

PROGRESS REPORT

TECHNICAL SERVICES DEPT. - W. G. KRUMMRICH PLANT

JOB NO.

91370:3690

REPORT NO.

1 (Final)

DATE

7, 17, 68

W.G. KRUMMRICH PLANT

C. O.

GENERAL OFFICE

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☒ V. Brawley	☐	☐	☒ R.J. Stratmeyer	☐

• TO RECEIVE DETAIL SECTION

TITLE: INCREASE AROCLOR CAPACITY

PERSONNEL: R. M. McCutchan (T. E. Greenman)

PROBLEM: The Aroclor capacity is inadequate to meet 1968 sales forecast.

SUMMARY: By mid-1967 it became apparent that the Aroclor department capacity had to be increased by at least 10% in order to meet the 1968 sales forecast of 32.75 M lbs/yr. The rated and actual capacity was 29.5 M lbs/yr.

The following capacity improvements have been completed:

Item	Date	Cost	OSR & Capacity
			Increase
1. Furnace improvement	9/67	Minor Work	2.0%
2. Six-inch Cl ₂ line	2/23/68	\$32,480	2.5%
3. Still Preheater & Alterations	4/18/68	\$9300(est)	7.0%
Total		\$41,780	11.5%

When the chlorination step is run at 195°C for quality reasons instead of the normal 150°C, the off-gas vapor losses increase with a resulting 2.5% decrease in OSR and capacity. May 1968 was run at 195°C and yet production was 3,166,383 lbs, breaking the old record by 9.6%.

The 1968 sales forecast will be met (15, 796, 967 lbs. thru June). The expanded Aroclor facilities are scheduled to start up on 10/14/68. The above capacity improvements result in estimated savings of \$52,000 and new earnings of \$158,000 before taxes.

DSW 311656

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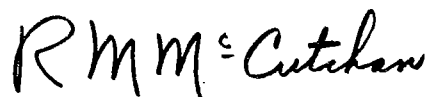
July 17, 1968

Future Work:EDC

1. Check preheater operation after alteration. 8/15/68
2. Monitor preheater operations for possible plugging. 10/15/68
3. Close job. 8/15/68

Acknowledgements

The capacity improvements summarized in this report are the efforts of the Production department itself, the TSD Mechanical Design Group and the TSD Process Group. Particular thanks goes to H. F. Ray and V. Brawley.



R. M. McCutchan
Technical Services Department

/tm

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REPORT OUTLINE

SUMMARY DETAILS:

I. BACKGROUND

- A. Capacity vs. Sales Forecast
- B. Production Limitations

II. CAPACITY IMPROVEMENTS

- A. Furnaces
- B. Six-inch Chlorine Line
- C. Still Preheater
- D. Summary of Capacity Improvements

III. CONCLUSIONS

IV. FUTURE WORK

APPENDIX

- A. Aroclor Production
- B. Timetable of Preheater Project
- C. Preheater Drawing

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DETAILS:I. BACKGROUNDA. Production Capacity vs. Sales Forecast

By mid-1967 it became apparent that the Aroclor production capacity was inadequate to meet the 1968 sales forecast. The rated capacity was 2.462 M lbs/mo., or 29.5 M lbs/yr. Through June 1967, the department was operating at 103.6% of rated capacity. The sales forecast was 32.75 M lbs. of Aroclors for 1968. Department capacity had to be increased by at least 10%.

B. Production Limitations

1. Low chlorine pressure caused considerable production loss. This was being corrected by the installation of a new 6" chlorine feed line to replace the existing 4" line (Project 3824, Mechanical Design Group).
2. Distillation was a bottleneck when producing Aroclor 1242, which is about 50% of the total Aroclor production. The distillation on stream rate (OSR) for 1242 was about 3900 lb/hr. while the chlorination OSR for 1242 was about 4300 lbs/hr. This assumes a total chlorination batch cycle of 7.5 hrs. For Aroclors 1254 and 1260, the distillation rate was not limiting. The two stills are fed continuously by vacuum.

II. CAPACITY IMPROVEMENTSA. Furnaces

In September 1967, the production department increased the heat supplied to the stills by decreasing the size of the furnace burner orifices and increasing the gas pressure. An overall OSR increase of about 2% resulted. (See summary paragraph of this section of this report for actual rates.)

B. Six-inch Chlorine Line

A new 6" chlorine feed line (Project 3824) was activated on 2/23/68. Periods of low chlorine pressure (below 18 psi) were eliminated. Normal pressure increased from 20 psi to 25 psi. Other changes were made in the department a short time later, but it is estimated that a 2.5% OSR increase resulted from this project.

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C. Still Preheater

1. Original Project

Since about 40% of the heat supplied by the furnaces to the stills was used in raising the temperature of the crude Aroclor to its boiling point, a sizeable distillation capacity increase could be achieved by preheating the still feed.

A still preheater estimate for \$8000 was approved, package submitted, and equipment installed under Project No. 5334 as per drawing TS-D-8333. The 150 sq. ft. spiral preheater cost \$2980. The following considerations determined the project design:

a. Temperature

Still Feed temperature before project 110°C

Still Feed temperature after project 195°C
(temp. of 200 # steam)

Boiling Point of Aroclor 1142 at 40 mm Hg 230°C

b. Flow Rate to Stills

Normal 7 gpm
Maximum 12 gpm

c. Flow Velocity

Because the still feed contains approximately 0.02% undissolved FeCl_3 catalyst, the flow velocity had to be sufficient to prevent excessive settling out. The need to avoid very low flow velocities, the need for low flow rate and a high ΔT , determined that a spiral heat exchanger was best suited for this purpose. The curved channel through which the Aroclor flows minimizes settling out.

d. Pressure Drop

Pressure drop through the heat exchanger was estimated to be 10 psi. Actually it is 12-14 psi. Before the installation of the preheater, the still feed was pulled by vacuum to the stills from the blow tanks. The increased pressure drop made a pump necessary in addition to the still vacuum. A 1-1/2 x 1 x 6 Durco Mark II was chosen.

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2. Alterations

After start-up the need for the following alterations was apparent.

a. Discharge Line

The spiral heat exchanger is protected against high pressures by a 100 psi carbon rupture disc. The discharge line went to sewer. If the disc ruptured while the pump was in operation, it would have been possible to lose an entire blow tank of crude Aroclor. The piping has been altered to tie the rupture disc discharge line back into the top of the blow tank.

b. Pump Impeller

The 5" impeller was replaced by a 6" one.

An overall demonstrated OSR increase of about 7% resulted from the installation of the still preheater. Start-up of the preheater was on 4/18/68.

D. Summary of Capacity Improvements

1. Capacity Variables

In order to evaluate the actions taken to increase capacity, the effect of two process variables had to be established.

a. Percent Chlorination

When chlorinating biphenyl to the 42-60% chlorine range, the OSR decreases approximately 8 lbs/hr for every 1% increase in final chlorine content. In other words, the OSR for Aroclor 1142 is about 50 lbs/hr greater than the OSR for Aroclor 1148. This data is based on production records for 10/1/67 to 4/17/68.

b. Chlorination Temperature

During most of the second quarter 1968, the chlorination temperature was 195°C instead of the normal 150°C. This was done to improve Aroclor stability. When operating at the higher temperature, off-gas condensate losses increase to reduce the OSR by about 100 lb/hr, or 2.5%.

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2. Aroclor on-stream-rates

The graph on the following page relates % chlorination to OSR as it increased with the improvements discussed in this report. The rates shown assume a chlorination temperature of 150°C. If 195°C is used, OSR decreases by 100 lb/hr as noted above.

3. Aroclor Capacity

Assuming full use of the preheater, 48% average chlorination at a temperature of 150°C, and a standard on-stream-time of 91%, the predicted OSR is 4380 #/hr with a production of 2.87 M lbs/mo. or 34.4 M lbs/yr. This meets the goal of 10% increase in Aroclor capacity.

The best month to date was May, 1968 when the preheater was used all month, average chlorination was 47.55% at 195°C, OST was 99.4%, resulting in an OSR of 4279 lb/hr and a production of 3,166,383 lbs. See Appendix A for 1967-8 production data.

III. CONCLUSIONS

Production of WGK Aroclor will be sufficient to meet the sales forecast. Preheater downtime must be kept to a minimum. At this writing the new Aroclor expansion is scheduled to start-up on 10/14/68.

IV. FUTURE WORK

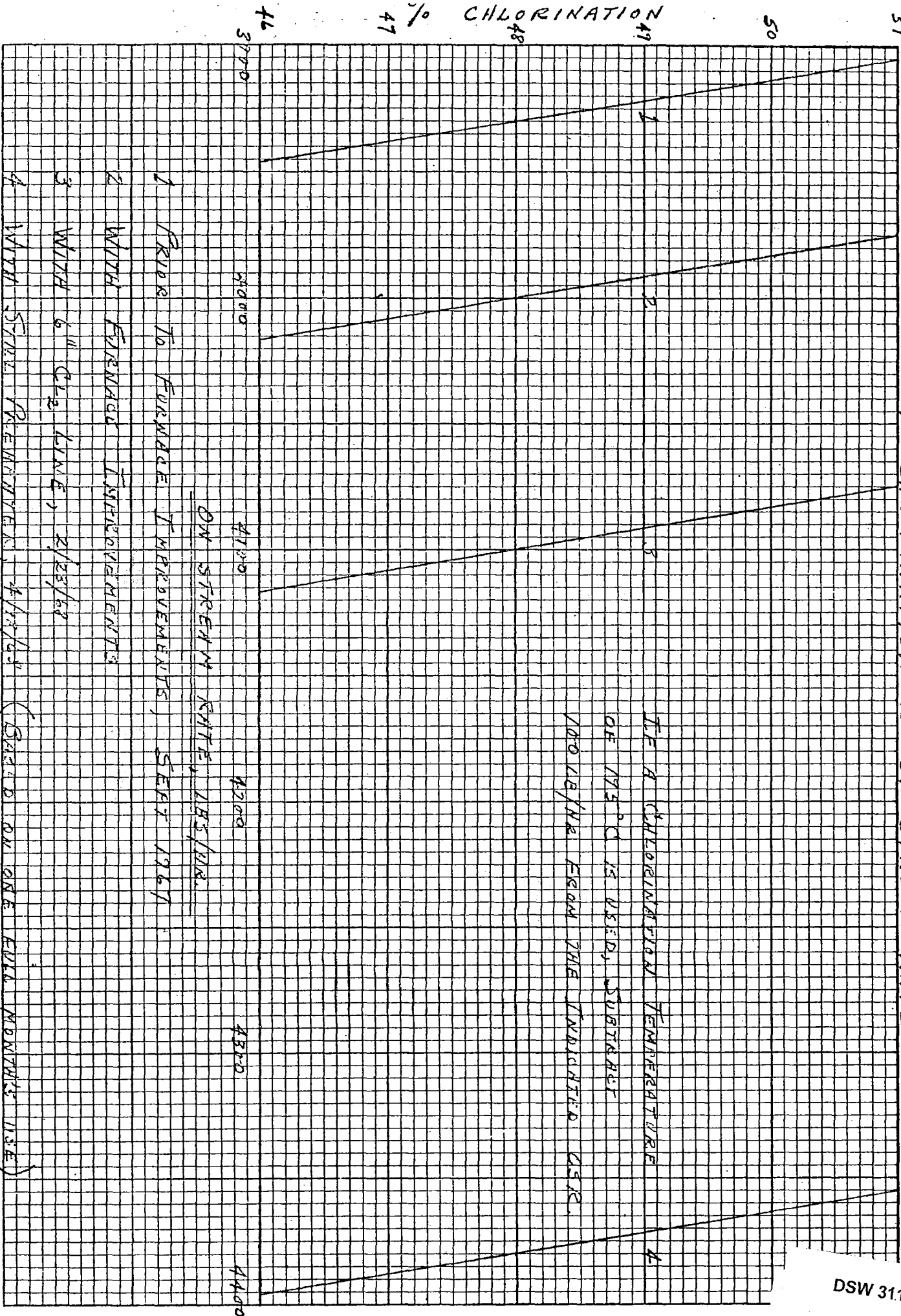
- A. Check preheater operation after alteration.
- B. Monitor preheater operation for possible plugging.
- C. Close job.

EDC
8/15
10/15
8/15

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% CHLORINATION VS. ON-STREAM-RATE



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APPENDIX A

<u>Month</u>	<u>%Cl₂</u>	<u>OST, %</u>	<u>OSR, lb/hr</u>	<u>Production</u>	<u>Comments</u>
July 1967	51.1	83.4	3917	2,446,613	
August	48.3	88.9	3855	2,550,544	
September	49.3	86.1	3800	2,355,684	Furnace im- provements
October	48.8	97.3	3866	2,798,453	
November	46.9	97.2	4127	2,887,372	
December	50.1	69.1	4119	2,118,204	Turn-around
Jan. 1968	49.2	79.7	3985	2,363,279	
February	47.0	81.6	3942	2,235,888	6"Cl ₂ line on 2/23
March	46.6	90.6	4116	2,773,669	
April	48.7	96.5	4063	2,824,184	195°C on 4/11
May	47.6	99.4	4279	<u>3,166,383</u>	Preheater on 4/18
June 1968	48.5	86.8	3893	2,433,564	

APPENDIX B

TIMETABLE

TSD Job No. 91370:3690 opened	10/7/66
Evaluation begun	7/1/67
Estimate 5334 (\$6440) submitted	8/1/67
Verbal approval received	8/2/67
Equipment ordered (spiral preheater)	8/11/67
Project package transmitted to P & S	8/29/67
Formal approval received	9/29/67
Revised Estimate 5334 submitted (+\$1560)	10/31/67
Equipment arrived at plant	11/7/67
Formal approval of revision received	11/29/67
Project installation completed	1/15/68
Project Start-up	4/18/68
Estimate 6621 for alterations submitted (\$1300)	5/6/68
Formal approval received	5/6/68
Alterations completed	7/1/68
Progress Report written	7/17/68
Job Closed	---

APPENDIX C

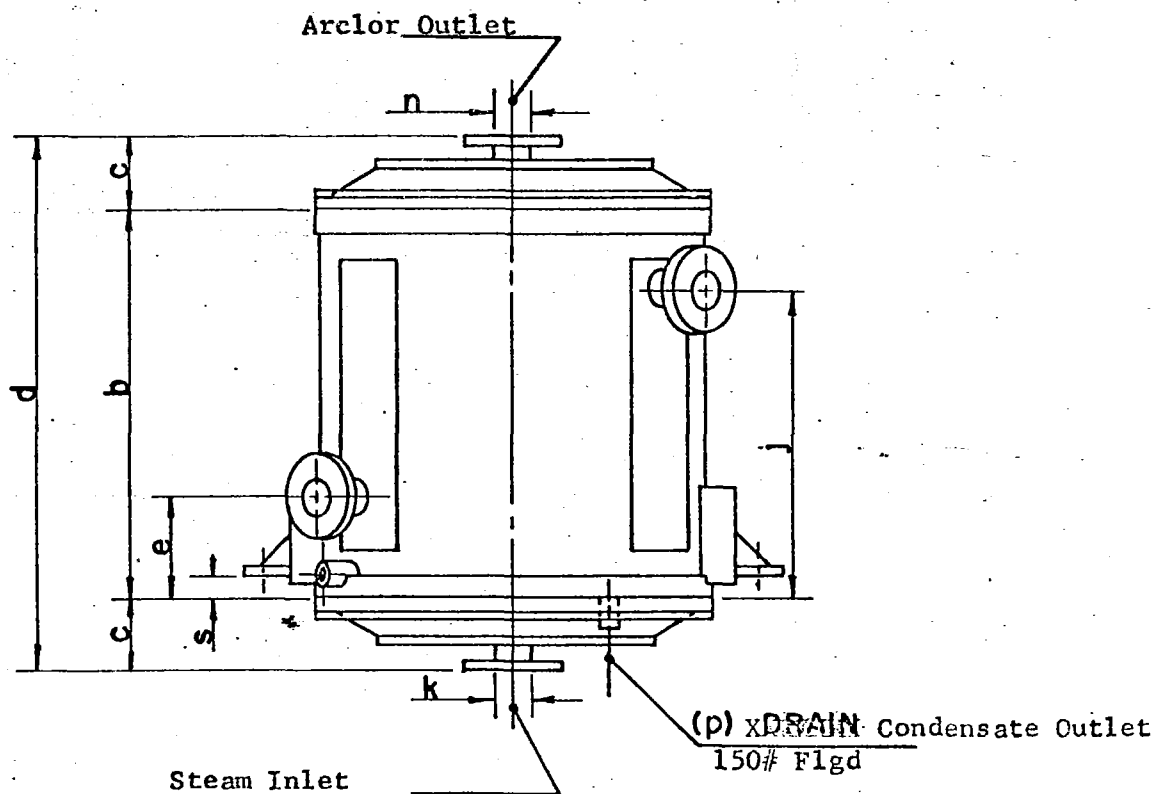
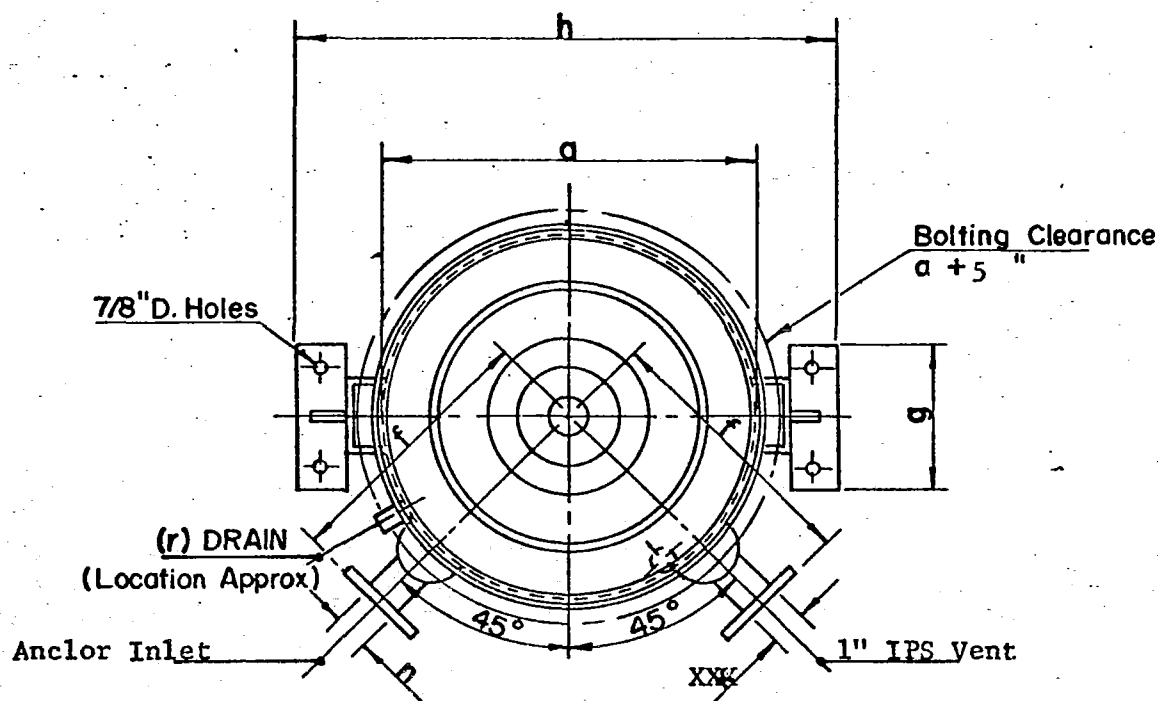
**AMERICAN HEAT RECLAIMING CORPORATION
SPIRAL HEAT EXCHANGER
SPECIFICATION SHEET**

CUSTOMER Monsanto Co.		YOUR JOB No.	
ADDRESS Krummich Plant		YOUR REFERENCE No.	
PLANT LOCATION		OUR INQUIRY No. I-9438	
		DATE July 25, 1967	
SERVICE OF UNIT Arclor Heater		ITEM No.	
TYPE I-V	No. OF EXCH. REQ'D. One	CONNECTED IN	
TOTAL SURFACE 150 sq. ft.		SURFACE PER EXCH.	
GUARANTEED PERFORMANCE			
	HOT SIDE	COLD SIDE	
FLUID CIRCULATED	Steam	Arclor	
TOTAL FLUID ENTERING	440 #/HR	7500 #/HR	
VAPOR			
LIQUID		12 GPM	
STEAM	440 #/HR		
NON-CONDENSABLES			
FLUID VAPORIZED OR CONDENSED			
STEAM CONDENSED	440 #/HR		
SPECIFIC HEAT B.T.U./#		.34	
SPECIFIC GRAVITY		1.25	
THERMAL CONDUCTIVITY		.07	
VISCOSITY		15 cp	
LATENT HEAT - VAPORS B.T.U./#	837		
TEMPERATURE IN °F	388	232	
TEMPERATURE OUT °F	388	380	
OPERATING PRESSURE # /SQ. IN.	200		
PRESSURE DROP # /SQ. IN.		10	
HEAT EXCHANGED - B.T.U./HR. 370,000		LOG. M.T.D. 50°F	
CONSTRUCTION			
DESIGN PRESSURE # /SQ. IN.	220	220	
TEST PRESSURE # /SQ. IN.	330	330	
DESIGN TEMPERATURE °F	400	400	
SPACING IN.	3/16"	3/16"	
CHANNEL SEAL	Alternate Channels Welded		
MATERIAL carbon steel	THICKNESS 1/4" 5/16" outside turns		
GASKETS compressed asbestos			
SHIPPING WEIGHT approx. 3500 #	WEIGHT FULL OF WATER		
DIMENSIONS see attached sketch			
REMARKS			

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a	b	c	d	e	f	g	h	j	k	n	p	r	s
35"	12"	6"	24"	5"	23"	12"	49"	7"	1"	1"	1"	1"	2"



DSW 311667

150 SQ. FT. SPIRAL HEAT EXCHANGER

For Monsanto Co.

Cust. No.:

Inq. No. T-9438

Date 7/25/67

AMERICAN HEAT RECLAIMING CORP.

1270 Sixth Avenue

New York 20, N.Y.

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