

INTER-OFFICE COMMUNICATION
INTERMEDIATES DIVISION

DATE JULY 26, 1972

TO: ENGINEERING
FOR: MR. C. C. THOMPSON
FROM: MR. D. C. LEE
RE: PVC PLANT--CONOCO BASIS

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Summary

Earlier preliminary cost estimates for a new PVC plant have been refined based on information obtained during the visit with Conoco in Oklahoma City July 20, 1972. A plant of 240 MM lb/yr capacity, or double Conoco's plant size, would require a capital investment of about \$13 MM before license fee for a Pasadena location. This cost is based on the same design concepts as used in Conoco's plant but provides for considerably more product storage, warehousing, and packaging facilities. Conversion cost of monomer in such a plant would be about 1.4¢/lb. Capital cost would be essentially the same as for a plant using the Shin-Etsu process, but operating costs should be slightly lower because of elimination of refrigerated cooling and colonized water in the Conoco process.

Discussion

Capital costs for a 240 MM lb/yr PVC plant (8 reactors) using Conoco technology are developed in Tables I - III. The costs of major equipment listed in Table I are essentially the same as those reviewed in Piscataway July 14, 1972. These major equipment costs are developed into a factored plant capital cost in Table II for a Pasadena location. The construction factors leading to the \$12.9 MM cost are based on open shop labor rates which currently average about \$5.75 per hour. The estimate includes 15-15,000 cu. ft. silos (or about 10 day's storage) and a warehouse for about two week's storage of 20% of the plant output.

Table III develops an alternate capital cost estimate. In this case the Conoco assessment data showing \$3,680 M battery limits cost for a 120 MM lb/yr plant was scaled up using a 0.95 scale factor. This produced a battery limits direct cost about 10% lower than developed from our own itemized equipment estimate. Using the same offsites estimate as in Table I gives a total plant cost of about \$900 M less than the itemized estimate.

A conversion cost of 1.32¢/lb is developed in Table IV. This cost includes a staff of 13 operators, 4 shift supervisors and a unit supervisor. It also includes double the maintenance manpower shown by Conoco for their 120 MM lb plant.

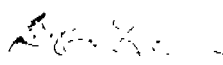
Table V tabulates the main deletions of major equipment from the previously assumed design based on Conoco's successful operation without these items of equipment. The items which might still be questionable are holding bins (\$260 M installed), back-up generator (\$410 M installed), and demineralized water units and tank (\$362 M installed). Keeping these items in the plant would therefore increase total cost by about \$1 MM.

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A rough comparison of the Shin-Etsu process with Conoco's indicates that there is probably little difference in capital requirements. Table VI summarizes the main items of equipment in which the processes differ. The Shin-Etsu reactors are appreciably cheaper on an installed basis, but this advantage is approximately offset by elimination in the Conoco process of chilled water cooling, jacket water pumps, gas holder, distillation, and use of demineralized water.



D. C. Lee

DCL/deh

Attachments

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TABLE I

CONOCO PVC PROCESS
MACHINERY AND EQUIPMENT
PASADENA LOCATION
240 MM LB/YR CAPACITY

<u>Battery Limits</u>	MS
1. Reactors (8)	1304
2. Slurry tanks	440
3. Charge pumps	20
4. Dump pumps	10
5. Centrifuges (4)	260
6. Centrifuge feed pumps	12
7. Driers (4 rotary)	320
8. Product collectors & sifters	170
9. Recovery compressors	155
10. Intercoolers	10
11. Condensers	25
12. Condenser chiller	25
13. Recovered monomer tanks	20
14. Solution tanks	25
15. Solution pumps	3
16. Defoamer equipment	5
17. Misc. pumps	8
18. Filter	3
	<u>2515</u>
<u>Offsites</u>	
1. Weighing & conveying	65
2. Silos	350
3. Conveying and packaging	64
4. TCE equipment	12
5. Waste heat boilers (present plant)	125
6. Acid tank	5
7. Hot water tank	38
	<u>655</u>
Total (Exclusive of Packaged Equipment)	3170

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TABLE II

CAPITAL ESTIMATE
CONOCO PVC PROCESS
PASADENA LOCATION
240 MM LB/YR

	Mtls <u>M\$</u>	Labor <u>M\$</u>	Total <u>M\$</u>
<u>Battery Limits</u>			
Machinery & Equipment (Table I)	2515	175	2690
Piping @ 42%		395	1130
Electrical @ 16%		147	430
Instrumentation @ 27%		171	727
Painting & insul. @ 8%		107	215
Structural @ 8%		42	215
Concrete @ 11%		147	296
Misc. @ 1%		13	27
Buildings		35	70
Site Preparation		38	130
B/L Direct Costs	<u>4660</u>	<u>1270</u>	<u>5930</u>
<u>Offsites</u>			
Machinery & Equipment (Table I)	655	45	700
-Install. as above @ 113%	528	262	790
Warehouse	200	-	200
Catalyst bldg.	50	-	50
Fire protection	102	103	205
Waste treatment	15	25	40
Water softener	40	10	50
Instrument and service air	65	15	80
Cooling tower	95	20	115
Roads & railroad	65	25	90
VCM pipeline	115	-	115
Site development			
Electrical	145	45	190
Piping	75	90	165
Other	10	100	110
O/S Direct Costs	<u>2160</u>	<u>740</u>	<u>2900</u>
Contingency @ 10%	680	200	880
Overtime @ 3%		60	60
Total, Direct Costs	<u>7500</u>	<u>2270</u>	<u>9770</u>
<u>Indirect Costs</u>			
Field indirects @ 60% labor			1360
Engineering @ 10% direct costs			975
Taxes @ 5% materials			375
Fee @ 3 1/2% job total			440
<u>Job Total</u>			<u>12920</u>
License			1580
<u>Total Capital</u>			<u>14500</u>

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TABLE III

SCALE-UP OF CONOCO ASSESSMENT CAPITAL

Basis: 1) Pasadena and Oklahoma City
construction costs equal
2) Scale-up factors
a) Battery limits - 0.95
b) Offsites - 0.65
c) Indirects & Eng- 0.80

	Base Case 120 MM Lb/Yr	240 MM Lb/Yr	360 MM Lb/Yr
	M\$	M\$	M\$
<u>Battery Limits</u>			
Direct Costs	2728	5280	7760
Indirect Costs	952	1670	2240
	<u>3680</u>	<u>6950</u>	<u>10000</u>
<u>Offsites</u>			
Direct Costs	1850	2900	3570
Indirect Costs	640	1120	1550
	<u>2490</u>	<u>4020</u>	<u>5120</u>
Contingency @ 10%	<u>620</u>	<u>1100</u>	<u>1510</u>
Plant Cost, before License Fee	<u>6790</u>	<u>12070</u>	<u>16630</u>

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TABLE IV

CONVERSION COST
CONOCO PVC PLANT
PASADENA LOCATION
240 MEI LB/YR
\$14,500 M CAPITAL (EX W.C.)

<u>Operating Costs</u>	<u>M\$/Yr</u>	<u>¢/Lb</u>
Operations: Salaries & benefits	360	0.15
Shipping	150	0.06
Non-VCM Raw Materials & Supplies	430	0.18
Lab	30	0.01
Steam 45 M Lb/Hr (2/3 waste heat steam)	65	0.03
Cooling water @ 1.5¢/M gal	30	0.01
Electricity - assume 260 KWH/ton	220	0.09
Water	10	0.01
Maintenance: Mtls	215	0.09
Salaries & benefits	250	0.10
Supr. & O.H.	50	0.02
Depreciation @ 6½%	905	0.38
Taxes @ 1½%	220	0.09
Plant O.H.	50	0.02
Computer lease	60	0.02
VCM loss @2% and 4.5¢/lb	<u>215</u>	<u>0.09</u>
Conversion Cost	3260	1.36

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TABLE V

DELETIONS FROM INITIAL DESIGN

CONOCO PVC PROCESS

PASADENA LOCATION

240 MM LB/YR

	Equipment Only	Total Installed
	<u>M\$</u>	<u>M\$</u>
1. Holding bins	83	260
2. Back-up generator	130	410
3. Refrigeration units	220	325
4. Jacket water pumps	21	66
5. D.M. water units	175	260
6. Chilled water tank	39	122
7. D.M. water tank	39	122
8. Distillation col. & condenser	52	164
9. Caustic tank	18	56
10. Gas holder	63	198
11. Waste treatment-reduction	140	<u>205</u>
		2188

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TABLE VI

SHIN-ETSU VS CONOCO
CAPITAL COMPARISON
(OTHER COSTS ASSUMED IDENTICAL)
PASADENA LOCATION

	<u>240 MM Lb/Yr</u>		<u>220 MM Lb/Yr</u>	
	<u>Conoco</u>		<u>Shin-Etsu</u>	
	<u>Equip.</u>	<u>Total</u>	<u>Equip.</u>	<u>Total</u>
	<u>Only</u>	<u>Install.</u>	<u>Only</u>	<u>Install.</u>
	<u>M\$</u>	<u>M\$</u>	<u>M\$</u>	<u>M\$</u>
<u>Battery Limits</u>				
1. Reactors	1304	4095	920	2890
2. Jacket water pumps	-	-	21	66
3. Centrifuges	260	816	185	580
4. Centrifuge pumps	10	31	7	22
5. Product collectors & sifters	168	528	118	370
6. Gas holder	-	-	63	198
7. Distillation col.	-	-	40	126
8. Condenser	-	-	12	38
	<u>1742</u>	<u>5470</u>	<u>1366</u>	<u>4290</u>
<u>Offsites</u>				
1. Conveying & weighing	64	200	45	142
2. Caustic tanks	-	-	14	44
3. Chilled water tank	-	-	39	122
4. D.M. water tank	-	-	39	122
5. Refrigeration	-	-	220	325
6. D.M. water units	-	-	175	260
	<u>64</u>	<u>200</u>	<u>532</u>	<u>1015</u>
<u>Totals</u>	<u>1806</u>	<u>5670</u>	<u>1898</u>	<u>5305</u>