REVISED

224,327 = .3367

NBE

PRODUCTION REPORT

Period Beginning 1/1/76 Ending 2/1/76

ITEMS	Beg. Inv.	Produced	Received	Yield	Used	Transfers	Adjustments	End. Inv.
NBE	35776	299468				309240		26004
Anhydrous Ammonia	1374		11820	.052	9470			372
Nitric Acid	30084		185220	.226 Low	67629			1476
Sulfuric Acid	49343		331800	.850	254468			1264
Ethylene Dichloride	61224		45589	.125	37313			6957
CBE	121260		290110	.889	266365			1450
Totals	299061	299468	864539		635745	309240		58.

Attach supporting receipts with report.

This report based on physical inventory.

Report prepared by [signature] Date 2/6/76

Report approved by [signature] Date 2/6/76

9350038

12/12/75 | Notes while Jim gone —

MOBIL Inspection — Gene

① Weekly Quality Control Chart to MOBIL
— FLOY to handle Will need help on production & molar yield figures.

② EDC loss problem
— Layne to follow problem.
Has writeup on same

③ MBE Sample to MOBIL (5 gals to MOBIL Research Lab)
— J. Pate to handle / We are to call Ellington when sent out

④ Post Started Piping Changes
Gerwin Contract to handle

BASALIN

① PFID flow sheet & equipment dwgs to Steve Pocsik
— Layne to follow up with Jim @ Shreve Engr.

② Panel con Design for Basalin
— Layne to Handle.

PONDS

① CHECK LHILL progress
— Layne to check elevations

* ② SECURE Clay Storage PILE — John Holcomb

cc: Jim Fowler
John Mile
Bill Shackelford

Layne

① EDC Solvent Problem

Read notes discuss with John Miles. Monitor problem daily calculate extraction & stripping losses

ⓐ Call Steve Pocsik (1-303-366-2775) who needs following for a stainless steel fixed orifice:

① Max. head on extraction psig or ft (dead headed - can get in field or off curve)

② Δ Elevation of flange to receiver orifice

③ Sp. gravity of S. acid

④ ϕ & type flange for orifice (usually 3" 150LB)

Restrict orifice to allow maximum of 20 gpm S. ACID

T-4 T-5

② Calculate Panel coils for Basolin & DCa (DCa highest priority)

ⓐ DCA autoclave — Special external panel coil to keep material molten between batches (steam) & assist in cooling during RXN (cooling). See John Miles — DCa Freeze point = 194F

Basalm

(B) E-B101 Panel COIL for NaOH Storage (50% NaOH ≅ 70F Freezpt)

(C) E-B106 Panel COIL DMBTF/ Xylene Storage (F Freezpt = 140F)

- Contact for help Panel COIL 217-789-4944 applications engr = Manny Sarreals (sp?)

- Design Book attached.

(3) Clay for Ponds. Please work with Maint. to see that clay pile is properly secured & cared for. Estimate quantity of clay on hand (Flug has Bulk Density).

(4) Check with Jami & see that the latest Basalm PFD & equipment dwgs are sent to Steve.

to John Miles

EDC Losses – Mobil Nitration

As you are aware EDC losses in Mobil Nitration are our major process problem to date. While not unusual for startup, I believe a concerted effort & continuing evaluation will be needed to correct the problem.

We need consistent measurement of level in the EDC storage tank:

1. Flush & blow connection on EDC level gage (to allow cleaning)
2. Filtration of Recycle EDC to remove am. sulfate crystals from the system at this point (plugs up level glass).
3. Concerted effort on part of operators to log T-3 levels on extraction & stripper logs (Likewise to note EDC gals. received in both operations).

Observations about EDC losses

1. Acid & EDC phase separation in T-1104. Data suggests (attached table I) that at times as much as 300 or 400 gallons of EDC is "lost" to the spent acid tank (≈30 LBS EDC/LB of product). At other times a near perfect EDC

recovery is poor. I believe that the loss is in technique specifically in the rate of removal & possibly settling time. I've ordered a 20 gpm flow limiting orifice from Steve Posik. But in the meantime:

Operators should (1) restrict (SPENT NaOH) flow from extraction (T-1) to the spent acid storage (T-5)

(2) as you suggested increase settling time to 2 hrs.

(3) resettle acid if an EDC layer becomes apparent.

(4) Hold back EDC observed in T-M105 while loading T/T's.

Quinn Cantrell is working upon isometric piping dwg for a permanent line from T-M105 to T-M104 so that EDC can be recovered.

(2) Stripping Operation. Attached data table II is quite erratic. But it does show that in a period of good operation (Batch 12, 13, & 14) an average of 180 gals per batch was lost.

① Gunn is making up a piping dwg for EDC recovery off the scrub in hopes of capturing stripping losses.

② We need to watch EDC recovery closely & obtain true starting & finish gages (w/o interference from vacuum or extraction or reactor charges)

I've asked Layne to work with you on this while Jim gone — all for now

Greg

cc: Bill Shockley
Layne

TABLE I
EXTRACTION
EDC
Reamy

EDC TANK T-M103

	Start		Finish		Diff in gals
	3' 8"		3' 8"		0
1	3' 5½"	1807.47	3' 6"	1837.18	-29.71
2	3' 3"	1671.30	3' 1½"	1586.11	85.19
3	3' 7½"	2026.95	3' 7¼"	2014.29	12.66
4	3' 8"		3' 8"		0
5					
6	3' 3"	1671.30	3' 2"	1615.92	55.38
7					
8	2' 1¾"	955.24	2' 5"	1021.58	-66.34
9					
BATCH 10	3' 8"	1947.13	3' 5"	1781.97	165.16
11	Level gauge BROKE				
12					
13	4' 8"	2572.25	4' 2"	2266.27	305.98
14					
15	3' 4½"	1752.19	2' 9"	1340.23	411.96
16	2' 7½"	1260.50	2' 10½"	1424.69	-164.19
17	Level gauge BROKE				
18					
19					
20	Level gauge BROKE				
21	"	"	"		
22	"	"	"		
23					
24	"	"	"		
25	"	"	"		
26	"	"	"		

TABLE X

STRIPPING

EDC Recovery

	Finish		Start		Δ Gals.
1					
2	3' 9½"	2026.95	1' 0"	316.77	1710.18
3	3' 8"	1947.13	2' 7"	1231.28	715.85
4	3' 5"	1781.97	2' 5¾"	1163.19	618.78
5	3' 0"	1507.27	2' 1½"	993.33	513.94
6	3' 3"	1671.30	2' ½"	969.22	702.08
7	3' 6¾"	1878.93	2' 9"	1340.23	538.70
8	3' 8"	1947.13	3' 1"	1560.57	386.56
9	3' 5½"	1807.47	2' 3"	1021.58	785.89
10	2' 7½"	993.33	1' 3½"	463.09	530.24
11	Level gage out of order				
12	4' 1"	2213.31	2' 6¾"	1218.80	994.51
13	4' 2½"	2294.58	2' 4½"	1098.96	1195.62
14	Level gage out of order				
15	2' 6½"	1206.31	7"	143.75	1062.56
16	"	"	"	"	
17	"	"	"	"	
18	2' 8½"	1314.99	2' 2"	969.22	345.77
19	Level gage out of order				
20	"	"	"	"	
21					
22	"	"	"	"	
23	"	"	"	"	
24					
25	Level gage out of order				
26					

4/15/7
p. 1
JTE

Vertac Checklist

1. For safety and vent losses, a conservation vent should be put on the solvent tanks even with a nitrogen sweep. Spent acid tank is first priority

2. A dessicant vent should be put on the HNO_3 stg. tk. vent to avoid venting on the top and sides of the tank.

3. Install the CBE meter on the CBE charge line. Meter is on hand.

4. Add incoming CBE purity to the QC chart.

5. Install a stripper agitator to speed up stripping.

6. Get spare reactor recirculation pump in. Pump has been shipped.

7. Try to avoid 300°F and 60 mm. as final strip conditions. 260°F and 30 mm is closer to known stability area.

8. JTE will check with Richmond, but 2 mo. snap. is recommended for spent acid sample retention.

Vertac Checklist

4/15/7
J.T.E.

9. Patch acid etched concrete with epoxy ~~[illegible]~~ acid-resistant material.

10. Suggest that the aqueous waste lbs be put on monthly accounting and that the lbs. aqueous waste/lb. NBE be routinely calculated. A reasonable goal will be provided from Mobil in light of process changes. Efforts, as discussed, should be try to reduce the aqueous waste. Namely, ① slightly increase % NH_3 in ~~so~~ solution from ~12% to ~14% ② Continue good attention on final wash pH ③ ~~Other~~ others.

11. Finish stripper receiver + pump to help strip times ~~and~~ and final conditions.

12. A safety shield should be put on the EDC tank 2-in. ø Rycch pipe level gauge.

13. A swartwout should be put on the jet steam vent to avoid hot water hitting personnel.

14. Safety sheets on CBE, NBE, EDC

MOBIL NITRATION

Capital

Purchased Equip	(56,600 IN PLANT, 46,200 TO BE PURCHASED)	102,800
Installation		47,000
Instruments (Installed)		10,000
Piping (Installed)		60,000
Electrical (Installed)		10,000
Construction Expense Misc		10,000
	TOTAL CAPITAL	239,800
	CONTINGENCY	35,200
		275,000

Operating costs / batch

Electrical - 100 HP x 4 hr/batch = 400 hp-hr @ 2.2¢/kwh		6.80
Steam - 8,000 #/batch	1.00/#	8.00
Refrigeration - 250 tons (5) tons/(hr) 15¢/hr		30.00
Cooling H_2O - 5000 GAL	10¢/M	0.50
Operating Labor - 2 men/shift	22.50	180.00
		227.30

Maintenance - mtrl & labor — $36,000/yr (161.65/batch)

Operation + Maintenance Cost — 288.95/batch

$.048/#

CAPITAL Cost — 6 mo @ 150,000 $/mo = 900,000.
12 mo @ 350,000 $/mo = 4,200,000.
$275,000 ÷ 5,100,000 # = $.054/#

PRODUCTION CAPACITY – MOBIL NITRATION

8850 #/BATCH (2200 GAL R)

.682

6036 #/BATCH (1500 GAL R)

2 BATCHES/DAY

12072

.8 OPERATING FACTOR

9658

30

289,728 #/MONTH

150/200 27½

200/250 21 ¢

250/300 14½

EQUIPMENT REQUIREMENTS - MOBIL NITRATION

① REACTOR		42,000
1500 GAL G/L PFAUDLER AVAILABLE 158 ft² JACKET, AGITATOR, ON LOAD CELLS		
② EXTRACTION TANK		
1500 GAL 316 SS REQ'D w/ AGITATOR	TANK	6200
	AGIT	1500
③ EDC DAY TANK		
1500 GAL CS REQ'D		2000
④ PRODUCT STILL / STRIPPER RECEIVER		3300
	REWORK	1200
2000 GAL 304 SS AVAILABLE 7'-0" ϕ x 5'-6 3/8" STRAIGHT SIDE, ASME F&D HEADS RATED 140 psi @ 320°F - GOOD FOR FULL VACUUM		
⑤ PRODUCT SURGE TANK		3500
	REWORK	1000
2500 GAL 347 SS AVAILABLE 7'-6" ϕ x 7'-6" JACKETED		
		60,700

(6) STRIPPER COLUMN

2'ϕ × 15½' w/ 1½"ϕ SS PALL RINGS AVAILABLE 2600

REWORK 1000

(7) REACTION COOLER 12,000

350 ft² 316 SS REQ'D

(8) STRIPPER HEATER 8400

200 ft² SS REQ'D

FULL VACUUM RATED @ 300°F

(9) EDC CONDENSER 2000

100 ft² CS REQ'D

FULL VACUUM RATED @ 300°F

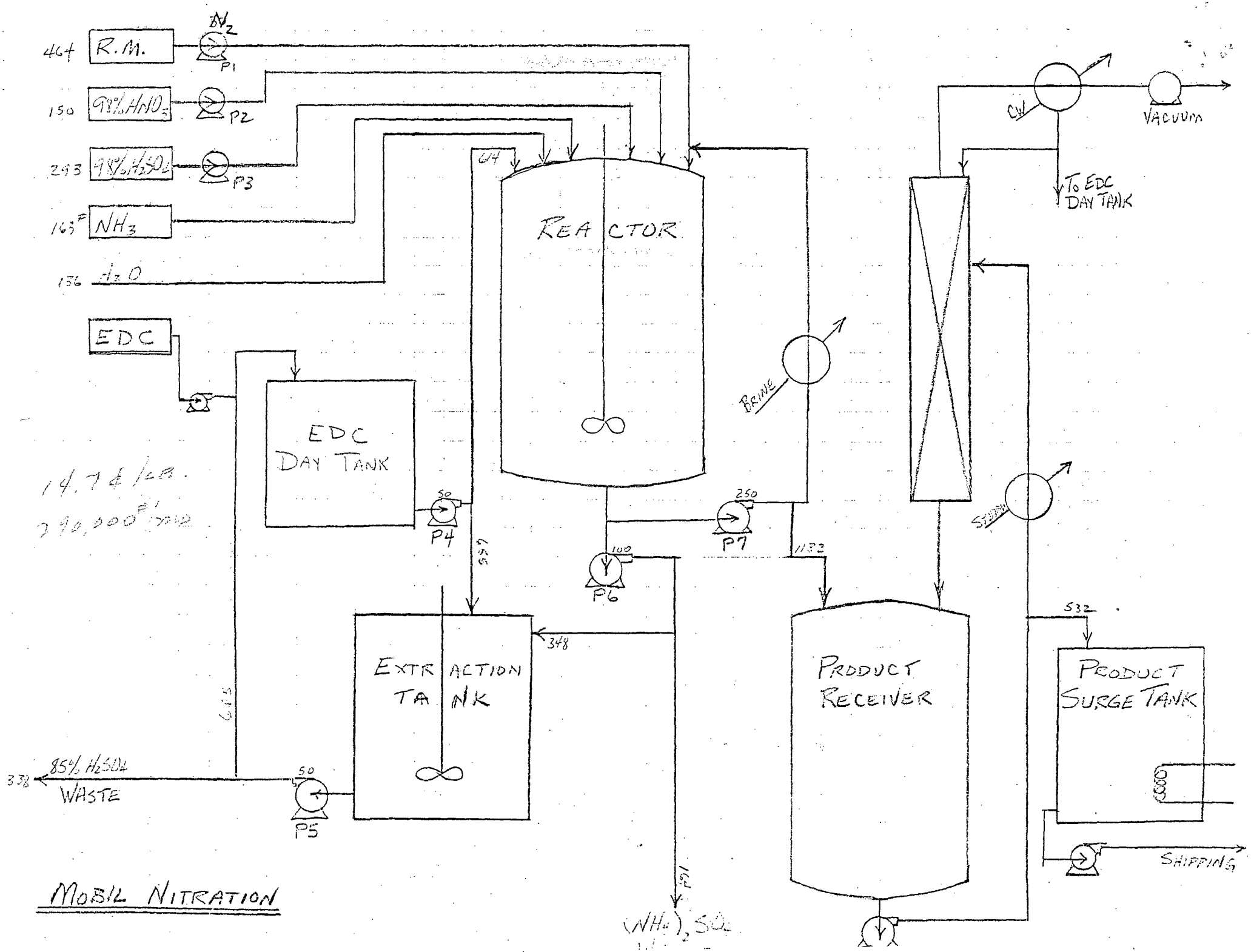
USE 2 - 60 ft² GLASS in SERIES AVAILABLE

26,000

PUMPS

①	R.M. CHARGE PUMP	20 min @ 24 GPM - N_2			
②	98% HNO_3	10 min @ 3 GPM	225 min @ 0.6 GPM		1000 00
③	98% H_2SO_4	220 min @ 1.5 GPM			1000 00
④	EDC to RX	20 min @ 31 GPM	2X1 - 80' N		1500 00
	EDC to EXTRACTION	20 min @ 33 GPM			
⑤	EDC to EXTR + DT	20 min @ 33 GPM	2X1 - 80' N		1500 00
	DRAIN 85% H_2SO_4	20 min @ 17 GPM			
⑥	SPENT ACID TO EXTRACTION	20 min @ 18 GPM	1½X1 - 60' N		1500 00
	DRAIN $(NH_4)_2SO_4$	20 min @ 8 GPM			
⑦	REACTOR CIRCULATION	200 - 250 GPM	3X2 - 60' U		2800 00
	PRODUCT TO STILL	6 min @ 200 GPM			
⑧	STILL PUMP	150 - 200 GPM	3X2 - 100'		2000 00
⑨	PRODUCT PUMP	100 GPM			1800 00
					13,100
⑩	VACUUM SYSTEM	100 cfm @ 29.5" Hg VAC			3,000
					16,100

TOTAL 1+2+3 102,800



MOBIL NITRATION

OPERATING COSTS - MOBIL NITRATION - REVISED. - 500,000 #/MO

I. RAW MATERIALS

ALL RAW MTRLS SUPPLIED BY MOBIL

II. UTILITIES - PER BATCH

① ELECTRICITY	600 KWH @ 2.5¢/KWH	15.00
② STEAM	17,000 # @ 1.00/M #	17.00
③ REFRIGERATION	1.5×10^6 BTU x .033¢/MBTU	50.00
④ COOLING WATER	10,000 GAL @ 10¢/M	1.00
⑤ TEMPERED WATER		1.00
⑥ NITROGEN		.50
⑦ TOTAL		84.50

III. OPERATING LABOR - PER BATCH

2 MEN/SHIFT @ 6.00/hr (INCLUDES BURDEN)	180.00

IV. MAINTENANCE (ROUTINE)

LABOR 8 man hr/batch	48.00
MTRL $30,000/yr	51.00
MAINTENANCE OVERHEAD →	13.00
	112.00

V. MISC. OPERATING EXPENSES

① SUPERVISION & CLERICAL	135.00
② OPERATING MTRLS	8.00
③ LABORATORY 0.5 TECHNICIAN/BATCH	26.00
	169.00

(7) ADMINISTRATIVE OVERHEAD

(1) GENERAL WORKS EXPENSE		85.62
(2) DEPRECIATION	$350,000 - 8yr S.L.	74.91
(3) INTEREST	$350,000 - 18mo @ 12%	71.26
		231.79
(8) CONTINGENCY - 10%		77.73
		$ 855.02

(9) COST PER # @ 500,000 #/mo & 80% OPERATING FACTOR (10,417 #/batch)

$$\$/\# = \frac{855.02}{10417} = 0.0821$$

7-21-75

#10

Expended to Date

Tagged Equip x 4	357,000
Instruments	28,000
Electrical Materials	44,000
Pipe	164,000
Insulation + Paint	10,500
Concrete Materials	16,000
Steel	45000
Packaging Bldg	28,000
RR Spur	5,500
CCI (182,376 OT) thru 7-15	347,000
Mec. Items	132,000
Engineering	100,000
	1,277,000
Estimate to Complete →	150,000
	1,427,000

Est Additional	Engrs	10
	CCI	100
	Equip	40
		150,000

81 000 - 35000 = 46 000

JM101 MOBIL Mitrat — BILL Stoelkoffer
John Miley

S&K

BOB FRITZ 215-659-0900

115PSIG STEAM BASIS —

BOUGHT 8/6/75 PO # 2425

① High VACUUM
Stage 4" TYPE T2a
WITH 6" DIA X 54" long
surface inner condenser

② Low VACUUM
Stage 2" TYPE S3a
WITH 5" DIA X 48" after
condenser

③ Steam Consumption (total to Both Stages) 720#/hr @ 115 PSIG Steam

④ C. Water Consumption (Total to Both Stages)
62 gpm

⑤ PRICE $3980 10 WEEKS
delivery from 8/6/75
(OCT 15th)

⑥ NOTE: Vacuum @ inner condenser
6" absolute / Barometric leg must

Condensing and Non-condensing Steam Jet Vacuum Pumps

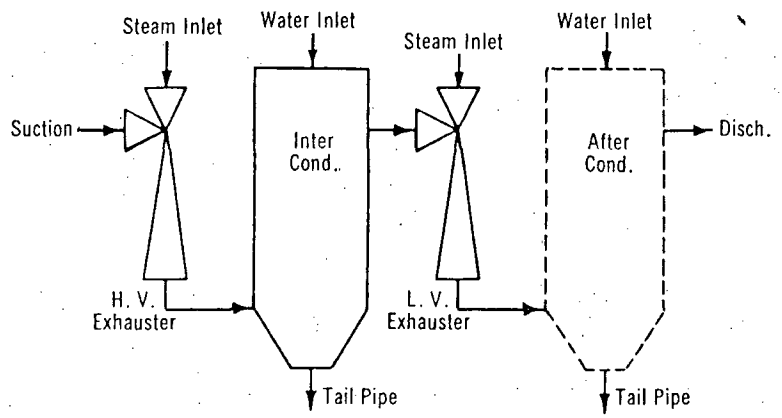


FIG. 3. Condensing Pump.

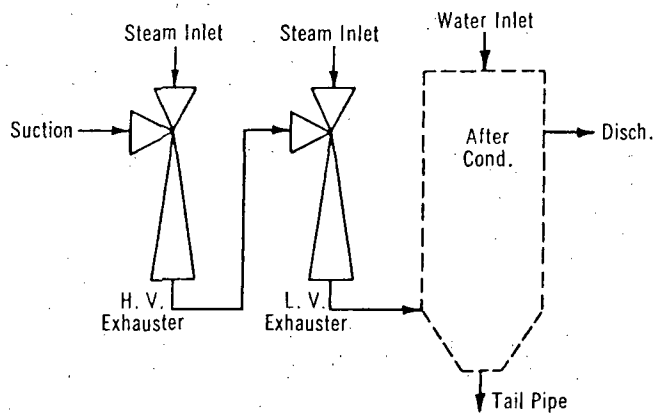


FIG. 4. Non-condensing Pump.

Based upon the use of auxiliary equipment, two and three-stage vacuum pumps can be either condensing or non-condensing types. Four, five, and six-stage units can also be non-condensing, but usually are condensing types.

Condensing Types (Fig. 3) have an intercondenser between ejectors that reduces steam consumption in later stages by (1) condensing first stage operating steam and condensable vapors; and (2) cooling the air and other non-condensables. The intercondenser may be a direct-contact barometric type, a low level type, or surface type. Pages 4, 5, and 6 contain additional details on the condensing type vacuum pump.

When the condenser is mounted at barometric elevation, there is no possibility of the condenser or suction lines flooding should steam service be interrupted or loss of vacuum occur.

A ground-level arrangement suitable for many applications is described on page 7. This type of steam jet vacuum pump is ideal for use when service conditions prohibit locating condensers at barometric height.

Non-condensing Types (Fig. 4) have the first stage ejector discharging directly into the suction of the second stage ejector and so on, using no condensers.

Compared to the condensing type, this arrangement imposes a greater load on subsequent stages, requiring more operating steam and larger units following. Non-condensing type vacuum pumps are used where condensers are not feasible, where initial cost is more important than operating cost, or when service is to be intermittent making operating cost a secondary consideration.

Both condensing and non-condensing types can be supplied with aftercondensers. The aftercondenser condenses the operating steam and any condensable vapors before the non-condensables are discharged to atmosphere.

Except for units of low capacity or those used for intermittent service, condensing units are more economical in operation than non-condensing types, although initial cost may be higher. For photos of multi-stage non-condensing vacuum pumps, refer to page 8.

MOBIL EQUIPMENT STATUS

11 Aug 75

Exchangers		Nomenclature	Vendor	P.O. #	Ordered	Shipped	Received
E-M101	7500	Nitration Reaction Cooler	La Chem Equip	2388	6 Aug 75	12 Aug 75 Younger Bros	
E-M102	2200	Still Condenser	La Chem Equip	2388	6 Aug 75	12 Aug 75	
E-M103	300	Still Tail Condenser	La Chem Equip	2388	6 Aug 75	12 Aug 75	
E-M104	2800	Still Heater	La Chem Equip	2388	6 Aug 75	12 Aug 75	
E-M105	3980	Surface Condenser & J-M101 A & B	S & K	2425	7 Aug 75	17 Oct 75	
E-M106	~	TW Heater	Denver	~	~	~	On Site
TANKS							
T-M101		H_2SO_4 Day Tank	Holland		8 Aug 75		
T-M102		HNO_3 Day Tank	Denver	~	~	~	On Site
T-M103		EDC Day Tank	Denver	~	~	~	On Site
T-M104		Extraction Tank	Denver	~	~	~	On Site
T-M105	3904	Spent Acid Hold Tank	Holland		8 Aug 75		
T-M106	3904	$(NH_4)_2SO_4$ Waste Tank	Holland		8 Aug 75		
T-M107		Aqua/NH_3 Blend Tank	Denver	~	~	~	On Site
T-M108	13375	HNO_3 Storage Tank	Holland	2328		1 Oct 75	
T-M109		Sump					@ Site
T-M110	7047	H_2SO_4 Storage Tank	Holland			15 Sept 75	
VESSELS							
R-M101	30000	Nitration Reactor	Fed Equip Co	2355	4 Aug 75	12 Aug 75	
Y-M101	10000	Solvent Stripper	La Chem Equip	2389	6 Aug 75	12 Aug 75	
Y-M102	3077	Product Surge Tank	Holland		8 Aug 75	15 Sept 75	
PUMPS							
P-M101	1072.50	98% H_2SO_4 Metering	Jack Tyler	2390	8 Aug 75	1 Sept 75	
P-M102	1072.50	97% HNO_3 Metering	Jack Tyler	2390	8 Aug 75	1 Sep 75	
P-M103-115			Denver				On Site

MOBIL NITRATION - 500,000 #/mo.

BATCH SIZE

ASSUME 80% OPERATING FACTOR

$$\frac{500{,}000\ \#}{mo} \Big| \frac{mo}{(30)(.8)\,days} \Big| \frac{day}{2\ batches} = 10{,}417\ \#/batch$$

(926 gal NBE @ 135 gpm)

RATIO FROM MOBIL PROCESS DESCRIPTION

$$\text{REACTOR SIZE} = 2200\left(\frac{10417}{8850}\right) = 2590\ gal$$

Select 3000 gal reactor. From Mobil conversation Pfaudler reactor agitator will be inefficient. Therefor select 3000 gal 316SS reactor with turbine type agitator. Also available 1500 gal G/L R4 to small & excess capacity does not exist in DCNB system for catchup.

JHMILES
5/21/85

8000 ①

EQUIPMENT REQUIREMENTS - MOBIL NITRATION - REVISED

I. VESSELS

P-10

① 97% NITRIC ACID DAY TANK — 1500
300 GAL 304SS

② 98% SULFURIC ACID DAY TANK — 1000
600 GAL CS

③ EDC DAY TANK — 3000
2500 GAL CS

④ REACTOR — 15,000
3000 GAL 316 SS ATMOSPHERIC
w/ 15 HP TURBINE AGITATOR

IGNIS

⑤ EXTRACTION TANK — 8,000
2000 GAL 316 SS
w/ AGITATOR

⑥ SPENT ACID HOLD TANK — 5,000
8000 GAL CS

⑦ $(NH_4)_2SO_4$ WASTE HOLD TANK — 5,000
5000 GAL CS

⑧ PRODUCT STILL / EDC STRIPPER — 8,000
3000 GAL 316 SS FULL VACUUM RATED

JH/MILES
5/27/76

(9) EJECTOR HOT WELL	1000
500 GAL CS	
M (10) PRODUCT SURGE TANK	3,000
2000 GAL CS w/ STEAM COIL OR JACKET	
	50,500

II. HEAT EXCHANGERS

(1) REACTOR COOLER	16,000
600 ft^2 316 SS TUBE CS SHELL	
(2) STILL HEATER	
400 ft^2 304 SS 75 psig SHELL SIDE	10,000
PL (3) STILL CONDENSERS	
(A) 100 ft^2 CW CONDENSER	3,000
CS FULL VACUUM RATED	
(B) 100 ft^2 BRINE TAIL CONDENSER	3,000
CS FULL VACUUM RATED	
	32,000

JHMiles

III. PUMPS

0	WASTE PUMPS (2 - 100 GPM)	3000
1	97% HNO_3 FEED PUMP - METERING TYPE PUMP - 0-2 GPM	1200
2	98% H_2SO_4 FEED PUMP - METERING TYPE PUMP - 0-3 GPM	1200
3	EDC DAY TANK PUMP - 40 GPM @ 80' - 2X1 CS	1200
4	REACTOR CIRCULATION PUMP - 500 GPM @ 130' - 4X3 316SS	4000
5	REACTOR PHASE SEPARATION PUMP - 20 GPM @ 60' - 1½X1 316SS	1500
6	EXTRACTION TANK PUMP - 40 GPM @ 80' - 2X1 316SS	1600
7	STILL CIRCULATION PUMP - 250 GPM @ 120' - 3X2 316SS	2500
8	PRODUCT SURGE TANK PUMP - 100 GPM @ 100' - 3X1½ CS	2000
		18,200

IV. MISCELLANEOUS

1	VACUUM SYSTEM	
	2-STAGE - NON-CONDENSING STEAM EJECTOR SET	3,500
2	IN-LINE STATIC MIXER	4,000
		7500

V. TOTAL EQUIPMENT $108,200

J.H. MILES

OPERATING COSTS - MOBIL NITRATION - REVISED - 500,000 #/MO

I. RAW MATERIALS

ALL RAW MTRLS SUPPLIED BY MOBIL

II. UTILITIES - PER BATCH

① ELECTRICITY	600 KWH @ 2.5¢/KWH	15.00
② STEAM	17,000 # @ 1.00/M#	17.00
③ REFRIGERATION	1.5×10^6 BTU x .033¢/MBTU	50.00
④ COOLING WATER	10,000 GAL @ 10¢/M	1.00
⑤ TEMPERED WATER		1.00
⑥ NITROGEN		.50
⑦ TOTAL		84.50

III. OPERATING LABOR - PER BATCH

2 MEN/SHIFT @ 6.00/hr (INCLUDES BURDEN) 180.00

IV. MAINTENANCE (ROUTINE)

LABOR 8 man hr/batch	48.00
MTRL #30,000/yr	51.00
MAINTENANCE OVERHEAD →	13.00
	112.00

V. MISC. OPERATING EXPENSES

① SUPERVISION & CLERICAL	135.00
② OPERATING MTRLS	8.00
③ LABORATORY 0.5 TECHNICIAN/BATCH	26.00
	169.00

(7) ADMINISTRATIVE OVERHEAD

(1) GENERAL WORKS EXPENSE		85.62
(2) DEPRECIATION	$350,000 - 8yr S.L.	74.91
(3) INTEREST	$350,000 - 18mo @ 12%	71.26
		231.79

(8) CONTINGENCY - 10% 77.73

$ 855.02

(9) COST PER # @ 500,000 #/mo & 80% OPERATING FACTOR (10,417 #/batch)

$$\$/\# = \frac{855.02}{10417} = 0.0821$$

To: JW Shackelford 5/26/75

From: John Miles

Subj: Mobil Nitration Meeting - Richmond Va. 5/20/75

Mobil:

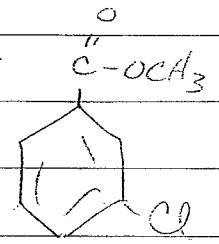
John Ellington - Process Engr - Mt. Pleasant, Tenn
John Randall - Mgr - Process Engr - Phosphorus Div
Julian Wolfenbarger - Process Engr - Phosphorus Div
Don Taggart - Mgr - Crop Chemicals formulation
T. Nichols - (part time

Vertac

Larry Graybill - Memphis
Larry Conoway - Eagle River
John Miles - Eagle River

I. Raw Material

Chloro Benzyl Ester



1. Raw material is m-chloromethylbenzoate

2. Raw material will be shipped in T/C with steam coils. Steam will be needed at unloading spot to melt CBE. N_2 pressure unloading can be used

3. Typical shipment analysis

95% CBE
0.5% MeOH
0.5% Dichloro CBE
Balance - para & ortho CBE isomers

4. Possibli problem area - CBE with high acid number can cause chloride attack on stainless steel at temperatures in excess of 200°F. Acid number will need to be checked by lab on each T/C received.

5. CBE will be valued at $15-20,000 per batch.

II. Nitration acid -

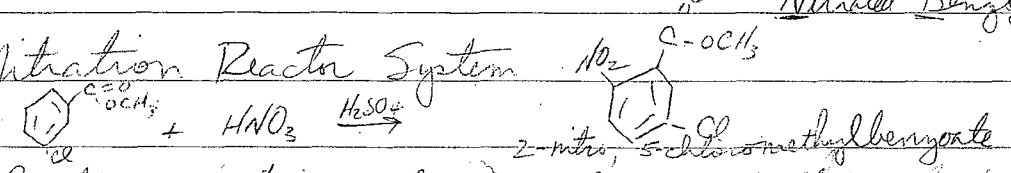
1. HNO_3 - 97%+
2. H_2SO_4 - 98%+

III. Solvent

1. Ethylene dichloride (EDC) - needs to be checked for MeOH - 0.5% max.

IV. Nitration Reactor System

Nitrated Benzyl Ester

1. 

2. Reactor, reactor cooler, and associated pump & piping can be carbon steel if system is kept dry.

3. 97% HNO_3 system can be aluminum

4. Mobil recommends using calcium chloride brine in refrigeration system instead of ethylene glycol due to hazardous condition if refrigerant leaks into reaction mix.

5. Important reaction considerations

A. Very intense agitation is required to prevent localized over concentration of nitrating acid & possibility of dinitro formation. Mobil will check on will supply information to check suitability of Pfaudler agitator we propose to use. Mobil has interlocks to stop acid feed & prevent acid feed and agitator restart in case of power failure or other agitator failure. Mobil recommends ammeter on agitator.

B. Good reaction temperature control is necessary. Formation of the desired NBE isomer is favored by lower temperatures while increased reaction rate is favored by higher temperatures. Mobil recommends 32°F operating temperature. They use dual electrical system with thermocouple sensors for fast response and interlock which cuts off acid feed at 37°F. They also meter and control acid feed rate due to a tendency for reaction to take off.

C. 1% excess of HNO_3 over molar quantities is recommended which should leave about 1% unreacted CBE

D. Tempered water is recommended for heat up prior to phase separation

E. Poor reaction can cause phase separation problems due to poor interface formation

V. Extraction System

1. after nitration the bottom acid layer can be drained from the reactor to the extraction tank for extraction with recycled & makeup EDC

2. For ambient temperatures extraction tank can be carbon steel

3. Acid contains 10-12% NBE prior to extraction

4. Extracted acid contains 1-3% NBE, 1-2% EDC, and 80-83% H_2SO_4

5. Spent acid is returned to Mobil via T/T or T/C

6. Adequate separation time must be allowed in extraction to prevent spent acid recycle to reactor which can retard reaction rate & yield

VI. Neutralization

1. Mobil recommends aqua ammonia rather than water plus gaseous ammonia sparge in order to minimize ammonia loss to vent.

2. Ammonia is recommended over caustic due to improved phase separation

3. pH is checked with litmus or hydrion paper

4. Adequate water must be added to prevent formation of $(NH_4)_2SO_4$ crystals

5. Aqeous $(NH_4)_2SO_4$ waste is returned to Mobil via T/T or T/C. Eagle River will need a storage tank to hold waste.

6. $(NH_4)_2SO_4$ waste will contain 3-5% organics which can be minimized by good operating technique & equipment design.

VII Distillation

1. Carbon steel is suitable material of construction.

2. Column not necessary for distillation. Flash pot with overhead condenser is suitable.

3. Mobil recommends steam jets for vacuum. They have had unfavorable experience on this process with vacuum pumps

4. Steam jet exhaust steam is condensed in a hotwell & recycled to aqua ammonia wash step.

5. Mobil recommends two stage distillation - down to 150 mm Hg use cooling water on condenser; down to end point of 30 mm Hg & 275°F use refrigerated brine on condenser.

6. Mobil has experienced no product degradation for heating up to 300°F

VIII Product

1. Product quality: 85-86% NBE
   2-3% CBE
   0.5% EDC (MAX)
   Balance other NBE isomers

2. NBE freezes at 118°F, therefore product storage tank and loading lines must be traced & insulated. Mobil will supply steam heated T/C for product shipment.

IX. Miscellaneous

1. Mobil approves of Eagle Rivers preliminary flow sheet. We will supply them a more detailed flow sheet incorporating data from this meeting for their comment by June 1, 1975

2. Mobil has supplied Eagle River with a quantity of physical property data per attachment "A".

3. Mobil has revised & increased quantities in their proposed production schedule

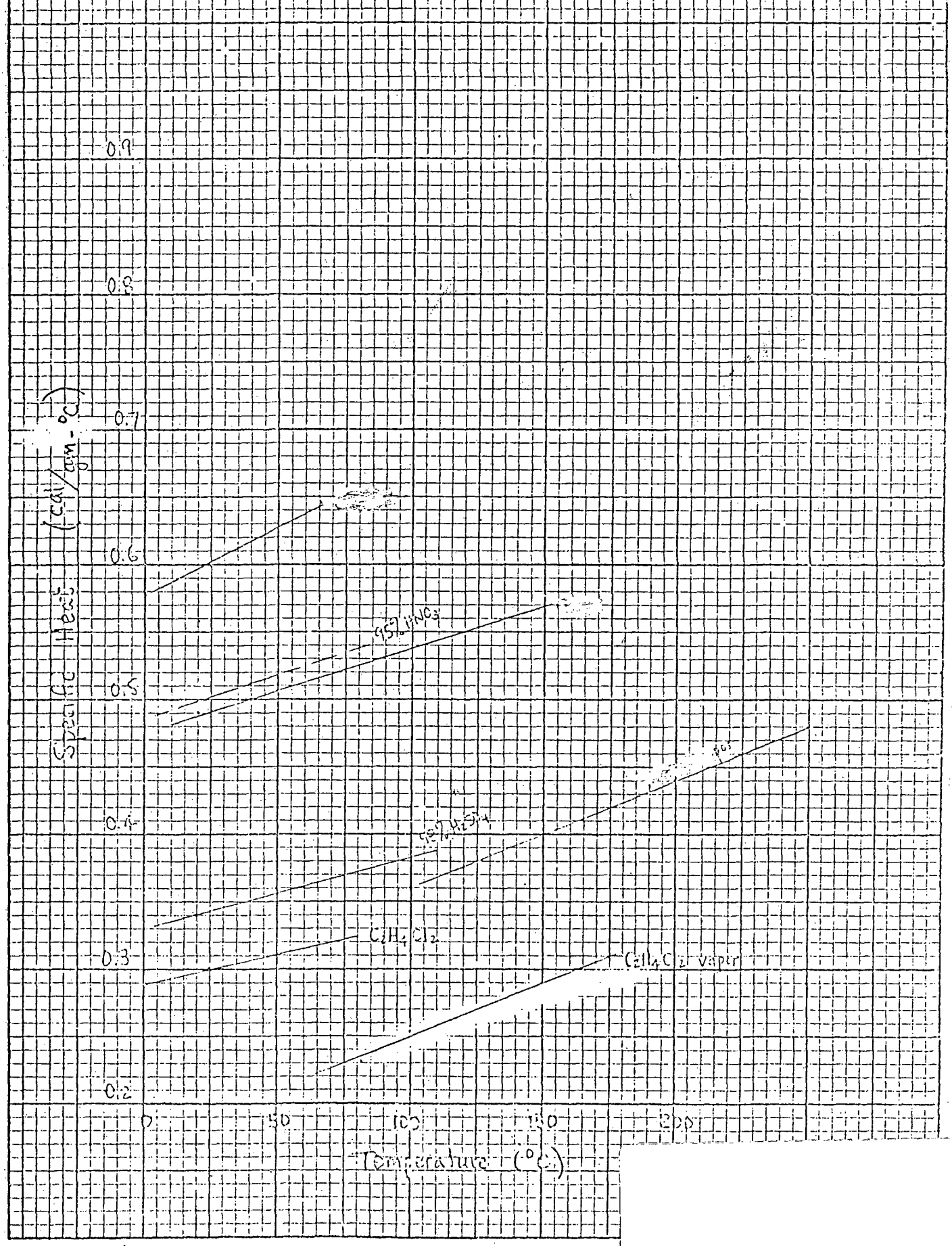
	#/mo
Oct 75	300,000
Nov-Dec 75	240,000
Jan 76	370,000
Feb-Mar 76	430,000
Apr-Dec 76	500,000

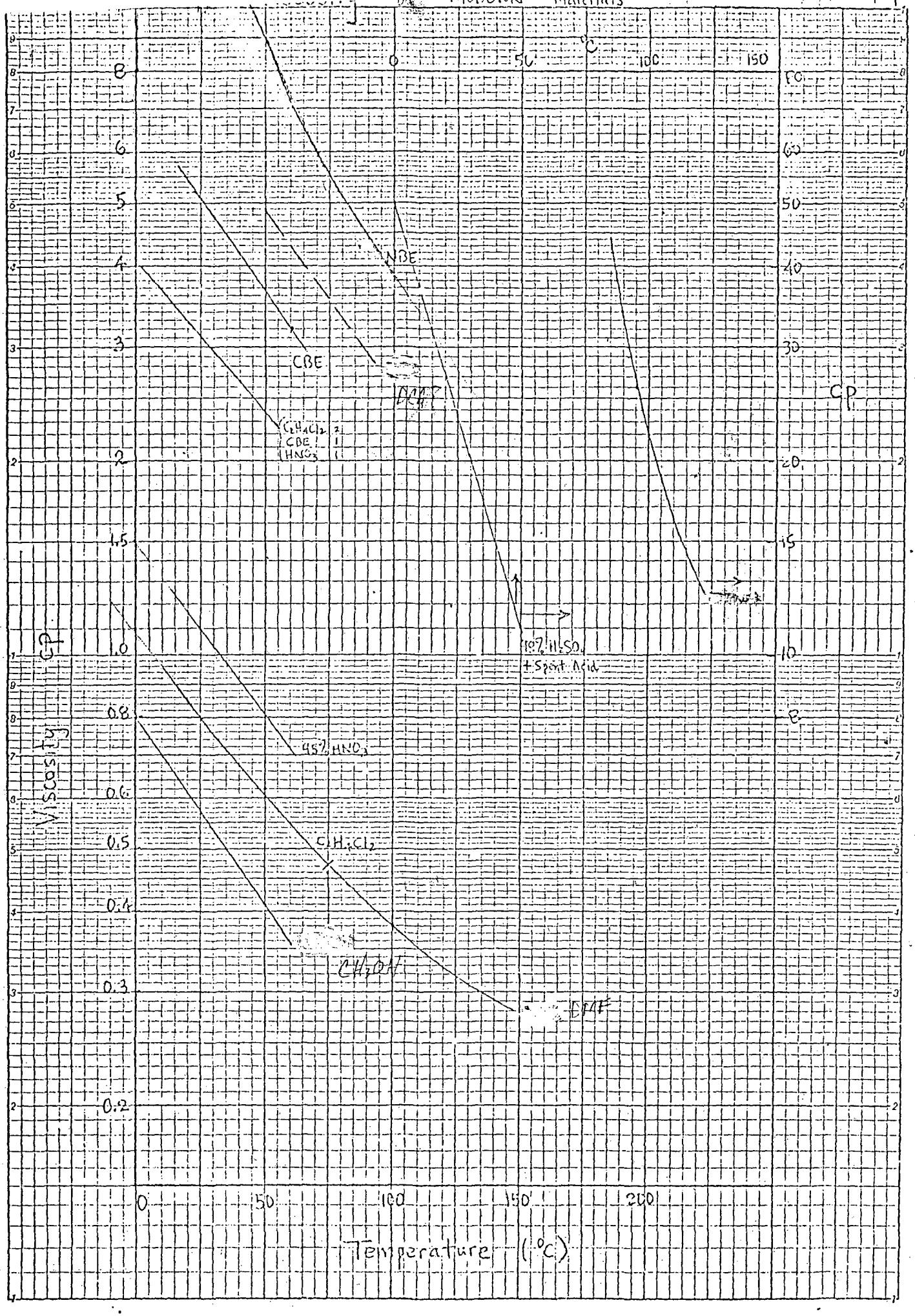
Eagle River will supply Mobil a revised operating cost and capital expenditure estimate based on the quantities by June 6, 1975

CC: Larry Graybill - Ventac, Memphis
Ray Shidi - Ventac, Shreveport
Larry Conoway - Eagle River
Don Faggert - Mobil, Richmond

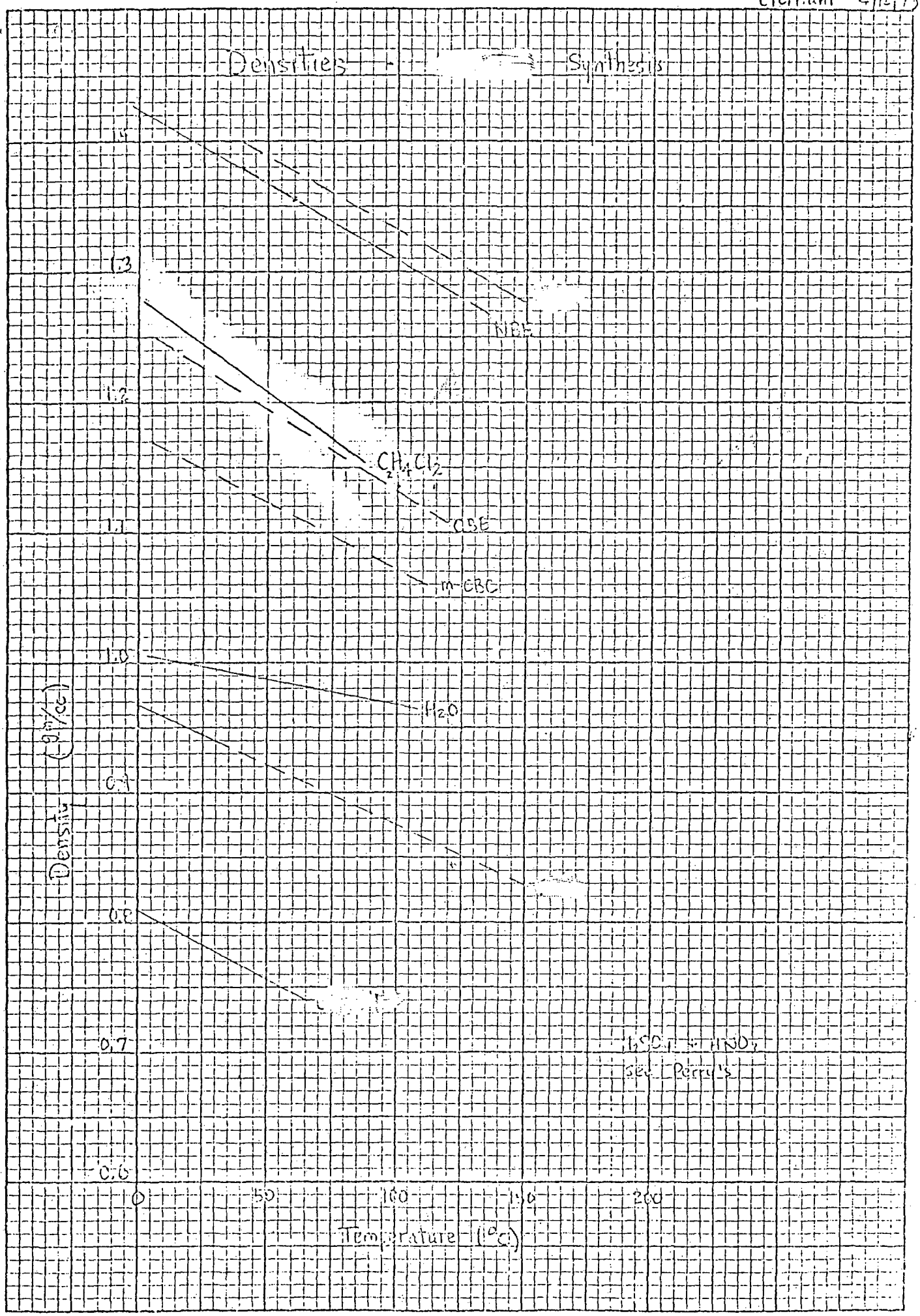
C.C. Hunt 4/12/73

Liquid Specific Heats — Motion




°C
0
50
100
150
°F
60
50
40
30
20
15
10
8
CP
8
6
5
4
3
2
1.5
1.0
0.8
0.6
0.5
0.4
0.3
0.2
Viscosity
NBE
CBE
DMF
$C_2H_4Cl_2$ 2
CBE 1
HNO_3 1
10% H_2SO_4
+ Spent Acid
45% HNO_3
CH_2Cl_2
CH_3OH
DMF
0
50
100
150
200
Temperature (°C)

C.E. Hunt 4/12/73



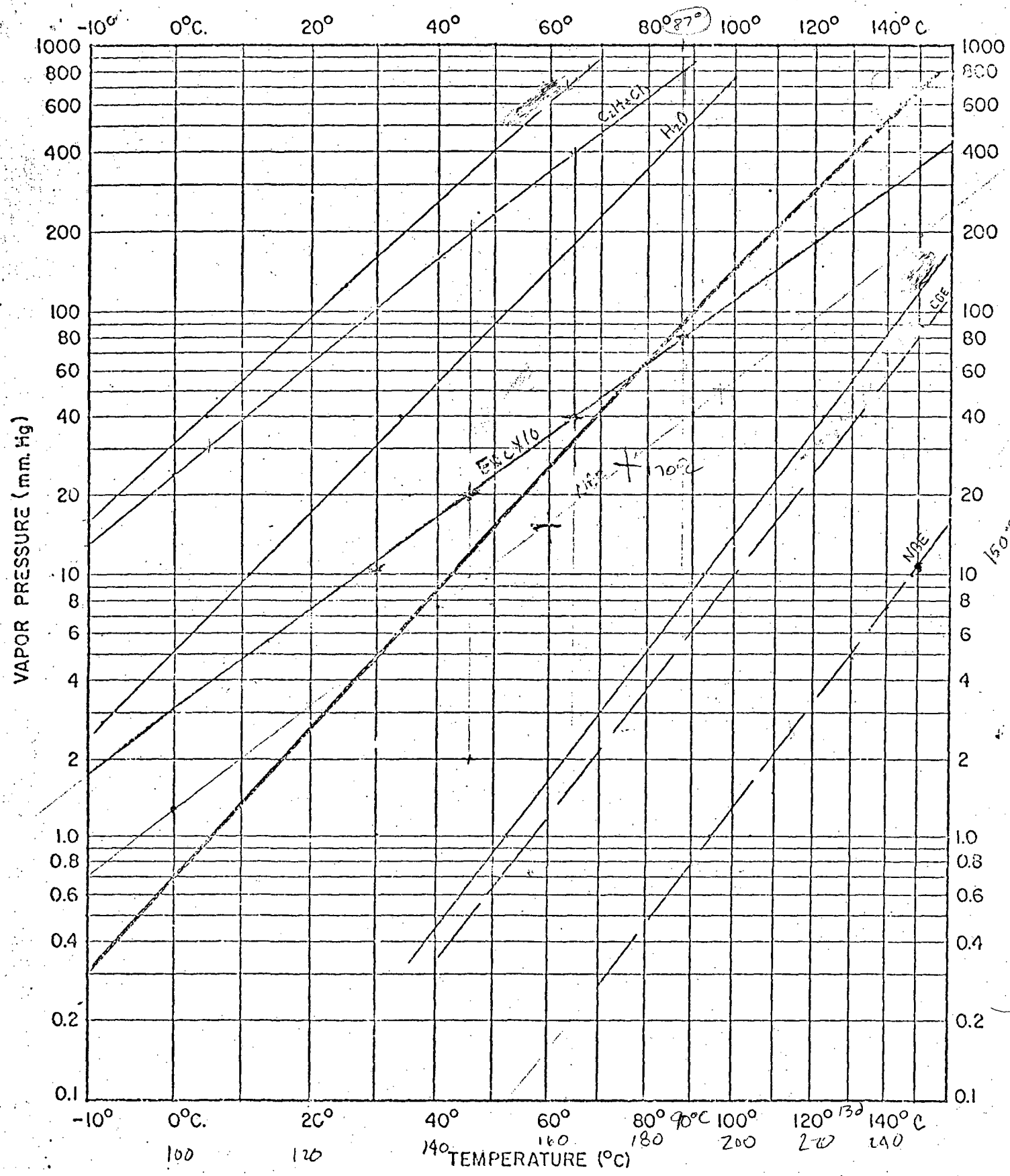
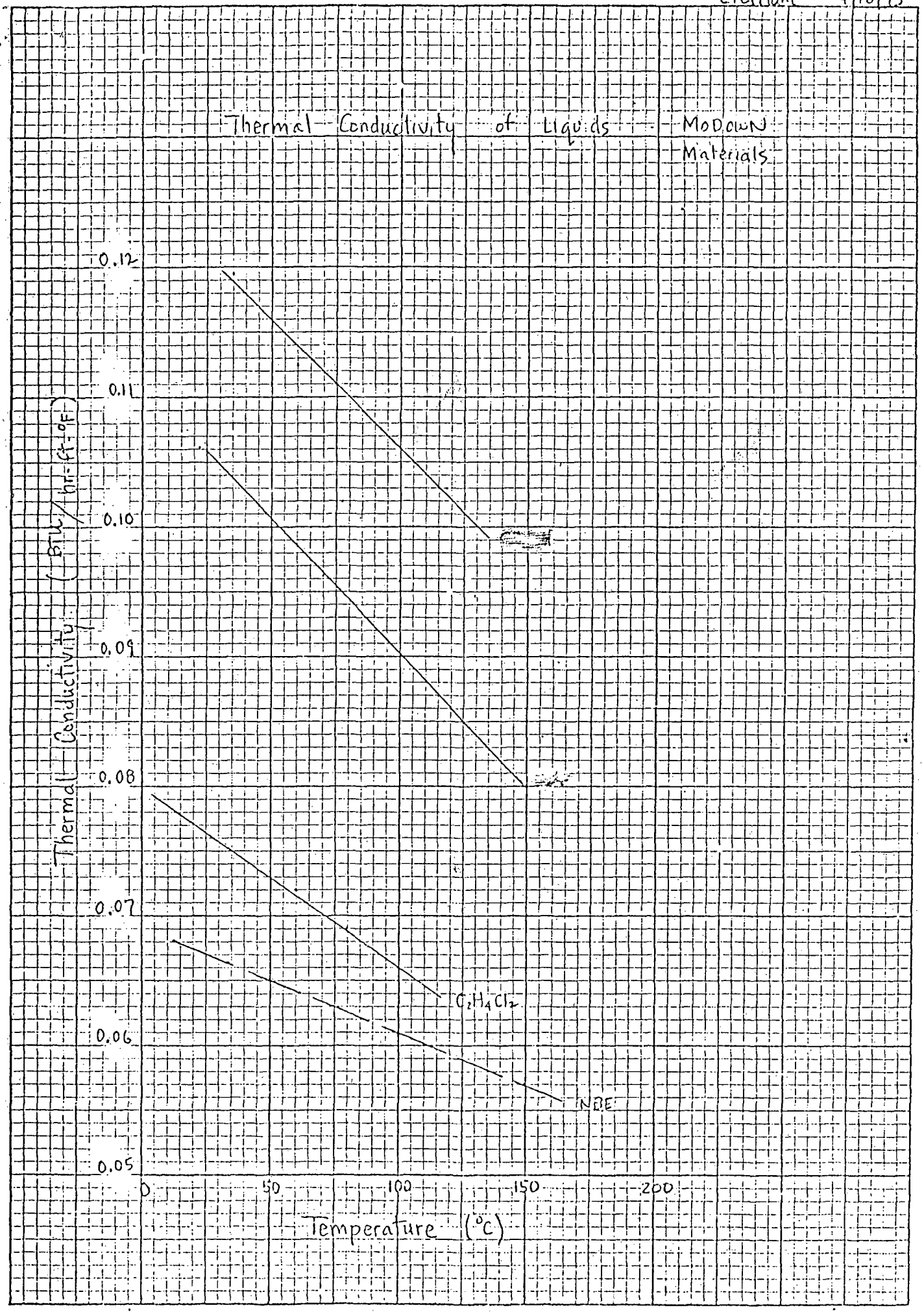


Figure III—Vapor pressure of BMF MODOWN Materials

C.E. Hunt 4/16/73

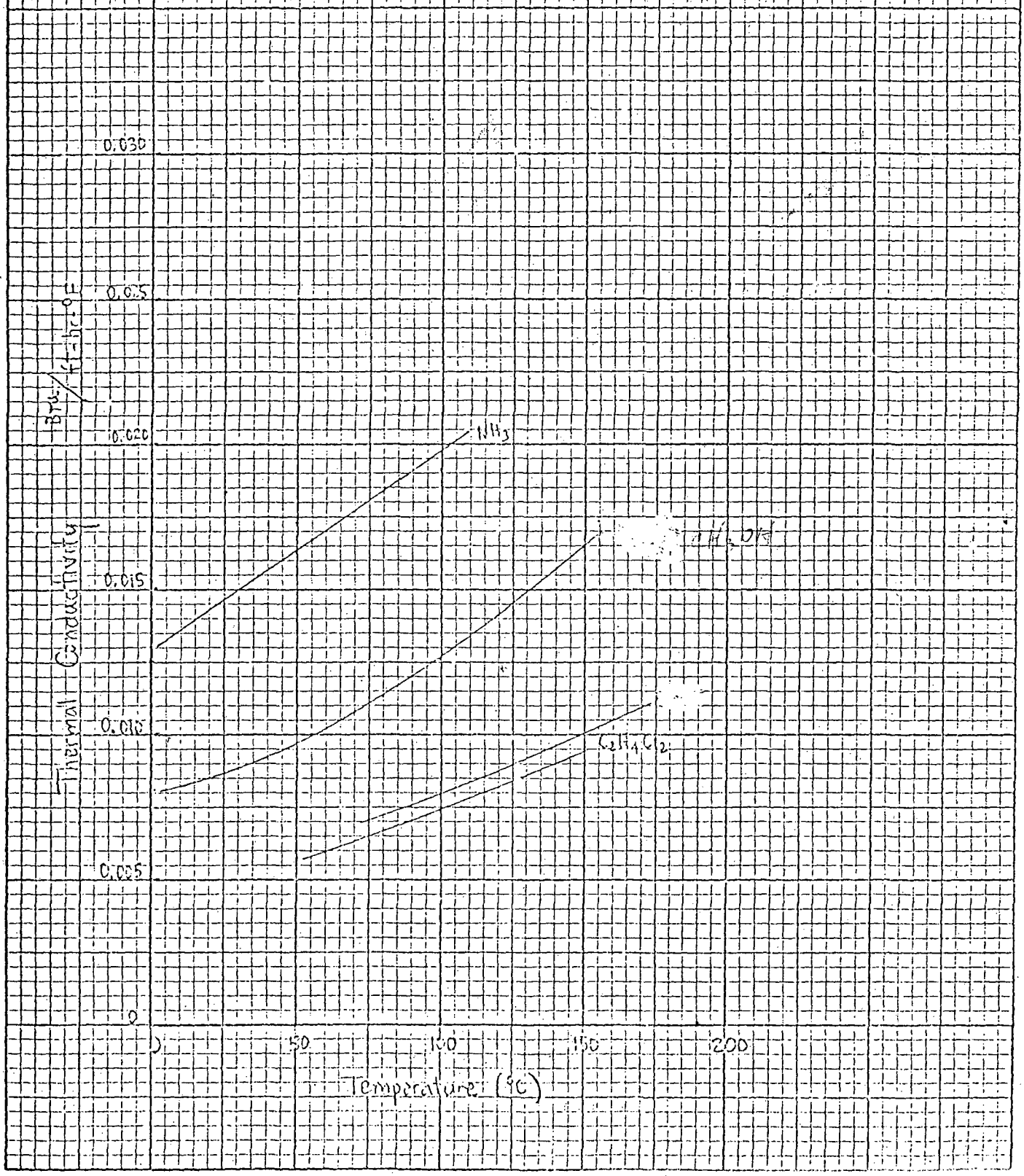


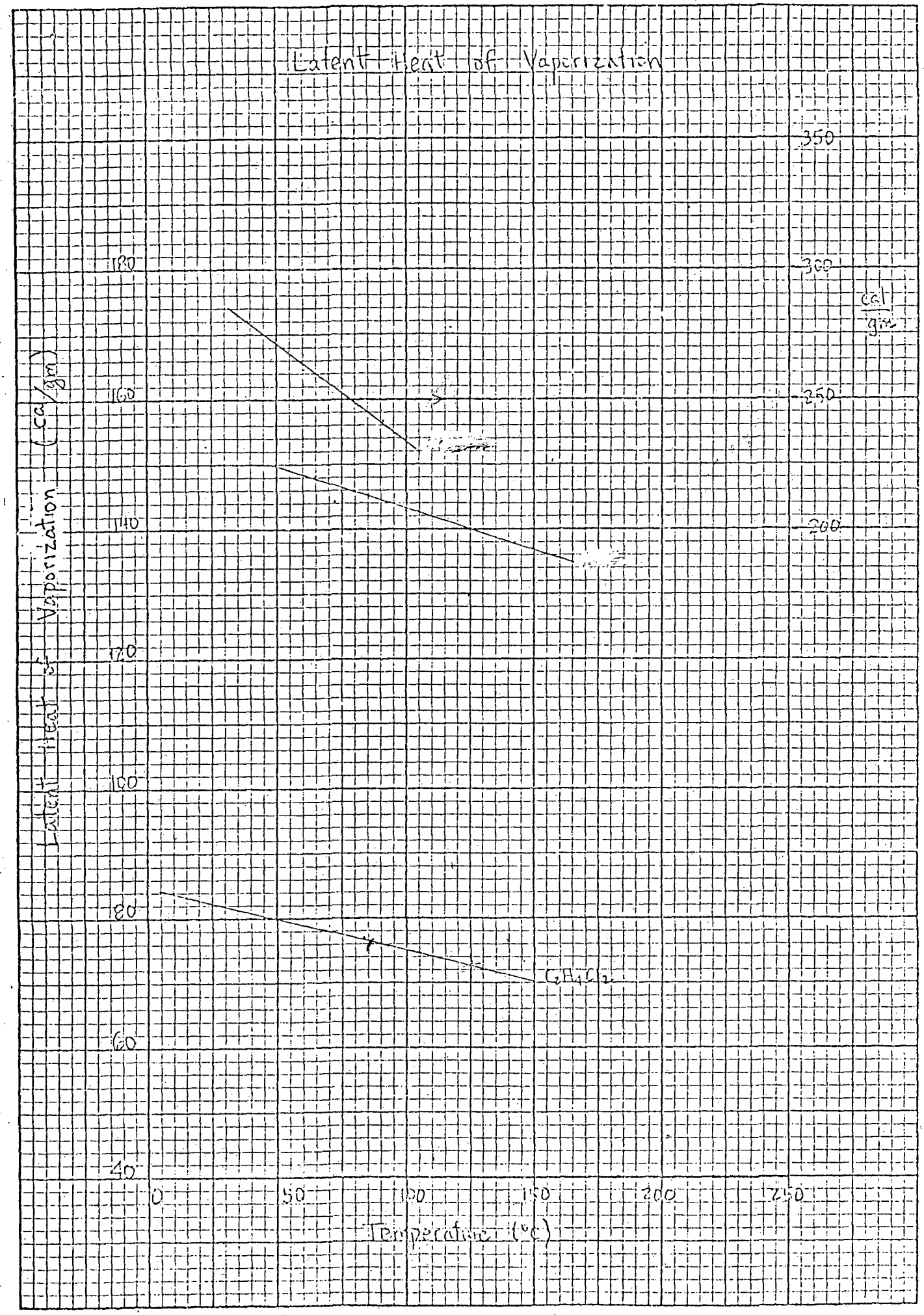
KEUFFEL & ESSER CO.

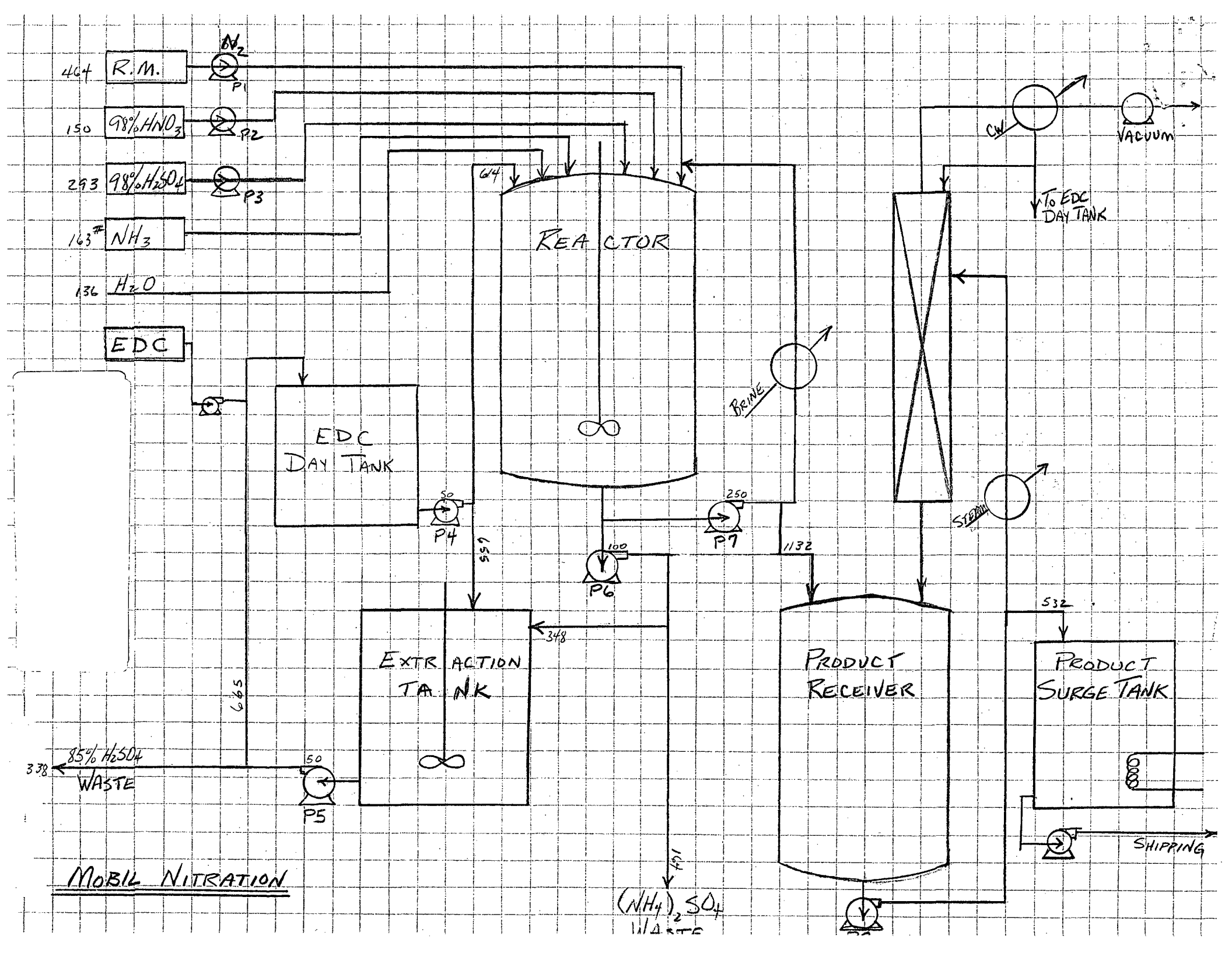
C.E. Hunt 4/13/73

McDowell Materials

Thermal Conductivity of Gases and Vapors




Latent Heat of Vaporization
Latent Heat of Vaporization (ca/gm)
180
160
140
120
100
80
60
40
350
300
250
200
cal/gm
0
50
100
150
200
250
Temperature (°C)
$C_2H_4Cl_2$



MOBIL NITRATION

MOBIL NITRATION

Capital

Purchased Equip (56,600 IN PLANT, 46,200 TO BE PURCHASED)	102,800
Installation	47,000
Instruments (Installed)	10,000
Piping (Installed)	60,000
Electrical (Installed)	10,000
Construction Expenses - Misc	10,000
TOTAL CAPITAL	239,800
CONTINGENCY	35,200
	275,000

Operating costs / batch

Electrical - 100 HP x 4 hr/batch = 400 hp hr × 2.2¢/KWH	8.80
Steam - 8000 #/batch $1.00/M	8.00
Refrigeration - 200 tons (50 ton/hr) 15¢/hr/ton	30.00
COOLING H_2O - 5000 GAL 10¢/M	.50
Operating Labor - 2 men/shift	180.00
	227.30

Maintenance - mtrl & Labor	$36,000/yr (61.65/batch)
Operation + Maintenance Cost	288.95/batch
	$.048/#

CAPITAL Cost

6 mo @ 150,000 #/mo = 900,000
12 mo @ 350,000 #/mo = 4,200,000
$275,000 ÷ 5,100,000 # = $.054/#

PRODUCTION CAPACITY - MOBIL NITRATION

8850 #/BATCH (2200 GAL R)
.682
6036 #/BATCH (1500 GAL R)
2 BATCHES/DAY
12072
.8 OPERATING FACTOR
9658
30
289,728 #/MONTH

EQUIPMENT REQUIREMENTS - MOBIL NITRATION

① REACTOR 42,000

1500 GAL G/L PFAUDLER AVAILABLE
158 ft² JACKET, AGITATOR, ON LOAD CELLS

② EXTRACTION TANK

1500 GAL 316SS REQ'D w/ AGITATOR TANK 6200
AGIT 1500

③ EDC DAY TANK

1500 GAL CS REQ'D 2000

④ PRODUCT STILL / STRIPPER RECEIVER 3300
REWORK 1200

2000 GAL 304SS AVAILABLE
7'-0" ϕ x 5'-6 7/8" STRAIGHT SIDE, ASME F&D HEADS
RATED 140 psi @ 320°F - GOOD FOR FULL VACUUM

⑤ PRODUCT SURGE TANK 3500
REWORK 1000

2500 GAL 347SS AVAILABLE
7'-6" ϕ x 7'-6" JACKETED

60,700

(6) STRIPPER COLUMN

2'φ x 15½' w/ 1½"φ SS PALL RINGS AVAILABLE 2600

REWORK 1000

(7) REACTION COOLER 12,000

350 ft² 316 SS REQ'D

(8) STRIPPER HEATER 8400

200 ft² SS REQ'D

FULL VACUUM RATED @ 300°F

(9) EDC CONDENSER 2000

100 ft² CS REQ'D

FULL VACUUM RATED @ 300°F

USE 2 - 60 ft² GLASS IN SERIES AVAILABLE

26,000

PUMPS

①	R.M. CHARGE PUMP	20 min @ 24 GPM - N_2			
②	98% HNO_3	10 min @ 3 GPM	225 min @ 0.6 GPM		1000 00
③	98% H_2SO_4	220 min @ 1.5 GPM			1000 00
④	EDC to R4	20 min @ 31 GPM	2X1 - 80' N		1500 00
	EDC to EXTRACTION	20 min @ 33 GPM			
⑤	EDC fr EXTR to DT	20 min @ 33 GPM	2X1 - 80' N		1500 00
	DRAIN 85% H_2SO_4	20 min @ 17 GPM			
⑥	SPENT ACID TO EXTRACTION	20 min @ 18 GPM	1½X1 - 60' N		1500 00
	DRAIN $(NH_4)_2SO_4$	20 min @ 8 GPM			
⑦	REACTOR CIRCULATION	200 - 250 GPM	3X2 - 60' U		2800 00
	PRODUCT TO STILL	6 min @ 200 GPM			
⑧	STILL PUMP	150 - 200 GPM	3X2 - 100'		2000 00
⑨	PRODUCT PUMP	100 GPM			1800 00
					13,100
⑩	VACUUM SYSTEM	100 CFM @ 29.5" Hg VAC			3,000
					16,100
		TOTAL 1+2+3			102,800

Mr. Don Faggert
Manager, Crop Chemicals Formulation
Mobil Chemical Company
P.O. Box 26683
Richmond VA 23261

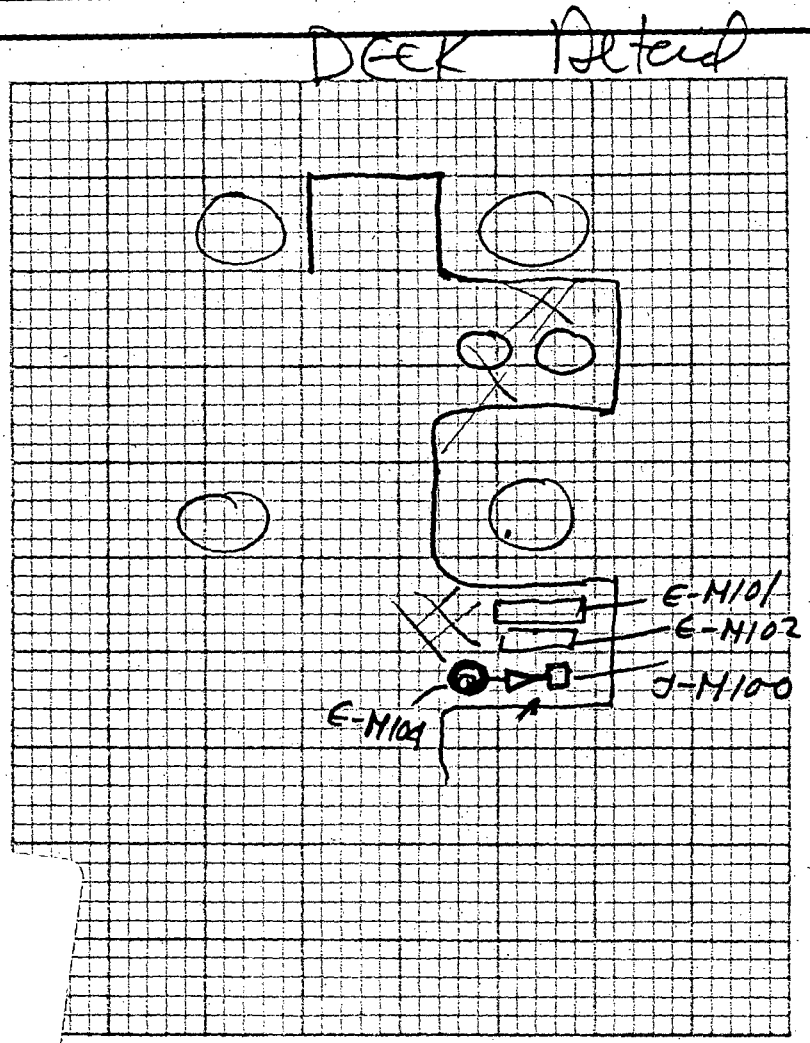
Dear Don

Single space

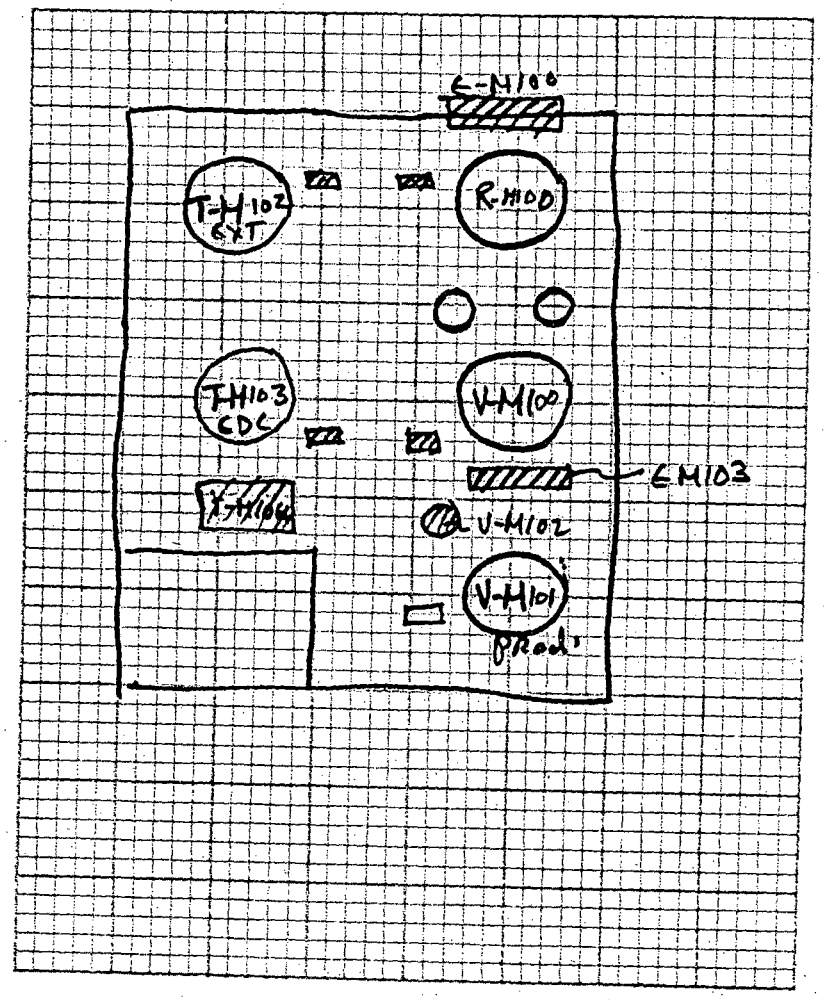
Enclosed are a preliminary flow diagram and a revised equipment list for Mobil's comments. ~~I have tried to incorporate the~~ I will have a more complete diagram at the meeting scheduled for June 10, but I thought your people would like to have an earlier idea of the direction we are taking.

Sincerely

John Miles
Project Manager



CLEMENTS & ASSOCIATES
Filters—Mixers—Pumps
Memphis, Tennessee
(901) 458-3302



CLEMENTS & ASSOCIATES
Filters—Mixers—Pumps
Memphis, Tennessee
(901) 458-3302

S.G. of 1.00 ⇒ 8.3458 #/gal

◇1 CBE – 95%

GAL/BA = $680 \times \frac{2590}{2200} = 801$ gal

9.973 #/gal × 801/gal = 7989 LBS

1 LB/GAL	9.973
2 GAL/BATCH	801
3 LB/DAY	15977
4 GAL/DAY	1602
5 GPM	53.4

⇒ LB/BATCH = 7989

@95% = 7589.55 #/CBE

◇2 EDC – 100%

GAL/BA = $900 \times \frac{2590}{2200} = 1060$ gal

9.815 × 1060 = 10399 #/BA

1	9.815
2	1060
3	20798
4	2120
5	70.66

} ⇒ 10399 #/Batch

GEORGE: ◇17, NBE PRODUCT, DOESN'T CHECK WITH SUM OF NBE IN CRUDE PRODUCT (◇7) and THAT EXTRACTED FROM HEAVY PHASE (◇5, ◇10)

ie. ~~8922~~ ≠ 8428 + 749 − 124 = 9053

Δ = 1369 #

8963

ERROR

(3) HNO_3 - 98%

$1467 \times \frac{2590}{2200} = 1727$ gal/Ba

1	12.535
2	1.727
3	43298
4	3454
5	17.27/~~6.12~~ 12.24

⇒ #/Batch = 21,649

98% ⇒ 21216 #

Based on 15%/85% ¼ hr/~~2~~ hr

(4) H_2SO_4 - 97%

$430 \times \frac{259}{220} = 506$

1	15.306
2	506
3	15490
4	1012
5	2.11

#/Ba = 7745

97% ⇒ 7512

(5) HEAVY PHASE

$510 \times \frac{259}{220} = 600$

1	—
2	600
3	—
4	1200
5	20

(6) AQUA AMMONIA –

$240\# \times \frac{259}{220} = 283\ \#\ NH_3$

$200\ gal \times \frac{259}{220} = 235\ gal\ H_2O$

$\#\ H_2O = 1965$

$\#\ MIX = 1965 + 283 = 2248$

$\%\ NH_3\ w/w = 12.59$

$S.G.\ NH_3 - H_2O = 0.9507$

1	7.934
2	283
3	4496
4	566
5	9.43

reaction time 30 min

flow = 283 gal

$gpm = \frac{283}{30} = 9.43$

(7) CRUDE PRODUCT

$1660 \times \frac{259}{220} = 1954$ gal / Batch

(16) NH_3 - GASEOUS AMMONIA

283 # / Batch 566 # / DAY

(15) POTABLE H_2O
1965 # / Batch

1	8.346
2	235
3	3930
4	471
5	7.85

(17) NBE PRODUCT
$780 \times \frac{259}{220} = 918$ gal

1	11.35
2	918
3	20845
4	1837
5	15.3 gpm

⇒ # / Batch = 10422

86% NBE ⇒ 8963 #
2-3% CBE ⇒ 313
0.5% EDC ⇒ 52
Balance 10.5% ⇒ 1094 ↓

(9) EDC TO EXTRACTION

$960 \times \frac{259}{220} = 1130$ gal/Batch

1	9,815
2	1130
3	22181
4	2260
5	37.7 gpm (30 min)

#/Batch = 11091 #

(10) 83% sulfuric acid
2% NBE
2% EDC

SG. = 1.79

$\frac{2590}{2200} \cong 1.18$

ENTER

1	CBE (680) x (1.18)	801	gal
2	EDC (900) x (1.18)	1060	
3	HNO_3 (220) x (1.18)	260	
4	H_2SO_4 (430) x (1.18)	506	
6	1/ $NH_3 + H_2O$	283	
		2910	gal

EXIT

5	HEAVY PH. (510) x (1.18)	600	
7	CRUDE PROD (1660) x (1.18)	1954	
8	2/ $(NH_4)_2SO_4 + H_2O$	384	
		2938	gal

1/ $240\# \times \frac{259}{220} = 283\# \ NH_3$

$200 \text{ gal} \times \frac{259}{220} = 235 \text{ gal } H_2O$

$\# \ H_2O = 1965$

$\# \ Mix = 1965 + 283 = 2248$

$\% \ NH_3 \ w/w = 12.59$

$S.G. \ Mix = 0.9507 \Rightarrow 7.934 \ \#/gal$

$gal. \ mix = 2248 / 7.934 = 283 \text{ gal}$

2/ $\frac{283\#}{17 \ \#/\#mole} = 16.65 \ \#mole$

$[16.65 \ \#mole \ (NH_4)_2SO_4] \times [132 \ \#/\#mole]$

$= 2198\#$

$\# \ H_2O = 1965 \qquad \# \ Mix = 4162$

$\% \ w/w = 53\% \Rightarrow S.G. \cong 1.30 \Rightarrow \#/gal = 10.85$

$4162 / 10.85 \Rightarrow 384 \text{ gal}$

2925 gal

(5) HEAVY PHASE

Basis 10,000 gal Batch

	26 821 #	H_2SO_4 —	80% w/w
	185 #	HNO_3 —	1%
total 33526 #	2 821 #	H_2O —	8%
	3 696 #	NBE + organics —	11%
	#/gal =	16.35 (?) EERONEOUS	100%

scale factor = 600 gal / 2925 gal = 0.205

Try vol. Basis (600 gal)

H_2SO_4	— 80%	vol ⇒	~~510~~ 480 gal
HNO_3	— 1%	⇒	~~6~~ gal
H_2O	— 8%	⇒	~~48~~ 72 gal
organics (NBE)	— 11%	⇒	~~66~~ 66 + 12 gal
	100%		600 gal

480 ~~510~~ gal ⇒ ~~7806~~ # H_2SO_4 = 7347#

6 gal ⇒ ~~75~~ # HNO_3 = 75#

48 72 gal ⇒ ~~601~~ # H_2O = 401 #

66 12 gal ⇒ ~~136~~ # NBE + = 749

8572 ~~8618~~ ⇒ S.G. = 14.29 OK

(10) SPENT ACID

gal = 600 − 54 (i.e. $600 - 66\left(\frac{11-2}{11}\right)$)

= 546 gal

ANALYSIS =

H_2SO_4	— 85%	⇒ ~~464~~ 487 gal	⇒ ~~6686~~ 7103.5#
HNO_3	— 1%	⇒ 5 gal	⇒ 68 #
H_2O	— 12%	⇒ 66 gal	⇒ 547 #
NBE	— 2%	⇒ 11 gal	⇒ 124 #
		546	S.G. =

5 HEAVY PHASE

see preceding page for % derivations

ANALYSIS	% vol	gal (600)	#
H_2SO_4	80	480	7347
HNO_3	1	6	75
H_2O	8	48	401
NBE	11	66	749
	100	600	8572

Den. = 14.29 #/gal

10 SPENT ACID (REMOVE ONLY NBE FROM 5)

ΔNBE = 11% to 2% gal = $600 - 66\left(\frac{11-2}{11}\right)$

ANALYSIS	%	gal (546)	#
H_2SO_4	85	464	7104
HNO_3	1	5	68
H_2O	12	66	547
NBE	2	11	124
	100%	546	7843

Dens = 14.36

(14) EDC CONDENSATE

Assume 100% EDC Recovery from (2)

gal = 1060

= 10399 gpm = 4.42 (4 hrs)

(11) EDC RECYCLE

Assume 100% Recovery from (9)

gal = 1130

= 11091 gpm = 37.7 (½ hr)

(R) EDC + (NH_3 + H_2O) TO OVERHEAD STILL

Assume Basic 100% EDC purity

— compare to (14)

gal = 1060

= 10399 gpm = 4.42 (4 hrs)

(7) CRUDE PRODUCT — BASIS

all aqua ammonia gone

~~EDC ⇒ 1060 gal ⇒ 10,400 #~~

Basis 10000 gal	#	%	
CBE	160	0.2	see next
H_2O	782	1.1	page for
EDC	37116	51	3000 gal
NBE	27798	38	batch calc.
other	7004	10%	
	72860	100%	

7 CRUDE PRODUCT - 1954 gal.

CBE - 0.2 %	3.9	gal	39 #
H_2O - 1.1 %	21.5	gal	179 #
EDC - 51 %	997	gal	9781 #
NBE - 38 %	743	gal	8428 #
IMP. - 10 %	195	gal	2047 #
	1960		20474 #

359

Moles FT^3/# Mole at S.T.P.

12 10399 # EDC ⇒ 105.04 # moles
M.W. = 99 = 37709.5 FT^3
Time = 4 HRS
∴ SCFM = 157.12

16 NH_3 : 283 # # moles = 16.65
M.W. = 17 ⇒ 5976.29 FT^3
Time = ½ HR.
∴ SCFM = 199.21

Phone: (501) 572-3701

P. O. Box 2648

Eagle River Chemical Corp.

Highway 242

WEST HELENA, ARKANSAS 72390

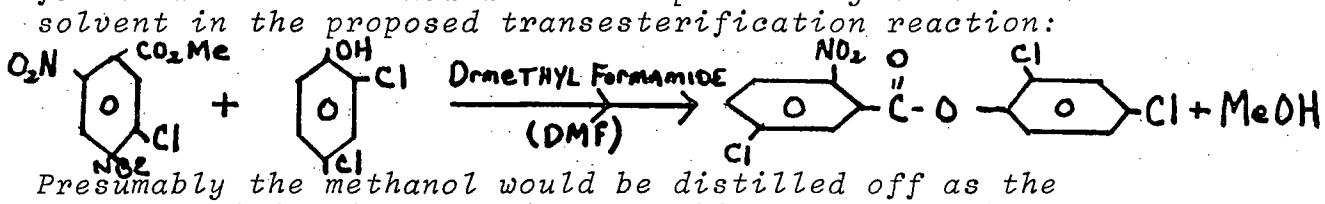
May 29, 1975

TO: LARRY GRAYBILL
FROM: LARRY CONAWAY

SUBJECT: MAY 21, 1975 MEETING WITH MOBIL (NBE CONTRACT NEGOTIATIONS)

In the course of our discussion with Mobil representatives on the possibility of our nitration of 3'chloro-methyl-benzoate (CBE) to make 2'-nitro-5'-chloro methyl benzoate (NBE), the writer had the opportunity to scrutinize Mobil's process flow sheet used in their NBE process. Although the Mobil NBE process is on a considerably larger scale than our proposed NBE process, the information gained may prove quite useful in determining what our material composition will be at various stages in the NBE process. You will find said data attached.

With respect to the composition of MODOWN, the final product formed from NBE, the writer was able to decipher the physical data charts given to us by Mobil and come up with an educated guess as to MODOWN composition. By correlating the vapor pressure and specific gravity information, it was determined that DCP, an intermediate of MODOWN, is most likely 2'4'-dichlorophenol. Dimethyl formamide is mentioned and it is presumably used as a solvent in the proposed transesterification reaction:



Presumably the methanol would be distilled off as the transesterification progresses. This appears to be an easy reaction, possibly catalyzed by mineral acid or ion exchange resin containing sulfonic acid groups. At the time of writing the mentioned information is all that the writer has. In the near future the writer will try to find more pertinent information on MODOWN by utilizing chemical literature which is not available here at Eagle River.

MOBIL NBE PROCESS DATA

181.5

REACTOR CHARGE DATA-10,000 GAL. REACTOR

10,320 lb.	96.04% HNO_3	= 163.784 lb-moles	=	832.26 gal.
28,483 lb.	99.01% H_2SO_4	= 287.531 lb-moles	=	1898.87 gal.
27,590 lb.	94.00% CBE	= 152.022 lb-moles	=	2759.00 gal.
5,977 lb.	100% EDC	= N/A lb-moles	=	569.24 gal.
126 lb.	100% NBE	= 0.584 lb-moles	=	N/A gal.

NOTES:

1. NBE charged to reactor comes in with makeup EDC.
2. Purities of components taken directly from Mobil NBE process flow sheet data.
3. 7.74 mole % excess HNO_3 based on 100% CBE & ignoring composition of impurities in CBE.
4. 1.27 mole % excess HNO_3 based on 94% purity CBE & assuming CBE impurities to be the same M.W. as CBE and mononitratable.
5. Theory yield = 32,791 lb. assuming no isomers of NBE formed.

REACTION SPENT ACID BEFORE EXTRACTION WITH EDC

26,821 lb. H_2SO_4
185 lb. HNO_3
2,821 lb. H_2O
3,696 lb. NBE

REACTION SPENT ACID AFTER EDC EXTRACTION

185 lb HNO_3
26,821 lb H_2SO_4
2,821 lb H_2O
675 lb NBE = 3.13 lb moles
172 lb other
Trace lb. EDC

CRUDE ORGANIC PHASE + EDC EXTRACTS TO STRIPPER

160 lb CBE
782 lb H_2O
37,116 lb EDC
27,798 lb NBE = 128.93 lb-moles
7004 lb other organics (Dinitro cmpds. + NBE isomers, etc.)

215.6

NOTES:

1. Overall degree of reaction = 99.38% complete
2. Calculated NBE yield based on starting materials = 84.45% of theory
3. Purity of NBE stripped product based on stripper Feed data extrapolated to after stripping (removal of all H_2O/EDC) = 79.51% pure

NOV15
OCT15

May 26, 1975

TO: J. W. Shackelford

FROM: John Miles

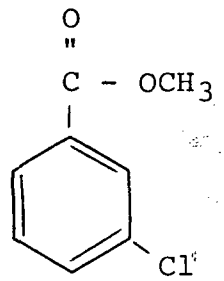
SUBJECT: Mobil Nitration Meeting - Richmond, Va. 5/20/75

Mobil:

John Ellington - Process Engineer - Mt. Pleasant, Tenn.
John Randall - Manager - Process Engineering - Phosphorous Division
Julien Wolfenbarger - Process Engineer - Phosphorous Division
Don Faggart - Manager - Crop Chemicals Formulation
T. Nichols - (Part-time) Mgr - Project Engr -

Vertac:

Larry Graybill - Memphis
Larry Conoway - Eagle River
John Miles - Eagle River



I. Raw Material (Chloro Benzyl Ester)

1. Raw material is M-chloromethylbenzoate

2. Raw material will be shipped in T/C with steam coils. Steam will be needed at unloading spot to melt CBE. N_2 pressure unloading can be used.

3. Typical shipment analysis
   95% CBE
   0.5% MeOH
   0.5% Dichloro CBE
   Balance - para & ortho CBE isomers

4. Possible problem area - CBE with high acid number can cause chloride attack on stainless steel at temperatures in excess of 200°F. Acid number will need to be checked by lab on each T/C received.

5. CBE will be valued at $15-20,000 per batch.

II. Nitration Acid

1. HNO_3 - 97% +

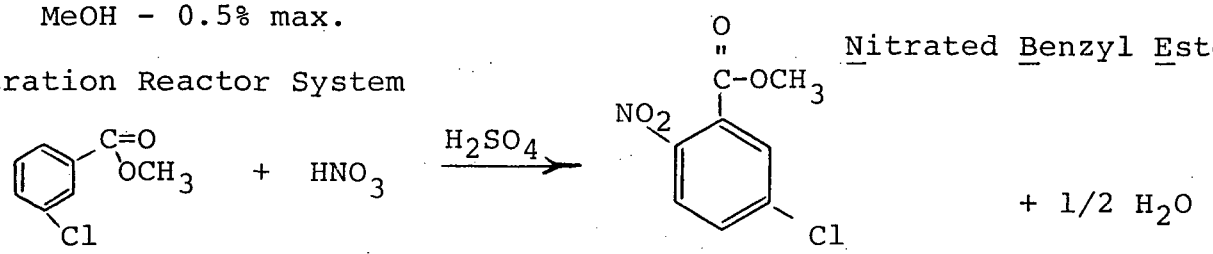
2. H_2SO_4 - 98% +

III. Solvent

1. Ethylene dichloride (EDC) - needs to be checked for MeOH - 0.5% max.

IV. Nitration Reactor System

Nitrated Benzyl Este

1. 

2-nitro, 5-chloromethylbenzoate

2. Reactor, reactor cooler, and associated pump and piping can be carbon steel if system is kept dry.

3. 97% HNO_3 system can be aluminum

4. Mobil recommends using calcium chloride brine in refrigeration system instead of ethylene glycol due to hazardous condition if organic refrigerant leaks into reaction mix.

5. Important reaction considerations

   A. Very intense agitation is required to prevent localized over concentration of nitrating acid and possibility of dinitro formation. Mobil will check or will supply information to check suitability of Pfaudler agitator we propose to use. Mobil has interlocks to stop acid feed and prevent acid feed and agitator restart in case of power failure or other agitator failure. Mobil recommends ammeter on agitator.

   B. Good reaction temperature control is necessary. Formation of the desired NBE isomer is favored by lower temperatures while increased reaction rate is favored by higher temperatures. Mobil recommends 32°F operating temperature. They use dual electrical system with thermocouple for fast response of sensors and interlock which cuts off acid feed at 37°F. They also meter and control acid feed rate due to a tendency for reaction to take-off.

   C. 1% excess of HNO_3 over molar quantities is recommended which should leave about 1% unreacted CBE.

   D. Tempered water is recommended for heat up prior to phase separation.

   E. Poor reaction can cause phase separation problems due to poor interface formation.

V. Extraction System

1. After nitration, the bottom acid layer can be drained from the reactor to the extraction tank for extraction with recycled and makeup EDC.

2. For ambient temperatures extraction tank can be carbon steel.

3. Acid contains 10-12% NBE prior to extraction

4. Extracted acid contains 1-3% NBE, 1-2% EDC, and 80-83% H_2SO_4

5. Spent acid is returned to Mobil via T/T or T/C

6. Adequate separation time must be allowed in extraction to prevent spent acid recycle to reactor which can retard reaction rate and yield.

VI. Neutralization

1. Mobil recommends aqua ammonia rather than water plus gaseous ammonia sparge in order to minimize ammonia losses to vent.

2. Ammonia is recommended over caustic due to improved phase separation.

3. pH is checked with litmus or hydrion paper

4. Adequate water must be added to prevent formation of $(NH_4)_2SO_4$ crystals

5. Aqeous $(NH_4)_2SO_4$ waste is returned to Mobil via T/T or T/C. Eagle River will need a storage tank to hold waste.

6. $(NH_4)_2SO_4$ waste will contain 3-5% organics which can be minimized by good operating technique and equipment design.

VII. Distillation

1. Carbon steel is suitable material of construction

2. Column not necessary for distillation. Flash pot with overhead condenser is suitable.

3. Mobil recommends steam jets for vacuum. They have had unfavorable experience on this process with vacuum pumps.

4. Steam jet exhaust steam is condensed in hotwell and recycled to aqua ammonia wash step.

5. Mobil recommends two stage distillation - down to 150 mm Hg use cooling water on condenser; down to end point of 30 mm Hg & 275°F use refrigerated brine on condenser.

6. Mobil has experienced no product degradation for heating up to 300°F.

VIII. Product

1. Product Quality: 85-86% NBE
   2 - 3% CBE
   0.5% EDC (Max.)
   Balance other NBE isomers

2. NBE freezes at 118°F, therefore product storage tank and loading lines must be traced and insulated. Mobil will supply steam heated T/C for product shipment.

IX. Miscellaneous

1. Mobil approves of Eagle River preliminary flow sheet. We will supply them a more detailed flow sheet incorporating data from this meeting for their comment by June 6, 1975.

2. Mobil has supplied Eagle River with a quantity of physical property data per attachment "A".

3. Mobil has revised and increased quantities in their proposed production schedule.

Oct. 75	300,000
Nov-Dec., 75	240,000
Jan. 76	370,000
Feb-Mar. 76	430,000
Apr-Jan. 78	500,000

Total 13,010,000 lbs.

Eagle River will supply Mobil a revised operating cost and capital expenditures estimate based on the quantities by June 6, 1975.

cc: Larry Graybill - Vertac, Memphis
Ray Guidi - Vertac, Shreveport
Larry Conoway - Eagle River
Don Faggart - Mobil, Richmond

Mobil Nitration Equipment List

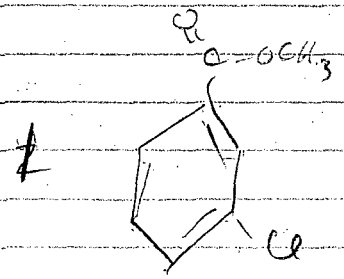
	Size	Mat'l	Remarks
1. A-M101 Nitration In-line Mixer	500 GPM	SS	Quote
2. A-M102 Aqua NH_3 Mixer		CS	Denver Equip
Exchangers			
1. E-M101 Nitration Reactor Cooler	600 Ft^2	316 SS Tube CS Shell	
2. E-M102 full vac rating Still Condenser	100 Ft^2	CS Tube CS Shell	
3. E-M103 full vac rating Still Tail Condenser	100 Ft^2	CS Tube CS Shell	
4. E-M104 Still Heater	400 Ft^2 75 PSIG	304 SS Tube CS Shell	
5. E-M105 Surface Condenser	50 Ft^2	CS Tube CS Shell	
6. E-M106 TW Heater	15 Ft^2	CS Tube CS Shell	Denver E-1390
1. J-M101 Still Jet	30 MM Hg	@ R-M101	Quote
1. M-M101 Reactor Agitator	15 HP Turbine	316 SS	Prefer w/ Reactor
2. M-M102 Extractor Agitator	10 HP Turbine	316 SS	Denver V-1101
Tanks			
1. T-M101 H_2SO_4 Day Tank	600 gal	A 285 C	Holland
2. T-M102 HNO_3 Day Tank	966 gal	3003-0	Denver T-1232
3. T-M103 EDC Day Tank	2500 gal	CS	Denver V-1140 3300 gal
4. T-M104 Extraction Tank	2000 gal	316 SS	Denver V-1101 2000 gal
5. T-M105 Spent Acid Hold Tank	10000 gal	CS	Quote
6. T-M106 $(NH_4)_2SO_4$ Waste	10000 gal	CS	Quote
7. T-M107 Aqua-NH_3 Blend Tank	2000 gal	CS	Denver T-1284
8. T-M108 97% HNO_3 Storage Tank	20000 gal	Alum 5083-H321	Ordered Holland
9. T-M109 Emergency Sump	5000 gal	Concrete	@ Fdn
10. T-M110 98% H_2SO_4 Storage Tank	20000 gal	CS	Field

Pumps		Size	Mat'l	Remarks
P-M101	98% H_2SO_4 Metering	0-3 GPM		Quote
P-M102	97% HNO_3 Metering	0-2 GPM		Quote
P-M103	EDC Charge	40 GPM @ 80'	CS	Denver - P1610
P-M104	Extraction Transfer	40 GPM @ 80'	316 SS	" P1403
P-M105	Spent Acid Transfer	50 GPM @ 80'	CS	" P1314
P-M106	Waste Transfer	100 GPM @ 80'	316 SS	" P1404
P-M107	Reactor Circulation	500 GPM @ 130'	316 SS	" P1580
P-M108	Rx Circ (Spare)	500 GPM @ 130'	316 SS	" P1402
P-M109	Product Transfer	100 GPM @ 100'	Alloy 20	" P1470
P-M110	Still Circulation	250 GPM @ 120	Alloy 20	" P1471
P-M111	Reactor Phase Transfer	20 GPM @ 60'	316 SS	" P1618
P-M112	EDC Portable Unload	10 GPM @ 30'	316 SS	" P1452
P-M113	97% HNO_3	50 GPM @ 80'	316 SS	" P1331
P-M114	98% H_2SO_4	30 GPM @ 80'	CS	" P1477
P-M115	Agro-NH_3 Blend	60 GPM @ 80'	316 SS	" P1350
Reactors				
R-M101	Nitration Reactor	3000 Gal	316 SS	Quote
V-M101	Solvent Stripper	3000 Gal	316 SS	Quote FV
V-M102	Product Surge Tank	2000 Gal	CS	Quote - Coils or Jacket
S-M101	$(NH_4)_2SO_4$ Stripper			Denver S1078
S-M102	" "			

Dalf
Nmx
NO2

40
120

98% HNO_3
65% HNO_3



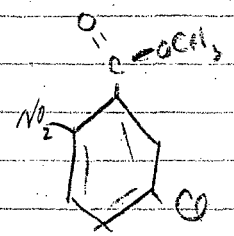
			DCBE
C	8×12 =	96	170.5
H	7×1 =	7	35.5
O	2×16 =	32	− 1.0
Cl	1×35.5 =	35.5	204.0
		170.5	

+

1 HNO_3

O	3×16 =	48
N	1×14 =	14
H	1×1 =	1
		63

↓



DBE	1×170.5 =	170.5
N	1×14 =	14
O	2×16 =	32
		216.6
H		1
		215.6

+

½ H_2O

2.7 EDC — ~~# 1993 langes handbook~~
~~also ethylidene dichloride~~
~~1.176 20/20°~~

#1994
83.5°C Bpt
1.253 gravity

From the desk of

R. M. FABIAN

To George 7/29/75

This is what we came up with on Basalin suggested toll charge (price) quotes.

As obvious we will lose money @ 48¢/lbs., since BASF won't be taking more than 1.5mm #/yr. The only way we can make out is to have Colex share some of the capital-dependent costs, e.g. depreciation, interest, etc.

Bob F.

VERTAC INCORPORATED

Building 4—Suite 412 • Shreve City Office Park
Shreveport, Louisiana 71105 • Phone 318-869-3434

1-28-75

ESTIMATED MANFACTURING COST
FOR ADDED PRODUCTION, ANNUAL BASIS PACO 613A

APPROPRIATION NUMBER: Eagle River Plant

Basalin (Starting w/ DN@CBTF) Basis: lbs of Basalin

1. PLANT PRODUCTION

RATE, ____ OF ____ /		Expected for '78-'79		
RATE, IN % OF NEW TOTAL CAPACITY				
ADDED, IN ____ OF ____ /	#/yr.	1.5mm	2.0mm	1.0mm
ADDED, IN % OF ADDED CAPACITY		75 %	100 %	50
Capital Cost:		①$550m	$550mm	$550m

2. ~~RAW MATERIAL & FUEL COST~~ R.M. on Toll basis

TYPE	UNITS	UNIT COST	USAGE /Batch	$	$	$
Electricity	KWH	0.025	1200	0.0114		
Steam	mmBtu	1.150	1.03	0.0005		
Cooling	m gal	0.06	26	0.0006	→	→
Process H_2O	m gal	0.40	25	0.0004		
N_2				0.0016		
Effluent Treatment		0.03/#	6300#	0.0719		
SUBTOTAL, RAW MATERIALS & FUEL				$0.0864	$0.0864	$0.086

3. UTILITIES

TYPE	UNITS	UNIT COST	USAGE /	$	$	$
ELECTRICITY						
STEAM						
WATER						
SUBTOTAL, UTILITIES				$	$	$

4. OPERATING LABOR $ 3 oper/shift + 6 packing		$0.141	$0.094	$0.188
5. ROYALITIES & RENTALS $ ____ /				
6. BURDEN				
A. REPAIR LABOR ②		$0.010	$0.010	$0.010
B. REPAIR SUPPLIES ②		0.018	0.018	0.018
C. OPERATING SUPPLIES ②		0.002	0.002	0.002
D. SUPERVISION		0.012	0.008	0.016
E. INDIRECT PAYROLL @ 35 % [Oper + Repairs Labor]		0.059	0.039	0.078
SUBTOTAL, BURDEN		$0.101	$0.077	$0.124
7. FIXED AND SERVICE COSTS				
A. GENERAL WORKS EXPENSE, INCL. TAXES & INS.		$0.015	$0.010	$0.02
B. DEPRECIATION (#110 m/yr)		0.083	0.055	0.11
C. LABORATORY		0.008	0.008	0.008
D. Interest @ 10% (#55m/yr.)		0.042	0.028	0.056
SUBTOTAL, FIXED & SERVICE COSTS		$0.148	$0.101	$0.194
8. TOTAL BULK COST		$0.476	$0.358	$0.592
9. LOADING, PACKING & SHIPPING				
A.				
B. Per B.C. Chang		0.022	0.022	0.022
~~SUBTOTAL, L.P. & S.~~ Total		$0.498	$0.380	$0.614
10. CONTINGENCIES Profit @ 10% ROI (A.T.)		$0.083	$0.055	$0.110
11. ~~TOTAL MFG. COST FOR ADDED PROD., ANNUAL BASIS~~ Suggested Quote →		$0.581	$0.435	$0.724
12. UNIT MANUFACTURING COST FOR ADDED PRODUCTION		$ /	$ /	$ /

NOTES: ① #667m capitalized value estimate by B.C. Chang discounted to #550m per value of presently installed equipment
② Assume fixed cost

PREPARED BY: B.C. Chang/RME | CHECKED BY | DATE

1/15/76

MOBIL NBE

TELECON R. GUIDI / BILL S.

We indicated to Ray the following:

- CURRENT

  10.5 MLBS/BATCH
  1.5 Batches/Day
  450 MLBS/MT — MAX
  100% O.F.

PROBLEMS/COMMENTS

- SOON

  10.5 MLBS/BATCH
  2 BATCHES/DAY
  500 MLBS/MT Good

80% O.F.
24 days/mo

- BEST WITH CURRENT SETUP BUT ATTAINABLE (No logistics problems, etc.)

  11 MLBS/Batch
  2 Batches/Day
  600 MLBS/MT O.K.

90% O.F.
27 days/mo

- PROJECTED WITH MOD EDC TANKAGE, ETC. & SEPARATE Φ SEPARATOR & NEUTRALIZER

  11 MLBS/Batch
  3 Batches/Day
  800 MLBS/MT

$100M Cap. EST.

80% O.F.

6/22/76

To: Bill Shackelford
Re: Mobil Nitration

I talked to Don Taggart today. They are projecting the following NBE production for the last half of the year

July	350 M lbs.
Aug	400 M lbs.
Sept - Dec	500 M lbs

They are also interested in a ballpark cost estimate of maximum production from our unit. They are looking for an alternate source of ~ 500 M lbs/mo CBE & also capacity to make into NBE.

John Miles

cc: George Mather
Mike McKellar

area

E-M101	Preferred ft2	minimum	maxi
RXN Cooler	600	500	700
E-M104 Stripper Heater	150	125	200
E-M102 Primary Condenser	150	125	200
E-M103 Secondary Condenser	75	50	100

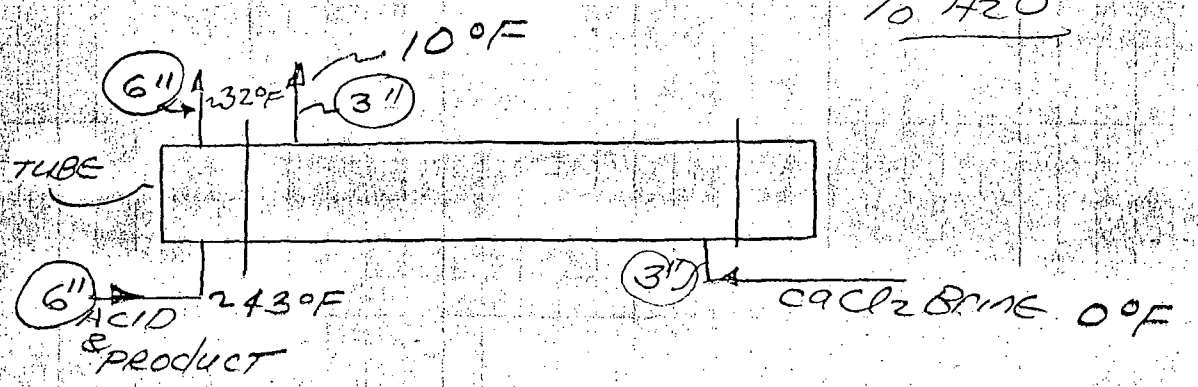
JIM

Cannot give you "QUICKIE" pressure drop info BUT BELIEVE you have enough GPM, pipe size data to avoid exchangers WITH too many passes, too small tubes, etc. etc.

Good Luck

E-M101

% H_2O



$$Q = (m\,\Delta H_{RXN}) + (M\,c_p\,\Delta T) + \text{NEGLECT (heat of mixing)}$$

(430 Btus/# CBE)

(7989# CBE/BATCH)

$Q = 3{,}435{,}000$ Btus

$Q_1 = 15\%$ Nitric in 1/4 HR $= \dfrac{15\% \times 3.4\ \text{mmBtus}}{1/4}$

$= 2.1$ mmBtus/hr

$Q_3 = 85\%$ Nitric in 3 Hrs $= \dfrac{85\% \times 3.4\ \text{mmBtus}}{3} = .963$ mmBtus

$Q_2 =$ " " " 2 Hrs $= \dfrac{85\% \times 3.4\ \text{mmBtus}}{2} = 1.45$ mmBtus

$Q_4 =$ 4 Hrs $= .73$ mmBtus

ΔT_m 63 65 5 0 58 65 Call it 38

ΔT_m = 32 34 (2 or 3 or 4) 5 0 27 34 CALL IT 27

$$\boxed{U = 84\ (\text{worst}) \longrightarrow 120\ (\text{BEST})}$$

Area (worst 2 hr addition) $= \dfrac{Q_3}{U\,\Delta T_m} = \dfrac{1.45\ \text{mmBtus}}{(84)(27)} = 639\ ft^2$

Area (3 hr addition) $= \dfrac{.963\ \text{mmBtus}}{(84)(27)} = 424\ ft^2$

Area 15% addition $= \dfrac{Q_1 = 2.1\ \text{mmBtus/hr}}{(84)(58)} = 431\ ft^2$

$Q = C_p M \Delta T = 1.45$ mmBtus/hr $= (.3)(600\ \text{gpm})(\Delta T)$

RECHECK ΔT_m Loop $\Delta T = \dfrac{1.45\ \text{mm}}{(.3)(600\ \text{gpm})(500\ \frac{\#}{hr}/\text{gm})(1.5\ \text{sp gr})} = 11°F$

$$\Delta_{coolant} = \frac{1.45\ mm}{10} = \underline{290\ gpm}$$

$$\Delta T_m = \begin{array}{cc} 43 & 32 \\ \underline{0} & \underline{10} \\ \underline{43} & \underline{22} \end{array}$$

call it $\underline{27}$

<u>Summary</u>

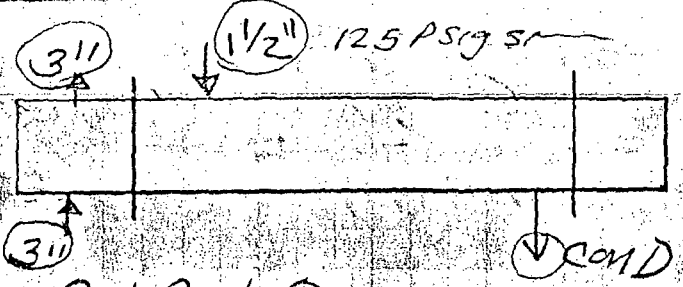
Area req'd with 3 HR addition time = 424 ft2

with 2 HR addition time = 639 ft2

" 4 HR " " = 320 ft2

<u>NOTE Hazard</u>: Plant in Nitration had ≈100% safety margin. Nominal 600 ft2 unit gives us that. Nominal 400 ft2 gives us ≈ 33% & 500 ft2 " " ≈ 66% safety margin.

E-M104



U = stripping
= 100 assumed
= 120-150 expected

$Q_T = Q_1 + Q_2 + Q_3$

$Q_T = cpM\Delta T_{initial} + M\lambda$ — assume 150 Btus/#

21 MLBS/Batch — 11.8 MLBS/Batch

9 MLBS final + $cpM\Delta T$ final heating

$Q = (.5)(12\text{MLBS})(135-70) + (12\text{MLBS})(150)$
$+ (.5)(9\text{M})(275-135)$

$= 390\text{M} + 1.8\text{MM} + 630\text{M}$

$Q_T = 2{,}820\text{ MM}$

$Q_1 = \frac{390\text{M}}{1/2 \text{ hr heating}} = 780\text{ MM}$

$Q_2 = \frac{1.8\text{ MM}}{2\text{ hrs}} = 900\text{ MM}$

$Q_3 = \frac{630\text{ MM}}{1} = 630\text{ MM}$

MOBIL OPN
260°F start @ 200 mmHg
275°F finish @ 30 mmHg

Start BULK of STRIPPING operation ΔT_{m_2} = 320 / 182 / 138 ; 320 / 182 / 138 ≈ 75 psig st

MOBIL: 320 / 260 / 60 ; 320 / 260 / 60

finish TERMINAL $\Delta T_{m_{21}}$ = 350 / 275 / 75 ; 350 / 275 / 75 ≈ 125 psig st

MOBIL: 350 / 275 / 75 ; 350 / 275 / 75

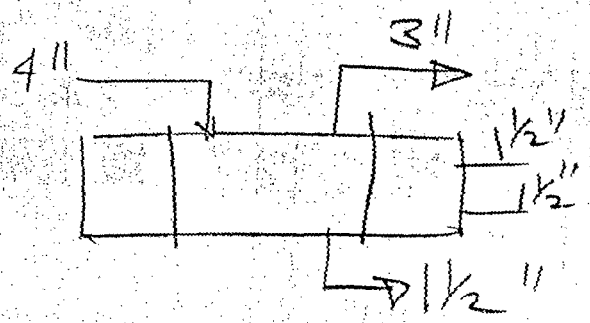
Area Q_2 = $\frac{Q_2}{U\Delta T_m} = \frac{900{,}000}{(100)(138)} = 65\text{ ft}^2$ gFM start

$= \frac{900\text{M}}{(100)(60)} = 150\text{ ft}^2$ MOBIL start

Area Q_{21} = $\frac{Q_2}{(100)(75)} = \frac{900}{(100)(75)} = 120\text{ ft}^2$ finish

(OVER)

E-M103



$U_{worst} = 20$

$U_{assumed} = 40$

$U_{expected} = 70$

Brine available

$C_p M \Delta T$ (= 20 gpm)

$= (.6)(5)(40\ MLBS$

$120\ MBtu's$

$Q = ?$

$U = 30$

$\Delta TM =$

$$\begin{array}{r} 183 \\ 10 \\ \hline 173 \end{array} \quad \begin{array}{r} 183 \\ 5 \\ \hline 168 \end{array}$$

168

$Q = 10\%$ of E-M102

$= 90M$

$A_{assumed} = \dfrac{150\ MBtu's}{(40)(168)} = 22\ ft^2$

$A_w = \dfrac{Q\ (20\%)}{U\ \Delta TM} = \dfrac{180M}{(20)(160)} = 56\ ft^2$

$Area\ reqd_{actual} = \dfrac{90M}{(70)(160)} = 8\ ft^2$

POINTS SERVED OVERNIGHT BY

F & W EXPRESS INC.

575 SO. FRONT Memphis, Tennessee TEL. 527-4551

1-3-77

To John, Mike, George
Dave —

Here is addendum to Mobil contract proposed by Taggart —

Would appreciate your thoughts — particularly w. regard to formula for low level produ. comp. and 4 a, b, c, in new appendix B —

BS

TERMINALS

MEMPHIS 527-4551

CLARKSDALE 627-7333

DYERSBURG AT 5-4491

CLEVELAND 843-5396

GREENVILLE ED 5-1118

DAILY OVERNIGHT DELIVERY

B. S.

Draft 12/15/76

AMENDATORY AGREEMENT

THIS AGREEMENT, made as of January 1, 1977, by and between Mobil Chemical Company, a division of Mobil Oil Corporation, a New York corporation, hereinafter called "Mobil", Vertac, Inc., a Texas corporation, hereinafter called "Vertac" and Eagle River Chemical Corporation, an Arkansas corporation, hereinafter called "Eagle River",

W I T N E S S E T H:

WHEREAS, Vertac and Mobil entered into an agreement dated September 1, 1975, (hereinafter the "Agreement") concerning the manufacture for Mobil of NBE, as defined therein; and

WHEREAS, the manufacturing operations contemplated by the Agreement have been performed by Eagle River, a wholly owned subsidiary of Vertac, and

WHEREAS, the parties desire to amend the Agreement and to effect an assignment of Vertac's interest in the Agreement to Eagle River:

NOW, THEREFORE, in consideration of the premises, the parties agree as follows:

1. Vertac hereby assigns to Eagle River its entire interest in the Agreement, Eagle River accepts such assignment and Mobil consents to it. Vertac unconditionally guarantees Eagle River's full performance of all of the obligations originally assumed by Vertac under the Agreement and all of the obligations assumed by Eagle River hereunder. Vertac agrees to hold Mobil harmless from and to indemnify it against all cost, loss, liability, and expense (including reasonable attorneys' fees) which results from any breach of the Agreement by Eagle River.

2. The Agreement is amended as follows:

   2.1 Section 8 is deleted and replaced with the following:

   "The parties agree that the yields to be achieved by the Contractor will be the yields set forth in Appendix D attached hereto. If the average yield with respect to any of the Materials during any calendar quarter is below those set forth in Appendix D, Contractor will give Mobil the opportunity to review Contractor's operations and will cooperate fully with Mobil in attempting to increase yields. If, within such period of time as Mobil deems reasonable, the yields have not reached the levels set forth in Appendix D, Mobil, without any liability, may terminate this contract on written notice to Contractor."

2.2 Section 12 is deleted and replaced with the following:

"To the extent that Mobil makes available Materials in accordance with the terms of this Agreement, the Contractor, beginning on January 1, 1977, shall manufacture and deliver to Mobil such quantities of NBE as are ordered by Mobil, provided that the Contractor shall not be obligated to supply more than 6,000,000 pounds during any calendar year or more than 500,000 pounds during any calendar month without its prior written consent."

2.3 Section 20 is deleted and each subsequent section is renumbered accordingly.

2.4 The original section 25 (now section 24) is deleted and replaced with the following:

"The term of this Agreement shall commence on the date first written above and shall terminate on December 31, 1979 unless extended pursuant to the next sentence or terminated pursuant to section 20 or Appendix B. Mobil, on written notice delivered to Contractor not later than 90 days before the end of 1979 may extend the term of this Agreement through December 31, 1980 and Mobil, on written notice delivered to Contractor not later than 90 days before the end of 1980, may extend the term of this Agreement through December 31, 1981."

2.5 The following is added to the Agreement as section 26:

"a) Contractor will not sell or convey any interest in its facilities for the manufacture of NBE except in a bona fide, arm's length, cash sale of all of said facilities and after first having given Mobil the opportunity to purchase said facilities for the price and on the terms and conditions available from the prospective purchaser. Contractor will notify Mobil in writing of the identity of the prospective purchaser and the price and terms and conditions offered by it. Mobil will have 90 days after receipt of said notice to exercise its right of first refusal by purchasing the facilities for such price and on such terms and conditions.

b) In the event Mobil terminates this Agreement pursuant to section ~~21~~ 20 Mobil shall have the right to purchase Contractor's facilities for the manufacture of NBE at their depreciated value on Contractor's books. Upon any such termination, Contractor will provide Mobil with a certificate signed by the chief executive officer of Contractor setting forth said depreciated value and an explanation of how such value was computed. Mobil may exercise the option provided for in this section 26 b) by

~~tendering to Contractor a check for said depreciated value against delivery of such instruments of conveyance as Mobil reasonably may require."~~

2.6 Appendix B attached to the Agreement is deleted and replaced with the Appendix B attached hereto. Appendix D attached hereto shall become Appendix D to the Agreement.

3. All other terms and conditions of the Agreement shall remain in full force and effect as written.

IN WITNESS WHEREOF, the parties have executed this Amendatory Agreement as of January 1, 1977.

MOBIL CHEMICAL COMPANY

By: _____

Title: _____

Date: _____

VERTAC, INC.

By: _____

Title: _____

Date: _____

EAGLE RIVER CHEMICAL CORPORATION

By: _____

Title: _____

Date: _____

	I	II
A =	400,000	=
B =	350,000	=
C =	0	70,000
D =	0	20,000
E =	0	500,000

6.21
6.3342
~~14.076~~
.1276

7.59
6.3342
13.9242
.21

APPENDIX B

1. Mobil shall pay Contractor $0.166 per pound of NBE delivered hereunder which meets the specifications set forth in Appendix A.

2. With respect to each calendar month in which Mobil takes less than 400,000 pounds of NBE, Mobil, within 45 days after the end of that month, will pay Contractor any amount which results from the following calculation:

$$[A - (B + C + D)] \times E = \text{amount payable}$$

Where:

A = 400,000,

B = number of pounds of NBE taken by Mobil in that month,

C = number of pounds of NBE which Contractor would have produced at the yields set forth in Appendix D but failed to produce in that month,

D = the sum of the following: (1) number of pounds which Contractor is obligated to deliver hereunder in that month (based on the yields set forth in Appendix D) by which Contractor fails to deliver, and (2) number of pounds which are not delivered or received or which Mobil

cannot use in said month on account of the circumstances described in section 18,

E = $0.123.

3. Amounts paid by Mobil pursuant to paragraph 2 above will be credited by Contractor against future invoices at a rate of $0.123 per pound for all pounds of NBE in excess of 1,500,000 pounds taken in any three consecutive calendar months. Said credit will be applied against the first invoice(s) to be rendered after the end of such three-month period.

4. The fee payable pursuant to paragraph 1 above with respect to deliveries in each calendar quarter will be increased or decreased, as the case may be, by the cumulative effect of the following:

   a. For each increase or decrease of $0.10 per hour, off a base of $ _____ per hour, in the weighted average wage rate of hourly employees at Contractor's West Helena, Arkansas facilities during the immediately preceding quarter, the fee will be increased or decreased by $0.0007 per pound, fractions in proportion.

   b. For each increase or decrease of $0.01 per KWH, off a base of _____/KWH, in the _____ power rate payable at Contractor's said facilities during the immediately preceding quarter, the fee will be increased or decreased by $0.0046 per pound, fractions in proportion.

c. For each increase or decrease of $0.10/M lbs., off a base of _____/M lbs., in the weighted average cost of steam at such facilities during the immediately preceding calendar quarter, the fee will be increased or decreased by $0.0003 per pound, fractions in proportion.

Contractor shall maintain, for a period of one year after the period to which they relate, all records relating to the fee adjustments referred to in this paragraph. Mobil, on 15 days advance written notice, may inspect Contractor's records for the purpose of determining the appropriateness of any fee adjustment proposed by Contractor. If Mobil disputes such adjustment and the parties are unable to resolve such dispute then Arthur Young and Company shall be given access to Contractor's records relating to the disputed adjustment and the determination of Arthur Young and Company with respect to the dispute shall be conclusive and binding on the parties. If Arthur Young and Company determines that the adjustment proposed by Contractor is appropriate, then Mobil will pay for the services rendered by Arthur Young and Company, otherwise Contractor shall pay for such services.

5. In the event governmental action or inaction prevents or substantially impedes Mobil's manufacture or sale of the herbicide which it produces from NBE, Mobil may terminate this Agreement on 30 days written notice to the Contractor.

APPENDIX D

TO AGREEMENT

BETWEEN MOBIL CHEMICAL COMPANY

AND

EAGLE RIVER CHEMICAL CORPORATION

MADE AS OF

1 JAN. 1977

NBE RAW MATERIAL YIELDS

Usage per pound of 83% NBE:

95% CBE	-	0.820 lb.
EDC	-	0.095 lb.
H_2SO_4	-	0.840 lb.
HNO_3	-	0.330 lb.
NH_3	-	0.050 lb.

NBE

Tanks Available:

P-10 Slurry Tank - SS - agit -

NBE W.O. Tank - probably worthless

Methanol Tank - Al -

Methylene Chloride Tank T116

Need Tanks for

H_2SO_4	20,000 gal	CS
HNO_3	20 000 gal	Al
Product (NBE) -	10000 gal.	CS - heated
EDC Storage -	10000 gal	CS
Spent Acid Storage	20,000 gal	CS
$(NH_4)_2SO_4$ Storage	20,000 gal	CS
NH_4OH Tank	2000 gal	CS
Extractor	2000 gal	SS
H_2SO_4 Day Tank	1000 gal	CS
HNO_3 Day Tank	1000 gal	Al

9111 8 [illegible] 7-15-77

ITEM	SERVICE	SIZE	MATERIAL
A-M101	Reactor IN-LINE MIXER	6" DIAMETER	SS
A-M102	NH_4OH IN-LINE MIXER	2" DIAMETER	SS
E-M101	RXN COOLER	885 ft^2 area	304SS TUBES CS SHELL
E-M102	PRIMARY CONDENSER	172 ft^2 area	304SS TUBE & SHELL
E-M103	SECONDARY CONDENSER	85 ft^2 area	CS TUBE & SHELL
E-M104	Stripper Heater	310 ft^2 area	304 SS TUBE & SHELL
E-M105 a & B	JET inner & after CONDENSERS	6"ϕ X 65" Long 5"ϕ X 99" Long	CS TUBE & SHELL
E-M106	Reactor TW HEATER	15 ft^2	CS SHELL & TUBE
E-M107 a, B, & C	Product Surge PANEL COIL	22" X 119" each W L	CS
J-M101	Stripper JET	2 stage – 20mm Hg vacuum	CS
M-M101	Reactor MIXER	15 HP 75 RPM	SS shaft with 2 turbines (30" ϕ)
M-M102	Extractor MIXER	10 HP 68 RPM	SS with turbine (28" ϕ)
P-M101	H_2SO_4 METERING	0-5 gpm @ 100 PSIg	Viton diaphram
P-M102	HNO_3 METERING	" " " " " " " "	
P-M103	EDC transfer	50 gpm @ 85 Ft	CS
P-M104	Extractor trfr	40 gpm @ 80 ft	SS
P-M105	SPENT ACID " "	120 gpm @ 80 ft.	CS
P-M106	Am. SULFATE " "	50 gpm @ 80 ft	CS
P-M107	Reactor Circulation	600 gpm @ 90 ft	SS
P-M108	" " " (SPARE)	" " " "	SS
P-M109	Product SURGE	95 gpm @ 120 ft	SS
P-M110	Stripper Circulation	250 gpm @ 120 ft	SS
P-M111	Interface transfer	35 gpm @ 35 ft	SS
P-M112	EDC Drain pump	10 gpm @ 30 ft	SS
P-M113	HNO_3 transfer	50 gpm @ 80 ft	
P-M114	H_2SO_4 " "	50 gpm @ 160 ft	

ITEM	SERVICE	SIZE	MATERIAL
P-M115	$CaCl_2$ Brine	600 gpm @ 90 ft	SS
P-M116	Sump Pump (air driven)	variable	VITON diaphram
S-M101	Am. Sulfate Strainer	2"φ	SS
S-M102	" " filter	60 gpm @ 10 PSI	SS
T-M101	H_2SO_4 Day Tank	1000 gal	CS
T-M102	HNO_3 Day Tank	1000 gal	al
T-M103	EDC Storage	3300 gal	CS
T-M104	Extractor	2000 gal	SS
T-M105	Spent Acid Storage	10000 gal	CS
T-M106	Am. Sulfate Storage	10000 gal	CS
T-M107	NH_4OH Blend tank	2000 gal	CS
T-M110	H_2SO_4 Storage	20000 gal	CS
T-M108	HNO_3 Storage	20000 gal	al
T-M109	Emergency Sump	6000 gal	Concrete
R-M101	Nitration Reactor	3500 gal	304 SS
V-M101	Stripper Vessel	2250 gal	304 SS
V-M102	Product Surge	6000 gal	CS

JIM

an excerpt
from my
Planavin file
on Nitration
Reaction Safety

Leo

CC Steve
BILL
Jolly

BATCH NITRATION EXPERIENCES

Failure to follow fundamental procedures for safe process control can lead to an unstable system. Here's how the effects of temperature, rate of addition and ratio iof reactants can cause explosions.

T. A. Ventrone
American Cyanamid Co.
Bound Brook, N.J.

In recent years nitration experience has considerably improved, very probably from better understanding its problems. But the hazards in this process have yet to be mastered completely. There may be fewer nitration explosions today, but they appear to be more severe.

In the earlier part of this century, and back to its inception as a process, nitration had become an awesome word. It was generally conceded that every nitration reactor would sooner or later be involved in an explosion, or at the very least, a disturbing though less serious upset. Considerable pride was exhibited over a reasonably safe record. Virtues were attributed to homemade safety procedures where credit should actually have gone to good fortune. However, much experience was gathered and certain basic considerations were developed for safe practices. Among these were: 1. limitizing the reactant amount by controlling the rate of addition; 2. interlocking reactant feed with temperature; 3. interlocking reactant feed with agitation.

Evidence of early recognition of some of the explosion causes lies in a 1919 New Jersey Dept. of Labor Safety Standard for the manufacture of nitro and amido compounds. For whatever the significance, it was printed at the New Jersey Reformatory. Here are three paragraphs from that standard:

"The nitrating tank shall be fitted with a safety device so that the faucet of the acid tank cannot be opened until the stirring apparatus of the nitrating tank has been put in motion. This rule is due to the fact that if a large quantity of acid accumulates in the bottom of the nitrating vessel (due to its not being constantly stirred) a powerful chemical reaction will occur when the stirrer suddenly starts up, and there is sudden combination with the benzol."

(Although the rule applies to all nitrations, the specific reference to benzol would indicate this to be the most prominent of the nitration problems in the New Jersey area.)

"The protruding end of the shaft of the stirring apparatus shall be fitted with a pendulum or similar device, so that persons in charge may, from a distance, know that the stirring apparatus is actually in motion and keeping the mixture constantly agitated, thus preventing undue generation of heat."

"The nitrating vessel must be equipped with a large pipe (which is to act in the capacity of a safety valve) extending through the roof, and provided on top with a suitable arrangement, which while keeping the pipe closed ordinarily, will open when a dangerous pressure develops in the nitrating vessel."

The importance of agitation

Here is documentation recognizing the importance of agitation including the need for an interlock with acid feed and the need for a large vent.

In the manufacture of nitroglycerine, agitation was recognized as critical enough to require auxiliary power. An electric motor generally provided the primary motive power with backup from a small steam engine. In some cases, arrangements were also made for manually rotating the agitator.

With reference to agitator interlocks, earlier ones were simple electrical connections and only functioned if power went off. It was found they could fail to protect against agitation loss by a broken shaft or by blades falling off. This obstacle was circumvented by the simple expedient of connecting to an ammeter. If the load on the motor reached the low setting, indicating loss of agitator blades or a sheared shaft, the feed pump could be automatically stopped. This system is also not fool proof in that the setting is a tricky one. There is still need for a good safe interlock.

There have been many explosions involving agitator stoppage, but to mention them here would be anticlimatic.

Another frequent cause of difficulty is temperature control failure. This may involve low temperature, high temperature, cooling system failure or the temperature effect from loss of agitation.

There are obvious dangers to combining reactants at too low a temperature. The reaction proceeds slowly building up the amount of unreacted material available for rapid reaction as the ultimate reaction temperature is approached. Loss of agitation results in the same arrangement and can be caused by seizing of the shaft, electrical failure, or even falling off of blades. The records show ample evidence of explosions from each of these primary causes, and observing these basic considerations has done much to reduce the problems that occurred.

A double risk

Risky as it is to shorten addition time or to vary the temperature, it is doubly risky to do both. One case involved a process which had gone through research and during early process development work the nitric acid addition rate and reactor temperature were standardized. After several batches, and for some unknown reason, the acid was added in half the time while the intermediate in the reactor was several degrees colder than previous operations. The delayed reaction at lower temperature permitted an accumulation of reactants that the cooling system could not handle. An explosion resulted.

In another situation the solid intermediate was added, through a feeder, to nitric acid at a rate that would allow the brine cooling to maintain reaction temperature. The brine pump was to be shut off at the beginning of the reaction to prevent lowering the reactor temperature below 10°C. The brine pump pilot light had been acting up and repeated maintenance efforts failed to keep it operating for any extended period. When the operator misread the thermometer, it was actually −10°C (a result of unnoticed brine pump operation) and the intermediate feed was started. Because of the low temperature, the intermediate feed proceeded at a fast rate. Eventually, the quantity of reactants reached a point beyond control and everything came out the open manhole.

drive upscale if the thermocouple is destroyed for one reason or another. In doing so, it reaches the preset high temperature limit alarm point, and an alarm sounds, and a red signal light goes on, and feeds shut off.

Obviously if the reverse occurred, the operator would be inclined to increase the feed rate. A complete power failure would just render the recorder useless. We therefore back up the recorder with a simple thermo-electric indicating thermometer. Essentially, then, we resort to the same safeguards as previously stated. And of course we are prepared to quench the batch in the event an unusual condition develops.

A particularly hazardous nitration mixture is one consisting of acetic anhydride and nitric acid. An interesting reference on the explosive nature of this mixture appeared in the following journal: Chemistry in Britain, Volume 3, Number 16, November, 1967. The article appeared in the correspondence section. I think if you would refer to the article, the authors are listed together with the original reference work.

The following table is worth noting. The compositions represent per cent by weight of nitric acid in acetic anhydride mixtures, and I'll also quote the comments concerning the behavior corresponding to the various mixtures as stated in the article.

% HNO_3 in Mixture	Behavior
26%	Did not detonate
41	" " "
50	" " "
55	Detonated
60	" "
70	" "

The lower limit of safety is considered to be approximately 50% nitric acid in the mixture. The investigators did not study the safe upper limit, but they expected it to be in the neighborhood of 85%.

A most important consideration, and it cannot be stressed too strongly, is that in preparing concentrations below the lower 50% limit, the nitric acid must be added to the acetic anhydride. And it should be added with good agitation and cooling. For concentrations above the upper 85% limit, the acetic anhydride must be added to the nitric acid; that is, you must do it in the manner described if you wish to perform the operation safely by avoiding the detonable concentrations.

After the few incidents we experienced at Givaudan our nitrators were completely redesigned. The vent stack, which is 24 in. in diameter, is now nearly as large as the reactor itself. More important, we have revised our method of feeding. We now resort to alternate feeding of the organic and the nitric acid, with the acetic anhydride added to the reactor beforehand.

By so doing there is never present a great excess of the acetyl nitrate, which is the nitrating agent in this instance. In conclusion, with the interlock system, large vent, and the revised procedure, a high degree of safety is assured.

VENTRONE: Does anyone know of a good agitator interlock?

JOE SIMS, Union Carbide: We have a similar batch processing problem where we have to worry about the inventory of reactants during ethylene oxide addition. We have an ammeter on the agitator motor with high and low limits clamped around the normal operating point. In cases such as ours, where the viscosity varies significantly during the batch cycle, the ammeter limits must be set rather far apart; but where viscosity does not pose a problem, this method provides a useful monitor of the agitator power input.

VENTRONE: That's right. We often use an ammeter but it's very touchy to get it set, unless the agitator blades fall off you don't know just how much of a load change that's going to give. I'm looking for something better than that.

The following information has come to my attention since the meeting:

Detection of absence of agitation in critical reactors is still best done by monitoring the agitator motor electrical load. This is often done with a low current (Ammeter) alarm, but a low power (Wattmeter) alarm is best.

Because of low power factor (particularly on oversized motors), no-load current is a high percentage of normal current. No-load power is a smaller percentage of normal power and the cut-out can be set to a lower value without interferring with normal operation and more easily detect an abnormal low load (like loss of an agitator blade).

Q. Would you care to make any comment on the means of cooling a large nitrator when the jacket is not enough and cooling coils have to be used, getting water through the coils, the danger of getting water into the mixed acid, and that hazard.

VENTRONE: I'm glad you brought that up because that was one of the questions I wanted to ask the audience. As far as cooling is concerned, for a long time we thought we had to keep water out of the batch; that we had to pull the water through the system, so there would be lower pressure in the coils than in the nitrator.

It was interesting to note that in a more recent process design, we decided to go the other way. I was asked why we might have been concerned, and the only thing I can speculate is that water in the batch might further dilute the sulfuric acid and add to the corrosion, or the possibility that additional water would prevent the sulfuric acid from doing its job, which Dr. Albrecht might like to dispute, but I assume the sulfuric acid is there to take up the water from the reaction and not further dilute the nitric acid.

E. J. FRITZ, DuPont Co.: We have had this happen, where water has leaked into the reaction mass, and you will find —at least we did—that the reaction of the water with the nitrosyl sulfuric will generate a tremendous amount of fumes immediately, which will alert you to this situation. You can shut down right then. We have had no other effects from it, except that we had to repair the unit again.

Q. In what Ted said, I gather you're concerned with detonation and nothing less than that.

VENTRONE: Not really. I don't think we're that concerned about a detonation, but maybe from what Bob VanDolah says we should be. No, we're more concerned about a simple runaway reaction developing pressure and, surprisingly and disturbingly, lately we found some that develop up to 3,300 lbs. In this particular nitration accident, we had reason to believe it would take 2800 lbs. to cause the damage which occurred.

That's a lot of pressure when you think in terms of the normal ignition of a flammable mixture in a vapor phase developing ten atmospheres. We don't generally get into detonations. I hope we don't.

There are instances when nitrations have to be driven to completion by raising the temperature after adding all reactants. Explosions or foamovers occurring during faster than normal heatup would indicate decomposition or unknown side reactions, occasionally at only a few degrees higher than normal.

Some complex reactions

These situations have occurred during relatively simple nitrations. Less is understood about more complex reactions. The following incident is an example of such a complex situation involving a change in reaction rate due to reactant unbalance.

An unbalance in a reaction system resulted in rupture of a 500 gal. 100 lbs./sq. in. design glass lined vessel. The head and agitator assembly landed 520 ft. away, and the reactor body was blown downward from the third floor to the first twisting 14 in. I-beams on the way. Building and equipment damage was limited to one 20 ft. x 20 ft. bay. There were no personnel injuries.

The process consisted of adding the intermediate slowly over three hours to sulfuric acid at 15-20°C. with cold brine in the jacket. Mixed acid is charged over five hours at a temperature of 17-20°C. The reaction mixture is heated to 55°C. with hot brine in the jacket. Brine circulation is stopped at 40°C. and the temperature rises to 55°C. at which time cold brine is applied to cool the mixture.

Safety features included:

1. Mixed acid charging through a two quart weir box with constant head maintained by pump (overflow returns to the measuring tank). High temperature or low load on the motor (indicating loss of agitation) would stop the mixed acid pump with only two quarts of acid left in the head tank to enter the reactor.
2. Dual temperature recorders with thermocouples in separate wells.

At the time of the accident, the batch was in the heatup cycle. Hot brine had been shut off at 40°C. Within a few minutes the operator noticed fumes coming from the nitrator. He tried to turn on the cold brine but was unable to reach the controls because of the fumes.

The operator left to summon aid and a few minutes later the explosion occurred.

Since the process appeared to be normal in all respects up to the time of the explosion, a check was made of all components entering the reactor.

More acid in the tank than expected

The intermediate containers were checked and both quality and quantity were satisfactory. A similar check of mixed acid cleared it for both quality and quantity. Sulfuric acid came from a storage tank and the quality was satisfactory. However, there was more acid in the storage tank than anticipated. Records of outages in the tank following previous batches checked with the amount of acid to be charged to the process. The outage for the batch in question was only 2/3 of the required acid.

Sulfuric acid is pumped from storage to a head tank to a specific reading on the gauge glass. The gauge glass did not extend to the bottom of the head tank and the volume below O" on the gauge held 570 lbs. of acid. If the tank contained more acid than needed, the excess was drained off through a bypass line, between the measuring tank and the nitrator, back to the storage tank.

The procedure after loading the head tank to the required level was to open the bottom valve and dump the acid into the reactor. It is now obvious that this system could allow some acid to return to storage unnoticed if the bypass valve were open.

During investigation of this explosion, there was a systematic review of all the factors involved in the process, changes or variables that had been noted, possible causes and expected effects from these causes and finally checking fully the most probable cause to be certain of its effect. This indicated the sulfuric acid shortage had caused the explosion and supporting evidence was secured as follows:

Laboratory tests performed with significantly less than the normal amount of sulfuric acid showed the reaction product to decompose violently in a steam bath with large gas evolution.

Laboratory stability tests (differential scanning calorimeter and gravimetric analysis) performed on a normal reaction mixture were inconclusive but did indicate a possible exotherm above 150°C.

Thermal sensitivity tests performed in the standard Janaf Thermal Stability Apparatus confirmed an initial exothermic reaction with a normal nitration mixture at 90°C. with a second and more powerful exotherm above 130°C. With low sulfuric acid concentration, the initial exotherm takes place at 60° with an instantaneous rise to 140° where the second reaction occurs—developing in the neighborhood of 3300 lbs./sq. in. gauge.

The test data led to the conclusion that the unbalance in reactants changed the rate of reaction and caused the temperature to exceed the normal 55°C. and at 60°C. the first exotherm took over.

Any review of nitration accidents would not be complete without including troubles outside the reactor. Explosions have occurred in vacuum systems where nitric acid, or nitrogen oxides, contacts organic compounds. Similar troubles can be expected in feed lines and feed tanks used jointly for acid and intermediate, or from acid backup into intermediate feed systems.

In summation

Reactions should be studied to determine the normal operating temperature, rate of addition and ratio of reactants to maintain a safe system. Tests should be conducted to determine the effect of temperature variation, changes in addition rate and unbalance in reactants. This information can then be used as the basis for process design and establishing safe operating procedures.

Discussion

STEVE SCALA, Givaudan Corp.: Ted asked if I would prepare a statement since we, at Givaudan, did have a few incidents with nitration. The nitration medium is somewhat different than those we have been discussing here.

To begin with, I couldn't agree more with Ted's earlier statements which are worth repeating. I will quote them:

1) Limitation of amount of reactants by controlling the rate of addition.
2) Interlock of reactant feed with the temperature.
3) The interlock of reactant feed with agitation.

In conducting nitrations at Givaudan we observe all three safeguards. I might add that our temperature

12/18/74

SAUL

GOOD ARTICLE! FORTUNATELY OUR SYSTEM has SEVERAL advantages. BELIEVE By definition THE MIXED ACID OLEUM IS THE DINITRO SOLVENT WHILE WATER IS THE COUNTER SOLVENT IN THE NITRATION SYSTEM. Thus one liquid phase IS PRESENT IN THE REACTION SYSTEM + THRUOUT CRYSTALLIZATION. Some of the other advantages of the Nitration for DINITRO are the lack of excess of either Reactant - Sulfur or Mixed ACID, the high operating temperature, + the LOW NITRIC CONTENT of THE MIXED ACID.

Based the article the Nitrator agitator interlocks should BE "ammeter" type (or equivalent). The problems discussed with ammeters in varying Batch Reactions should BE MINIMAL for a continuous system. Secondary Battery operated (or something) temperature indicators (over an above primary electrical system) for each REACTOR.

Nitration Safety for Reaction Systems

- Interlocks per Denver.

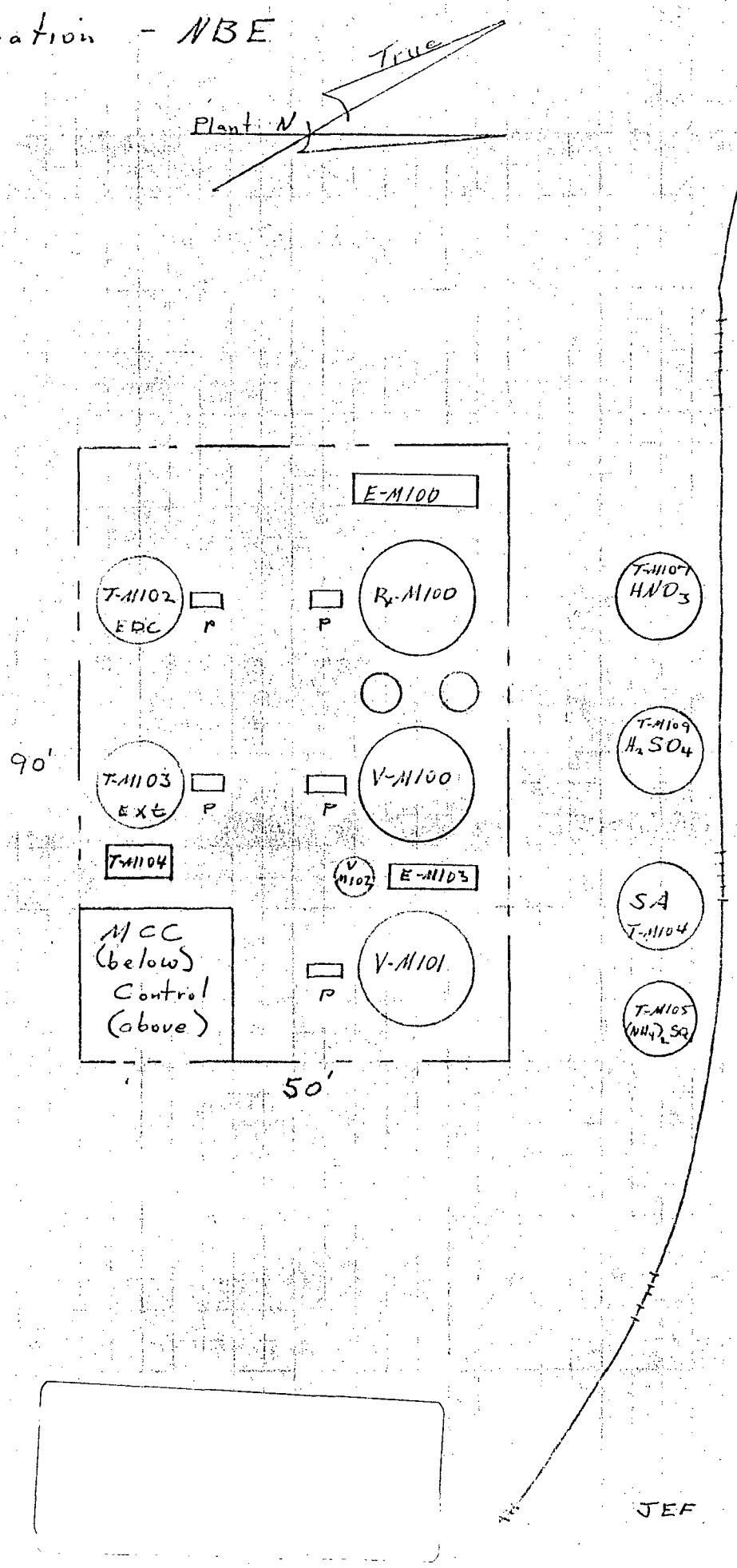
- Emergency cooling direct city potable water supply to reactor tempered H2O systems (60 to 75 psig) (City pressure as motive force)

- Sulfuric acid quench capability even during power failure to the reaction system.

- Emergency power for R-1023, R-1024, & R-1009 agitators.

July 21, 1975

Mobil Nitration - NBE
Plot Plan



Mobil Nitration Equipment List

	Size	Mat'l	Remarks
1. A-M101 Nitration In-line Mixer	500 GPM	SS	Quote
2. A-M102 Aqua NH_3 Mixer		CS	Denver Equip
Exchangers			
1. E-M101 Nitration Reactor Cooler	600 Ft^2	316 SS Tube CS Shell	
2. E-M102 full vac rating Still Condenser	100 Ft^2	CS Tube CS Shell	
3. E-M103 full vac rating Still Tail Condenser	100 Ft^2	CS Tube CS Shell	
4. E-M104 Still Heater	400 Ft^2 75 PSIG	304 SS Tube CS Shell	
5. E-M105 Surface Condenser	50 Ft^2	CS Tube CS Shell	
6. E-M106 TW Heater	15 Ft^2	CS Tube CS Shell	Denver E-1390
1. J-M101 Still Jet	30 MM Hg	@ R-M101	Quote
1. M-M101 Reactor Agitator	15 HP Turbine	316 SS	Prefer w/ Reactor
2. M-M102 Extractor Agitator	10 HP Turbine	316 SS	Denver V-1101
Tanks			
1. T-M101 H_2SO_4 Day Tank	600 gal	A 285 C	Holland
2. T-M102 HNO_3 Day Tank	966 gal	3003-0	Denver T-1232
3. T-M103 EDC Day Tank	2500 gal	CS	Denver V-1140 3300 gal
4. T-M104 Extraction Tank	2000 gal	316 SS	Denver V-1101 2000 gal
5. T-M105 Spent Acid Hold Tank	10000 gal	CS	Quote
6. T-M106 $(NH_4)_2SO_4$ Waste	10000 gal	CS	Quote
7. T-M107 Aqua-NH_3 Blend Tank	2000 gal	CS	Denver T-1284
8. T-M108 97% HNO_3 Storage Tank	20000 gal	Alum 5083-H321	Ordered Holland
9. T-M109 Emergency Sump	5000 gal	Concrete	@ Fdn
10. T-M110 98% H_2SO_4 Storage Tank	20000 gal	CS	Field

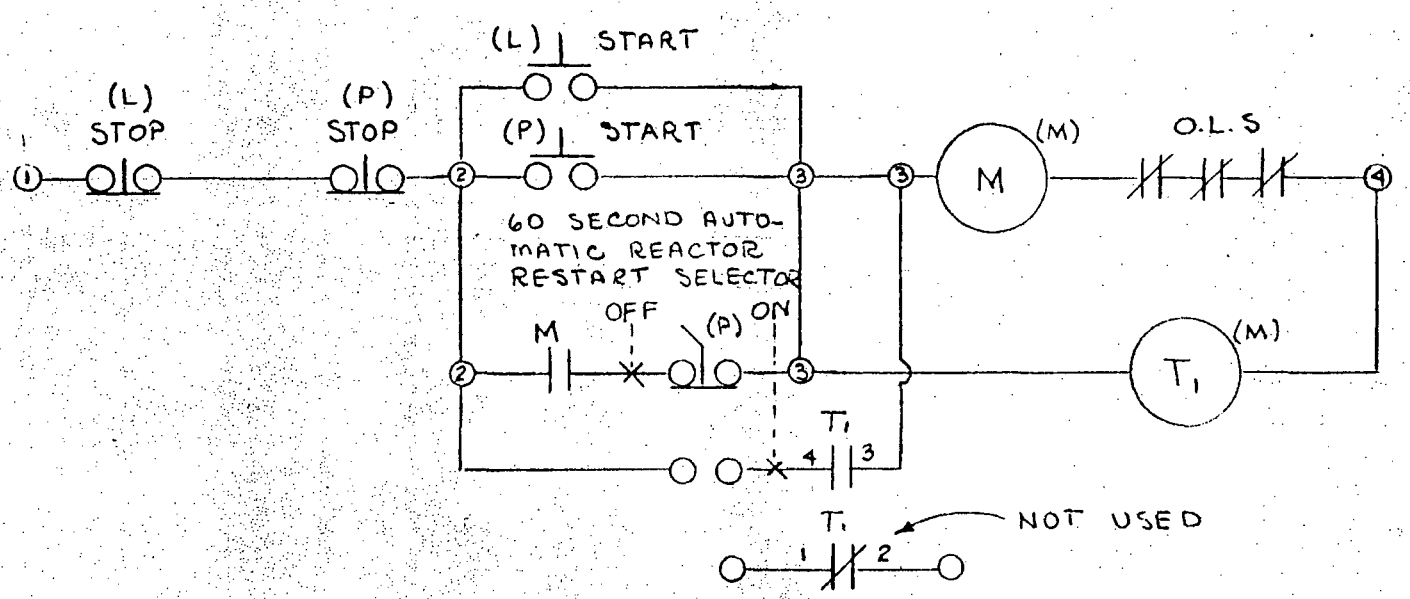
Pumps		Size	Mat'l	Remarks	
P-M101	98% H_2SO_4 Metering	0-3 GPM		Quote	
P-M102	97% HNO_3 Metering	0-2 GPM		Quote	
P-M103	EDC Charge	40 GPM @ 80'	CS	Denver -	P1410
P-M104	Extraction Transfer	40 GPM @ 80'	316 SS	"	P1403
P-M105	Spent Acid Transfer	50 GPM @ 80'	CS	"	P1314
P-M106	Waste Transfer	100 GPM @ 80'	316 SS	"	P1404
P-M107	Reactor Circulation	500 GPM @ 130'	316 SS	"	P1580
P-M108	Rx Circ (Spare)	500 GPM @ 130'	316 SS	"	P1402
P-M109	Product Transfer	100 GPM @ 100'	Alloy 20	"	P1470
P-M110	Still Circulation	250 GPM @ 120'	Alloy 20	"	P1471
P-M111	Reactor Phase Transfer	20 GPM @ 60'	316 SS	"	P1618
P-M112	EDC Portable Unload	10 GPM @ 30'	316 SS	"	P1452
P-M113	97% HNO_3	50 GPM @ 80'	316 SS	"	P1331
P-M114	98% H_2SO_4	30 GPM @ 80'	CS	"	P1497
P-M115	Aqua-NH_3 Blend	60 GPM @ 80'	316 SS	"	P1350
Reactors					
R-M101	Nitration Reactor	3000 Gal	316 SS	Quote	
V-M101	Solvent Stripper	3000 Gal	316 SS	Quote	FV
V-M102	Product Surge Tank	2000 Gal	CS	Quote - Coils or Jacket	
S-M101	$(NH_4)_2SO_4$ Strainer			Denver	S1098
S-M102	" "				

42-381 50 SHEETS 5 SQUARE
42-382 100 SHEETS 5 SQUARE
42-389 200 SHEETS 5 SQUARE
NATIONAL

DEC 75

MOBIL per D. Taggart

	ACTUAL #/#NBE	TARGET
CBE	.8101	.82
HNO_3	.3583	.3569
H_2SO_4	.8683	.8765
EDC	.2134	.0996
NH_3	.0641	.0440



T1 - EAGLE AIRFLEX SERIES AF4 "OFF-DELAY" TIMER, ADJUSTABLE TIMING RANGE 0.2 TO 60 SECONDS, 15 AMP, 120 VOLT CONTACTS.

(L) - LOCATED AT DRIVE

(P) - PANEL MOUNTED

(M) - LOCATED IN MCC

NOTE: WHEN THE SELECTOR SWITCH IS IN THE "ON" POSITION AND THE AUTOMATIC RESTART CIRCUIT IS ACTIVATED, DEPRESSING EITHER STOP BUTTON ONLY SIMULATES A MOMENTARY POWER FAILURE THEREFORE THE REACTOR WILL RESTART AUTOMATICALLY WHEN RELEASED.

REVISION	BY	DATE	DESCRIPTION

CLIENT: EAGLE RIVER CHEMICAL COMPANY

PROJECT:

TITLE: REACTOR RM-101 AUTOMATIC RESTART SELECTOR CIRCUIT

SHREEVE ENGINEERING, LTD

LITTLE ROCK · BATON ROUGE

DRN BY DEH	DATE	DESIGNED	DATE
CHKD BY	DATE	SCALE:	
PROJ. ENGR.		DWG. NO.	
JOB NO.			

2/4/96

To: Mike McKeller

Re: CBE Tank car inventory

T/C UTLX 95668

Diameter = 96"
Total volume (full) = 11021 gallons

T/C ACFX 92103

Diameter = 102"
Total Volume (full) = 10919 gallons

John Shiles

	1	2	3	4	5	6	7
	BI	CBE REC	EI	CBE USED	NBE	U.C.	
Mar 77							
Apr	0	283940	8790	275150	331341	.830	
May	8790	323480	37950	294320	384073	.766	
June	37950	522460	194530	365880	447105	.818	
July	194530	483360	191730	486160	595914	.816	
Aug	191730	628060	221650	598140	745683	.802	
Sept	221650	322386	116670	427360	551871	.774	
Oct	116670	478140	526	594282	707347	.840	
Nov	526	491400	399910	452016	583812	.774	
Dec	399910	559960	60304	539566	675077	.80	
Jan 78	60304	402700	0	463004	524022	.883	
TOTAL		4495880		4495878	5546245	.8106	

2-11-78

MOBIL NBE BILLING CORRECTION - 1ST QUARTER '78

(IN $ PER LB NBE SHIPPED)	$ PER LB
① PRICE CORR. (LBS X 0.007)	0.0070
② WAGE RATE CORR. $\frac{5.45 - 5.12}{0.10} \times 0.0010 \times LBS$	0.0033
③ ELECTRIC POWER CORR. $\frac{.02813 - .02800}{.01} \times 0.0046 \times LBS$	.0000
④ STEAM - NO CORR.	
⑤ LOW PRODUCTION - OMIT	
TOTAL CORR'N	$ 0.01036
PLUS BASE PRICE	0.16000
TOTAL PRICE PER LB.	$ 0.17036

Mobil Chemical Company

CROP CHEMICALS GROUP

P.O. BOX 26683
RICHMOND, VIRGINIA 23261
TELEPHONE (804) 798-4291

February 6, 1978

Mr. John Miles
Eagle River Chemical Corporation
P. O. Box 2648
W. Helena, Arkansas 72390

Dear John:

This will confirm our telephone conversation of this date regarding the release of UTLX 95668. The replacement car for CBE service is MOBX 11378.

When ready to release UTLX 95668, please call D. L. Grueder, Mobil Traffic for destination for cleaning of cars.

Any questions, please advise.

Sincerely,

F. L. Lattire

F. L. Lattire
Manager, Product Control

cbm

cc: D. L. Grueder
Floy Williams