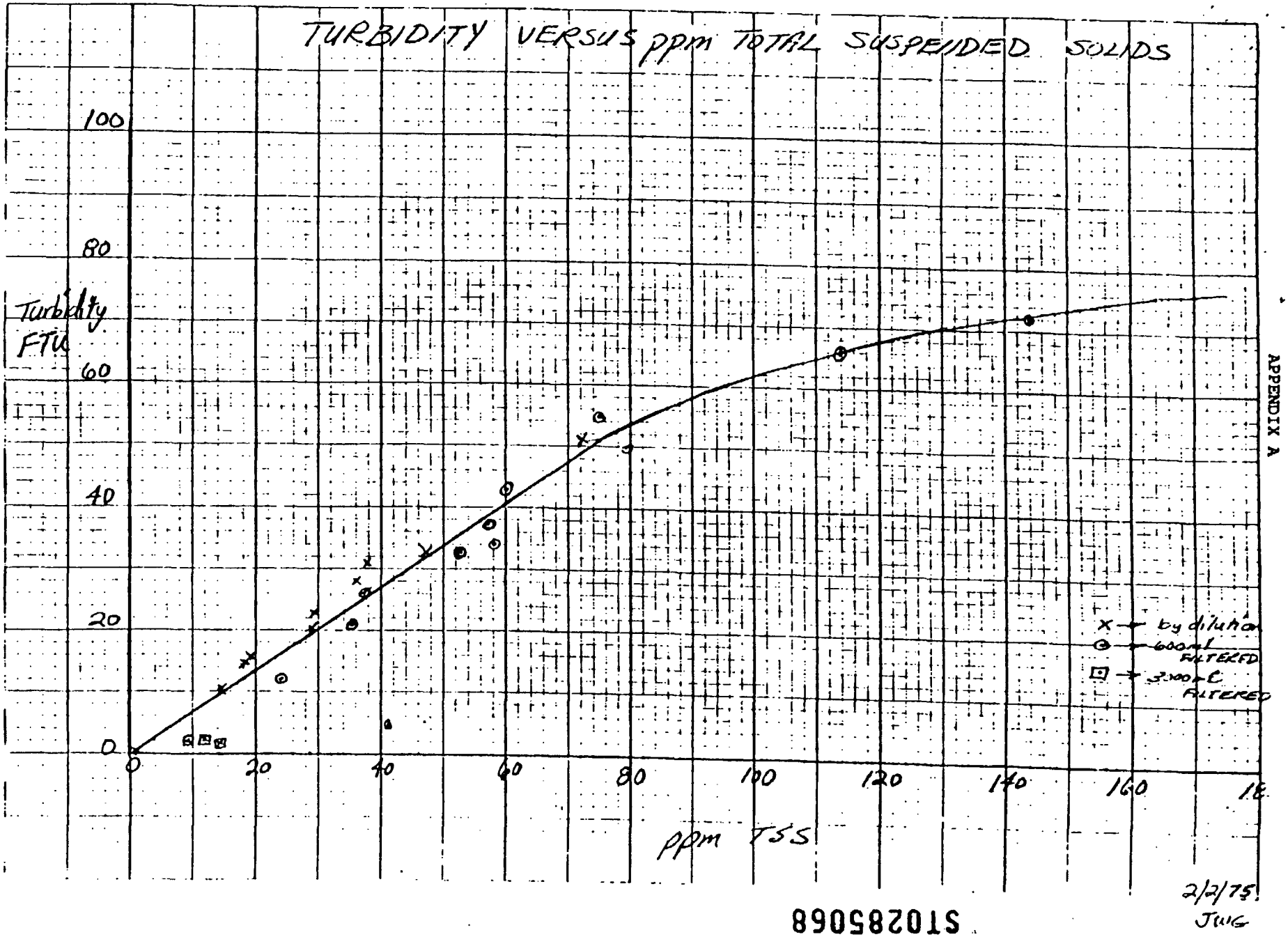
APPENDIX

A) Turbidity vs. ppm TSS Curve

B) TEM to AA Correlation

C) Calculations for Filter Aid Costs

D) Filter Press Data for Handling Brine Treating Sludge



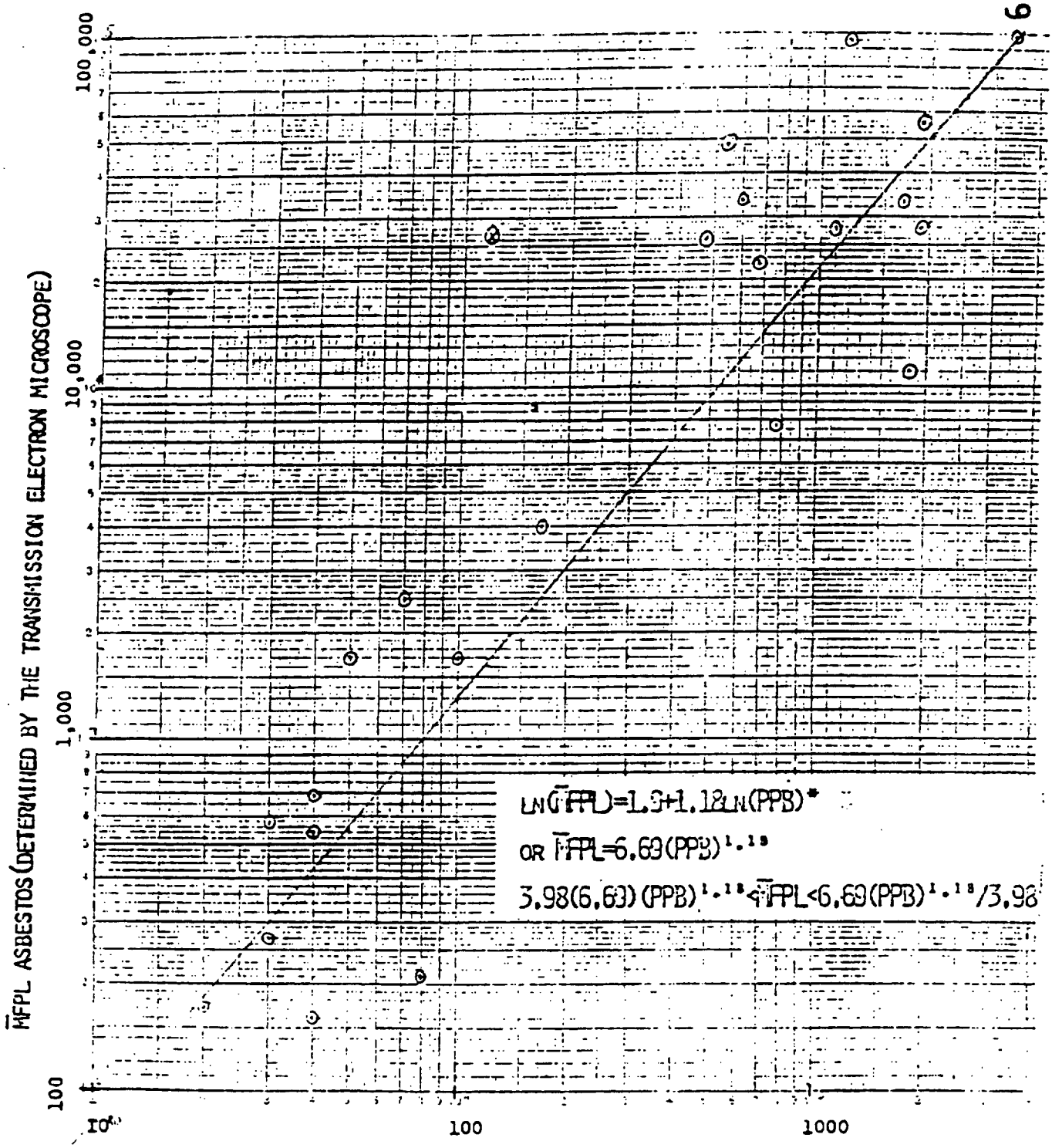
APPENDIX A

ST0285068

ST0285069

APPENDIX B

CONVERSION OF PPB ASBESTOS (WORK BY C. HINZE) TO $\overline{F}$FPL (WORK BY L. MARTIN). THE LIQUID ANALYSED INCLUDES CELL EFFLUENT, BRINE, AND BIG-LAGOON WASTE WATER. THE LINEAR REGRESSION CORRELATION CO-EFFICIENT IS .0/.



*LEAST SQUARES REGRESSION

ST0285070

APPENDIX C

SAMPLE CALCULATIONS

I. Filter Aid Cost for Evaporator Feed Filtration

A) For Body Feed - For (1) A 3 to 1 ratio (2) 15 FTU Avg. Inlet Turbidity (3) 24 ppm Total Suspended Solids Avg. (4) 3000 gpm Stream (5) Using DIC 476 at 5¢/lb (6) Using 4 filters (1600 ft^2 - area each) (7) 0.5 gpm/ft^2 Rate

Feed Rate - 3000 gpm x 10 lb/gal x 60 min/hr x 24 hrs/day =

43.2 $\bar{M}$ lbs/day

Body Feed Rate - 43.2 $\bar{M}$ lbs/day x 24 ppm TSS in feed x

$$\frac{3 \text{ ppm body feed}}{\text{ppm TSS}} = 3{,}110 \text{ lbs/day}$$

Body Feed Cost - 3,110 lbs DIC 476/day x 365 days/yr x

$ 0.05/lb DIC 476 = $56,765/year

B) For Precoat - For (1) 8 hour cycles (2) 0.5 gpm/ft^2 rate
(3) 4 filters (1600 ft^2 area/filter)
(4) 0.1 lb precoat/ft^2 filter area

Precoat Use -

4 filters x 1600 ft^2/filter x 0.1 lbs precoat/ft^2 filter area

x 3 precoats/day = 1,920 lbs/day

Precoat Cost -

1,920 lbs DIC 476/day x 365 days/yr x $0.05/lb DIC 476 =

$ 35,040/yr

C) Total Filter Aid Cost For Evaporator Feed Filtration

$ 56,765/yr Body Feed Cost + $35,040/yr Precoat Cost = $ 91,805/yr