Interoffice Communication

To Distribution

From J. K. McCrary, Ponca City, Oklahoma

Date July 27, 1984

Subject VCM Cost Profiles Report--Review Issue

Attached is the review issue of the VCM Cost Profiles Report. We will be scheduling a meeting to review this document in the near future. Please call me at ETN 442-5503 if you are interested in attending.

Jeffrey K. McCrary
Process Engineer
Chemicals (Vista) Division
Process Engineering Department

pjc
Enc
CC:

Houston
R. Y. Elliot
J. G. Dopper
F. J. Endelman
W. J. Ritter
G. W. Inbody
R. J. Anderson
R. D. Gamblin
E. A. Vogelfanger
J. A. Hall

Ponca City
D. E. Michels
R. W. Churns

Lake Charles
R. A. Conrad
R. Bryan

TABLE I

VCM COST PROFILES

SUMMARY

Plant	Location	MM LB/YR Nameplate Capacity	MM LB/YR Typical Operating Rate[1]	MANUFACTURING COST ¢/LB VCM Variable	Total Cost at Capacity	Total Cost at Typical Rate
B. F. Goodrich	La Porte, TX	1,000[5]	820	14.94	16.19	16.46
Dow	Plaquemine, LA	1,250	1,015	15.14	16.60	16.94
Vista	Lake Charles, LA	670	500	15.08	16.68	17.23
Shell	Deer Park, TX	1,120	650	15.22	16.53	17.47
B. F. Goodrich	Calvert City, KY	1,000 → 1.2 (x)	735	15.44	17.08	17.67
PPG No. 2	Lake Charles, LA	500	475	15.81	17.60	17.69
Georgia Pacific	Plaquemine, LA	1,000	600	15.81	17.04	17.85
Dow	Oyster Creek, TX	700	510	15.14	17.17	17.92
Borden	Geismar, LA	300	290	15.54	18.29	18.38
Formosa Plastics	Point Comfort, TX	530	295[2]	15.32[2]	17.14[2]	18.58[2]
Shell	Norco, LA	840	300[2]	15.42[2]	16.82[2]	19.35[2]
PPG No. 1	Lake Charles, LA	400	315[2]	15.81[2]	18.87[2]	19.69[2]
Ethyl	Baton Rouge, LA	300	190[2]	15.53[2]	18.18[2]	19.71[2]
Formosa Plastics	Baton Rouge, LA	300	125[2]	15.45[2]	18.17[2]	21.97[2]
Dow	Freeport, TX	200	90[3]	15.14[3]	18.61[3]	22.87[3]
Borden	Geismar, LA	300	100[3]	22.77[3]	24.25[3]	27.21[3]
Total		10,410	7,010	-	-	-
Production Weighted Average[4]		870	650	15.34	17.00	17.64

Notes:

[1] Data from R. Y. Elliot. Based on 1983 production estimates.

[2] Plant was permanently shut down in 1983. Excluded from production weighted average.

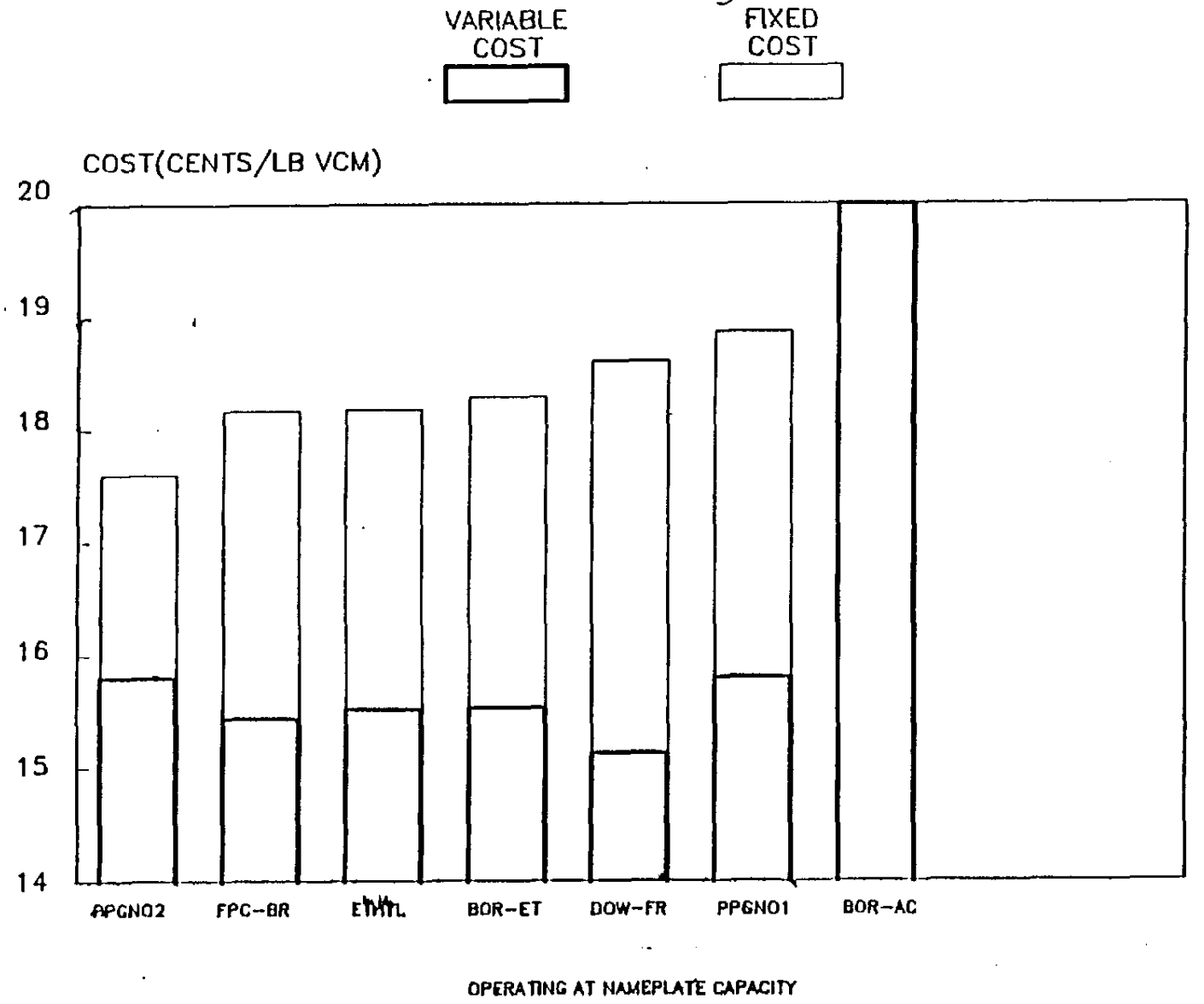
[3] Acetylene based VCM process. Excluded from production weighted average.

[4] Production weighted average manufacturing cost = $\frac{\text{sum [(operating rate) x (cost)]}}{\text{total production}}$

[5] Dow shut down 450 MM pound capacity at Plaquemine in 1984. Total manufacturing cost at 800 MM pound VCM capacity 16.58¢/lb VCM.

VCM COST PROFILES:

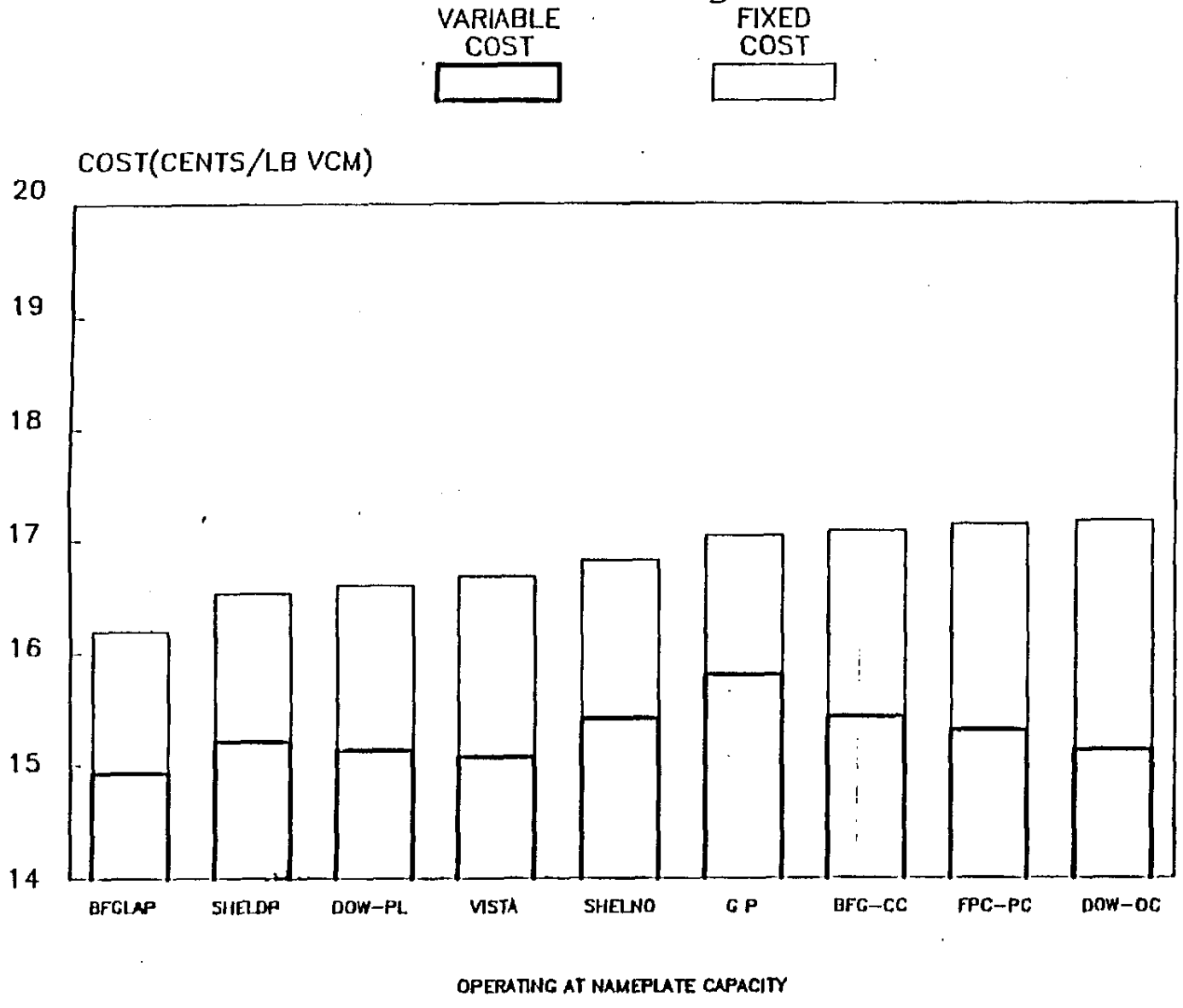
Manufacturing Costs



OPERATING AT NAMEPLATE CAPACITY

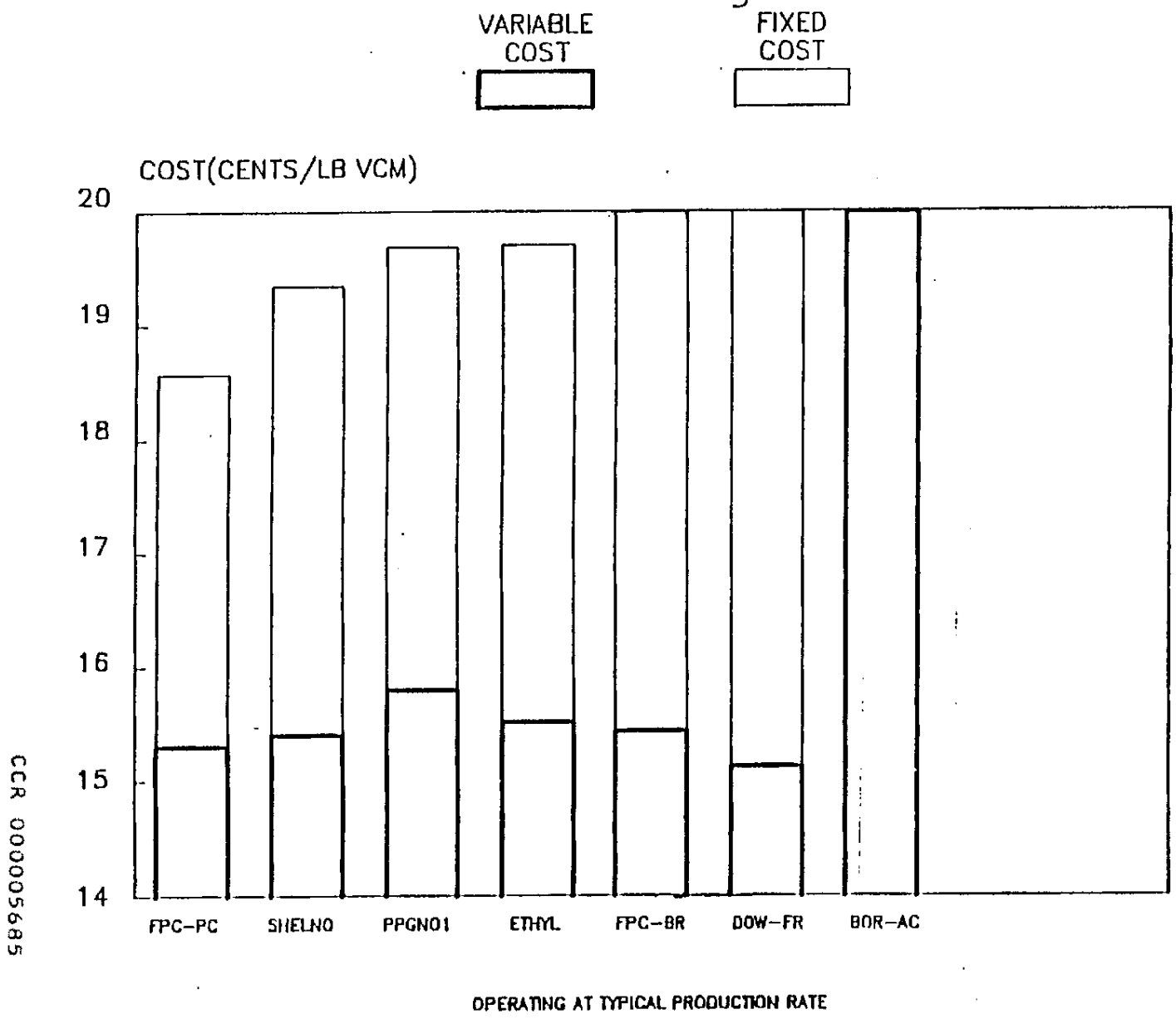
VCM COST PROFILES:

Manufacturing Costs



VCM COST PROFILES:

Manufacturing Costs

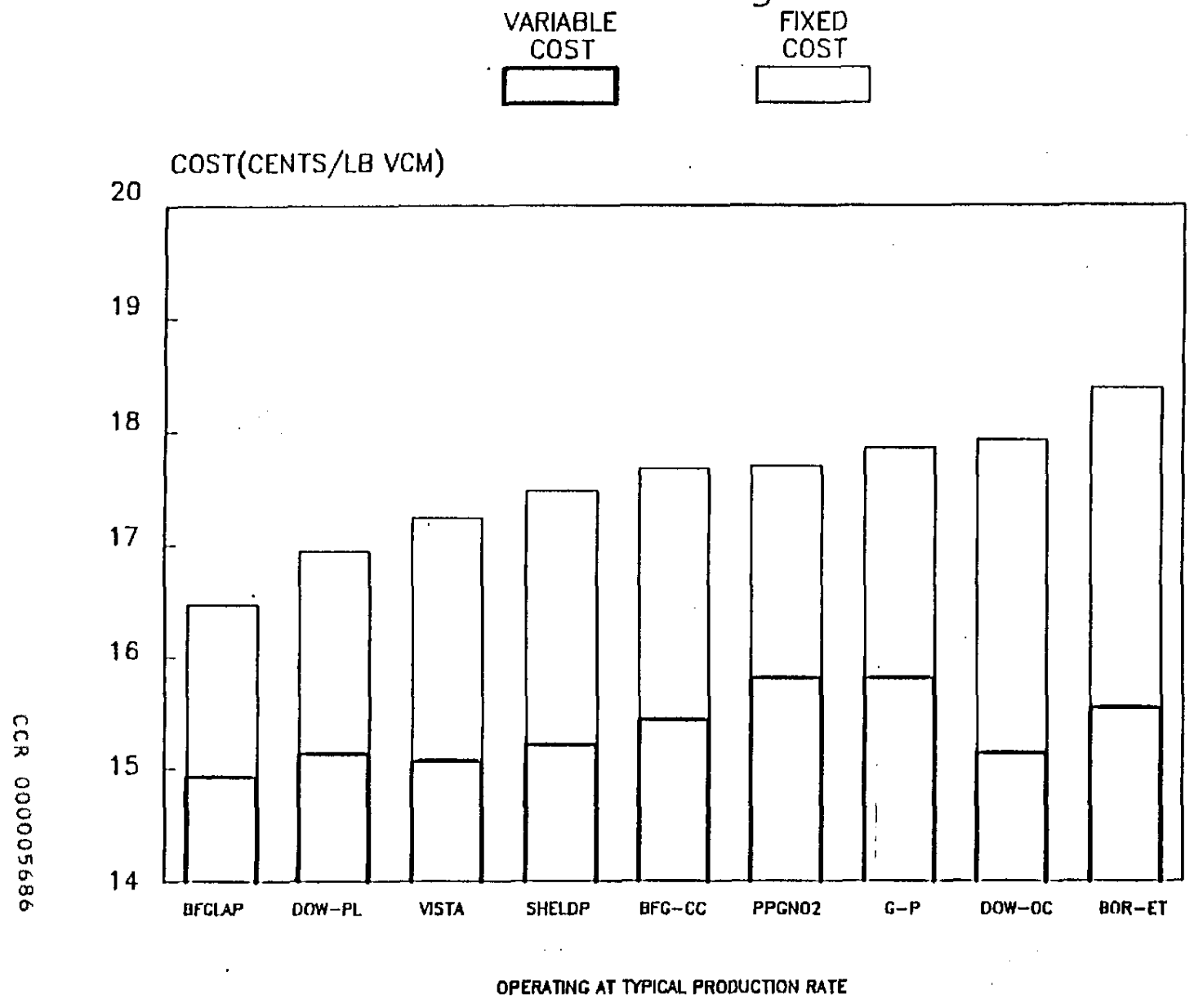


OPERATING AT TYPICAL PRODUCTION RATE

CCR 000005685

VCM COST PROFILES:

Manufacturing Costs



OPERATING AT TYPICAL PRODUCTION RATE

(conoco)

Interoffice Communication

To J. G. Dopper, Vista Chemical Co.

From G. J. Fryar

Date October 8, 1984

Subject VCM Cost Profiles

The VCM Cost Profiles activity was undertaken to provide the business area and marketing a "tool" to assist in evaluating sales opportunities for VCM and PVC. The ultimate objective was improvement of sales margins through a better understanding of our competitive position in industry. Basic requirements for this "tool" were formulated with Fred Endelman, Bill Ritter, and others and consisted of:

1. Accurate concise descriptions of competitive VCM producers, with site/process/transportation/feedstock idiosyncracies noted.

2. Detailed manufacturing cost buildups reflecting the idiosyncracies of item 1, but using standard unit costs for all producers in the first edition.

3. Flexibility in report format and microcomputer software to allow simple and rapid updating either as the need arose or on a prescribed frequency.

The broad philosophy statement above recognized the needs that you and the sales staff have in bidding competitively against Dow and others in the international arena with U.S. origin VCM. It also recognized the domestic possibilities in PVC sales which might be accrued using VCM from a Vista plant historically operated at higher relative capacity levels (thus lower unit costs) than those of competitors.

The cost buildups for all domestic VCM producers were entered on a diskette for use with Vista's IBM microcomputers. It was envisioned that you, for example, would be able to call up this information within seconds of identifying a need. Similarly if you recognized a need to revise input raw material costs for current or future projections, those changes could be made in seconds. It was anticipated that "master" versions of the software and hard-copy work would be maintained and periodically updated by Bill Ritter's group, although it may now be desirable for Jeff McCrary to handle this effort for the short term.

For the VCM Cost Profiles activity to reach its full potential of service to you and the marketing staff, the following actions must all take place:

1. A coordinator (i.e. Ritter or McCrary) must be designated as the clearing house for maintenance of the system and storage of industry VCM intelligence.

2. Intelligence gathering sources (plant personnel, sales people, yourself, etc.) must communicate information to the coordinator in timely fashion.

3. You, and whoever else you feel necessary, need to be acquainted with use (not necessarily maintenance, though) of the software program. (This should require no more than 15-20 minutes.)

4. A working policy must be established to govern frequency of updates, verification of intelligence reports, and responsibility for maintenance.

Those of us involved in developing the original scope also envisioned that this concept should ultimately be expanded to cover selected products in the other business areas also. An excellent foundation currently exists for extension to the PVC area for example.

An invitation was extended to me to present the views expressed in this letter at the introductory meeting held at Timberway on September 20. Unfortunately, other developments concerning the Justice Department consent decrees precluded my attending the meeting. I firmly believe the VCM Cost Profiles are a valuable piece of work, but more importantly, can be a valuable tool with minimum maintenance effort.

Garvin J. Fryar
Chief Process Engineer
Chemicals and Coal Division
Process Engineering Department

lk
cc:

Vista Chemical Co.
J. K. McCrary, Timberway
D. E. Michels, Timberway
W. J. Ritter, Timberway
R. Bryan, L.C. VCM Plant

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VCM COST PROFILES

An analysis of the manufacturing costs of the U.S. VCM producers and of the competitive position of Conoco in the U.S. was made by PED at the request of F. J. Endelman, Conoco Chemicals Business Research. This study provides insight into:

1. Important technology factors affecting the manufacturing costs of U.S. VCM producers assuming equal unit costs for raw materials, energy, and labor for all producers.

2. The competitive position of Conoco in the U.S. VCM market again assuming equal unit costs for raw materials, energy, and labor.

3. Prospects for Conoco in VCM.

Raw materials currently constitute 80 percent of the VCM manufacturing cost for Conoco. Fixed costs (in-plant) account for only 10 percent. However, fixed costs can vary greatly from plant to plant and, therefore, affect manufacturing costs. Staffing variations as a result of plant capacity; number of parallel plant trains; and, in some cases, technology are the major constituents of fixed costs.

Actual feedstock and supply prices strongly affect the variable portion of manufacturing costs. This report assumes identical prices for each VCM producer. Further study should be made to determine the effects of regional prices on the applicable VCM producers. Price differences on a regional or producer specific basis can dominate technology factors when determining actual production costs.

The manufacturing cost for Conoco's VCM plant is 16.68 cents per pound VCM in a sold-out VCM market and 17.23 cents per pound VCM at 500 million pounds per year or "typical" production rate. The Conoco VCM plant ranks fourth in manufacturing costs among the thirteen active VCM plants in a sold-out market and third at typical production rates. Conoco's manufacturing cost is below the production-weighted industry average cost of 17.00 cents per pound VCM sold-out and 17.64 cents per pound VCM at typical production rate.

INTRODUCTION

VCM COST PROFILES

Conoco Chemicals' Business Research office commissioned this analysis of manufacturing costs for VCM producers. The objective of this work is to provide insight into:

1. Important factors affecting the manufacturing costs of VCM producers.

2. The competitive position of Conoco in the VCM market.

Four factors exhibit the major effects on the manufacturing cost of VCM. They are:

Plant Capacity
Feedstock Prices
Number of Parallel Trains
Technology

Manufacturing costs were determined for each U.S. VCM producer. These costs include the effects of plant capacity, process technology, and parallel process trains. The effect of differences in feedstock price as a function of market price and plant location is not considered. The manufacturing costs were prepared assuming equal feedstock unit prices for all producers. Plant capital investment and working capital costs are not included in the buildups.

The basis of calculating manufacturing costs is that raw material, energy, and labor unit prices are the same for each producer. Further competitive analysis may show this to be untrue. Regional or producer specific raw material and energy costs may dominate technology factors when determining actual production costs.

The term "Manufacturing Costs," when used in this report, refers to the sum of fixed and variable costs only and excludes depreciation and amortization costs and other ex-plant costs. The term "Typical Production Rate" refers to an estimate made by Rebecca Elliot[1] of the 1983 annual VCM production.

ANALYSIS

In this report, the manufacturing costs for all U.S. VCM plants is calculated. This calculation does not consider regional or producer specific differences in the unit prices of feedstocks, energy, labor, or any other component of manufacturing cost.

The manufacturing cost at typical operating rate and at nameplate capacity is shown in Table I for each U.S. VCM plant. Variable manufacturing cost, nameplate capacity, and typical operating rates are also shown. Table I is arranged in order of increasing manufacturing cost at typical operating rates.

	CENTS PER LB VCM		
		MANUFACTURING COST	
	Variable Cost	At Nameplate Capacity	At Typical Rates
Conoco	15.08	16.68	17.23
Lowest Cost Producer	14.94	16.19	16.46
Weighted Average	15.34	17.00	17.64

At typical operating rates, Conoco's manufacturing cost (17.23¢/Lb VCM) is the third lowest behind B. F. Goodrich, La Porte, Texas (16.46¢/Lb VCM) and Dow, Plaquemine, Louisiana (16.94¢/Lb VCM). Conoco is 0.41 cents per pound VCM lower than the production weighted average cost (17.64¢/Lb VCM).

At nameplate capacity, Conoco's manufacturing Cost (16.68¢/Lb VCM) is the fourth lowest behind B. F. Goodrich, La Porte, Texas (16.19¢/Lb VCM); Shell, Deer Park, Texas (16.53¢/Lb VCM); and Dow, Plaquemine, Louisiana (16.60¢/Lb VCM). Conoco is 0.32 cents per pound VCM lower than the production weighted average cost (17.00¢/Lb VCM). Conoco's variable manufacturing cost (15.08¢/Lb VCM) is second lowest railing only B. F. Goodrich, La Porte, Texas (14.94¢/Lb VCM) and is 0.26 cents per pound VCM lower than the production weighted average (15.34¢/Lb VCM).

The effect of fixed costs, particularly labor, on the variation of total manufacturing costs among VCM producers outweigh the effects of other cost differences such as raw material conversions (see Figures 29A and B in Appendix A). Excluding values from the Borden acetylene-based plant, the industry wide range in variable costs due to variations in material yields and technology differences is about 0.6 cents per pound VCM. However, the range of fixed costs is 2.25 cents per pound VCM. Fixed costs correlate strongly to plant size (see Figure 30 in Appendix A). Larger plants can operate more efficiently in this area. The number of parallel trains in a plant is also important. A single train plant can operate at approximately 0.4 cent fixed cost lower than similarly sized dual train plant.

A comparison of manufacturing costs, both at nameplate capacity and at typical operating rate, shows the effect of economies of scale. All of the plants, except PPG No. 2, with manufacturing costs below 18 cents per pound VCM have typical operating rates above 500 MM pounds per year. All of the plants, except PPG No. 2, above 18 cents per pound VCM have typical operating rates below 500 MM pounds per year. The two leading producers

both have nameplate capacities of at least 1,000 MM pounds per year with typical operating rates above 80 percent of capacity. The lower cost producers (below 18 cents per pound VCM at typical production rates) are B. F. Goodrich (La Porte and Calvert City), Dow (Plaquemine and Oyster Creek), Conoco, Shell (Deer Park), PPG No. 2, and Georgia Pacific. At nameplate capacity this group is joined by Shell (Norco) and Formosa Plastics (Point Comfort). The higher cost producers (above 18 cents per pound VCM at typical production rates) are Borden (both Geismar Plants), Formosa Plastics (Point Comfort and Baton Rouge), Shell (Norco), PPG No. 1, Ethyl, and Dow (Freeport). Of this group, Shell (Norco), Dow (Freeport), and Ethyl were shut down, presumably permanently, during 1983.

A comparison of variable costs shows differences between the various VCM technologies. Technology differences show a range of 0.38¢/Lb VCM in raw material, 0.25¢/Lb VCM in by-product credit, 0.26¢/Lb VCM in processing supplies, and 0.49¢/Lb VCM in utilities. The range in variable cost is 0.87¢/Lb VCM. The lowest variable cost plant is the B. F. Goodrich plant at La Porte, Texas, which employs B. F. Goodrich oxychlorination technology and Stauffer technology elsewhere. Next are the Stauffer oxygen based oxy plants: Conoco, Shell (Deer Park), and Dow (Plaquemine, Oyster Creek, and Freeport). Following these are Formosa Plastics (Point Comfort) with Mitsui Toatsu technology, B. F. Goodrich (Calvert City) and Formosa Plastics (Baton Rouge) with B. F. Goodrich technology, Shell (Norco) and Borden using Stauffer air based oxychlorination technology, and Ethyl's plant at Baton Rouge using Ethyl technology. The two PPG plants and the Georgia Pacific plant use PPG technology which has the highest variable cost. The Borden acetylene based VCM plant has the highest apparent variable cost. Presumably it continues to operate because its raw material costs are lower than those assumed in this report and because of integration (HCl transfers) with Borden's ethylene based VCM plant.

The basis of this report includes common feedstock and other supply prices. The results of vertical integration or favorable contracts, however, are lower manufacturing costs due to lower prices for ethylene, chlorine, or natural gas. For instance, a one cent per pound reduction in the ethylene price leads to a manufacturing cost reduction of almost 0.5 cents per pound VCM. A five dollars per ton reduction in the chlorine price leads to a manufacturing cost decrease of over 0.15 cents per pound VCM (ethylene and chlorine price variances of at least this much may be seen in the Gulf Coast).[79] A natural gas contract at 50 cents per MSCF, such as is held by PPG and Georgia-Pacific, would decrease manufacturing costs more than 0.8 cents per pound. Feedstock and supply prices are important factors in VCM production costs and should be considered in a thorough market analysis.

The Borden acetylene feedstock plant in Geismar, Louisiana, appears to be a poor competitor due to the large acetylene cost. If Borden receives natural gas at 50 cents per MSCF, the manufacturing cost at the plant would be approximately 13 cents per pound rather than the 26.3 cents per pound VCM shown in Figures 25A and B. Borden had a low cost natural gas contract with Texaco that terminated in 1982.[1] The plant manufacturing cost buildup and the current operating rate hint that Borden may still receive a limited supply of natural gas at a lower-than-market price.

EPA emission compliance is dictating capital investments for sime plants for continued market presence. This factor figures in the decisions for some of the plant closings this year. The only remaining plant in operation without compliance may be Formosa Plastics in Baton Rouge.

The outlook for Conoco in VCM has improved this year. Three plants have shut down in 1983, lowering the U.S. total VCM capacity 1,340 MM pounds VCM per year, to 9,070 MM pounds VCM per year. Conoco EPA emission compliance was met this year through the VCM modernization project. This resulted in slightly improved variable costs over previous years of air-based operation.

Although poor market conditions are bad for all VCM producers, Conoco's presence may be sheltered by several high cost producers. 1983 has seen three plant closings. The Borden acetylene feedstock plant, Formosa Plastics in Baton Rouge, and the older (400 MM pounds VCM per year) PPG plant are all candidates for closing and may not survive the next market shakeout (see Figure 31 in Appendix A). The Borden ethylene based VCM plant is also a high cost plant is not supplied by captive feedstocks.

The prospects for a major expansion at Conoco, however, do not appear as bright. Several comapnies are better prepared for expansion of VCM capacity in terms of both required investment and turnaround time. The Dow plant in Plaquemine, Louisiana, is prepared for a 400 MM pounds VCM per year expansion "when the market is ready," requiring a relatively small investment.[3] Borden is preparing a conversion to oxygen feedstock in oxychlorination and expansion to 450 or 600 MM pounds VCM per year in their ethylene-feedstock plant, to improve their variable and fixed costs, and to feed expanded PVC operations.[4] The Shell Norco, Louisiana, plant is prepared for startup on short notice, although EPA compliance investments are still outstanding.[5] B. F. Goodrich have a partially complete 1,600 MM pounds per year VCM plant in Convent, Louisiana, where construction work was postponed in 1981.[7]

The four examples above total up to 3,440 MM pounds VCM per year additional capacity in various stages of preparation. In addition, B. F. Goodrich are presently considering a 500 MM pounds VCM per year expansion at La Porte, Texas; and Formosa Plastics have discussed plans for a new chlorine/EDC/VCM complex in Baton Rouge, Louisiana.[5]

TABLE I

VCM COST PROFILES

SUMMARY

Plant	Location	MM LB/YR Nameplate Capacity	MM LB/YR Typical Operating Rate[1]	MANUFACTURING COST ¢/LB VCM Variable	MANUFACTURING COST ¢/LB VCM Total Cost at Capacity	MANUFACTURING COST ¢/LB VCM Total Cost at Typical Rate
B. F. Goodrich	La Porte, TX	1,000	820	14.94	16.19	16.46
Dow	Plaquemine, LA	1,250	1,015	15.14	16.60	16.94
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Borden	Geismar, LA	300	100[3]	24.80[3]	26.28[3]	29.24[3]
Total		10,410	7,010	-	-	-
Production Weighted Average[4]		870	650	15.34	17.00	17.64

Notes:

[1] Data from R. Y. Elliot, Conoco Chemicals. Based on 1983 production estimates.

[2] Plant was permanently shut down in 1983. Excluded from production weighted average.

[3] Acetylene based VCM process. Excluded from production weighted average.

[4] Production weighted average manufacturing cost = $\frac{\text{sum [(operating rate) x (cost)]}}{\text{total production}}$

ASSUMPTIONS

BASES AND ASSUMPTIONS

VCM COST PROFILES

1. Unit prices for feedstocks, by-products, processing supplies, etc, are assumed to be identical for each VCM producer for this study. The price bases are the August 1983 and September 1983 Chemicals operating statements (Blue Books). No discounts are provided for captive supply or market situations.

2. Amortization, depreciation, ex-plant costs, and revenue taxes are not included in the development of manufacturing costs for each VCM producer. All references to manufacturing costs in this report include only in-plant fixed and variable costs. These costs are exclusive of business overhead, R&D, or interest costs.

3. Information for this report was obtained from:

   a. Vendor-supplied confidential information.
   b. EPA publications.
   c. Publicly available literature.
   d. Personal contacts and correspondence both inside and outside Conoco.
   e. SRI Report, "Vinyl Chloride."

   When specific information was not available, costs were generally assumed to be equal to those at the Conoco VCM plant. For example, the variable cost for the Dow plants is assumed to be the same as the variable cost at the Conoco VCM Plant.

4. This study is confined to battery limits and offsites. Plant location, land, storage facilities, and product transportation are not considered.

5. All royalty fees are assumed to be capital expenses. None are included in the manufacturing cost buildups.

6. All feedstock purities are identical to those for the Conoco VCM plant at Lake Charles.

7. Plant operator staffing is based on information from vendor files when available and on policies at the Conoco VCM plant. The VCM Plant has nine operators per shift plus two breakers and eight laboratory technicians. Staffing is scaled according to the number of units in each plant.

8. Salaried labor costs are a percentage of the operating labor costs. This percentage is the proportion present at the Conoco VCM plant (considered not part of a complex). Salaried labor costs are discounted 10 percent for the VCM producers located in a complex.

9. Maintenance labor costs are scaled from the Conoco VCM plant costs based on the number and size of process units. Maintenance rates for VCM producers using fluidized bed oxychlorination reactors take into account the process differences from the fixed bed process used at Conoco. Maintenance material costs are calculated in a similar manner (see Appendix B).

10. Contract maintenance costs are scaled from the Conoco VCM plant costs based on size and number of units. This value includes casual and roving maintenance labor costs.

11. Benefits costs are a percentage of payroll based on the Conoco VCM plant. The payroll value used includes all permanent company employees at the plant such as roving crews for turnaround maintenance work within a multiplant complex.

12. Operating supply costs are a fixed percentage of operating labor. The basis is the percentage for the Conoco VCM plant.

13. Insurance, clearances, and taxes are assumed to be equal to those at the Conoco VCM plant on a basis of cost per pound of nameplate production capacity for each plant. All of the U.S. VCM plants, except B. F. Goodrich (Calvert City, Kentucky) are located in Louisiana and Texas.

14. The Conoco VCM Plant has a 600 psig to 150 psig back pressure turbine driving its propylene refrigeration compressor. Replacing this turbine with an electric motor would reduce steam consumption and increase electricity consumption with a net savings in utilities. Further analysis is required to determine the magnitude of this savings. Other Stauffer licensed plants and the Dow plants are in a similar situation. It is not known whether a similar savings could be made in other plants.

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VCM PRODUCERS

VCM COST PROFILES

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

BORDEN (ACETYLENE FEED)

GEISMAR, LOUISIANA

BACKGROUND DATA

Startup Year	Between 1957 and 1965[27,28] (formerly Borden-Uniroyal joint venture under the name of Monochem, Inc.,[4] Borden became sole owner in 1982).
Capacity	300 MM Pounds VCM/Year[3]
Expansions/Modernizations	None
Environmental Status	Not known. The plant is assumed to be in compliance.

MARKET POSITION

Feedstocks/Supplies

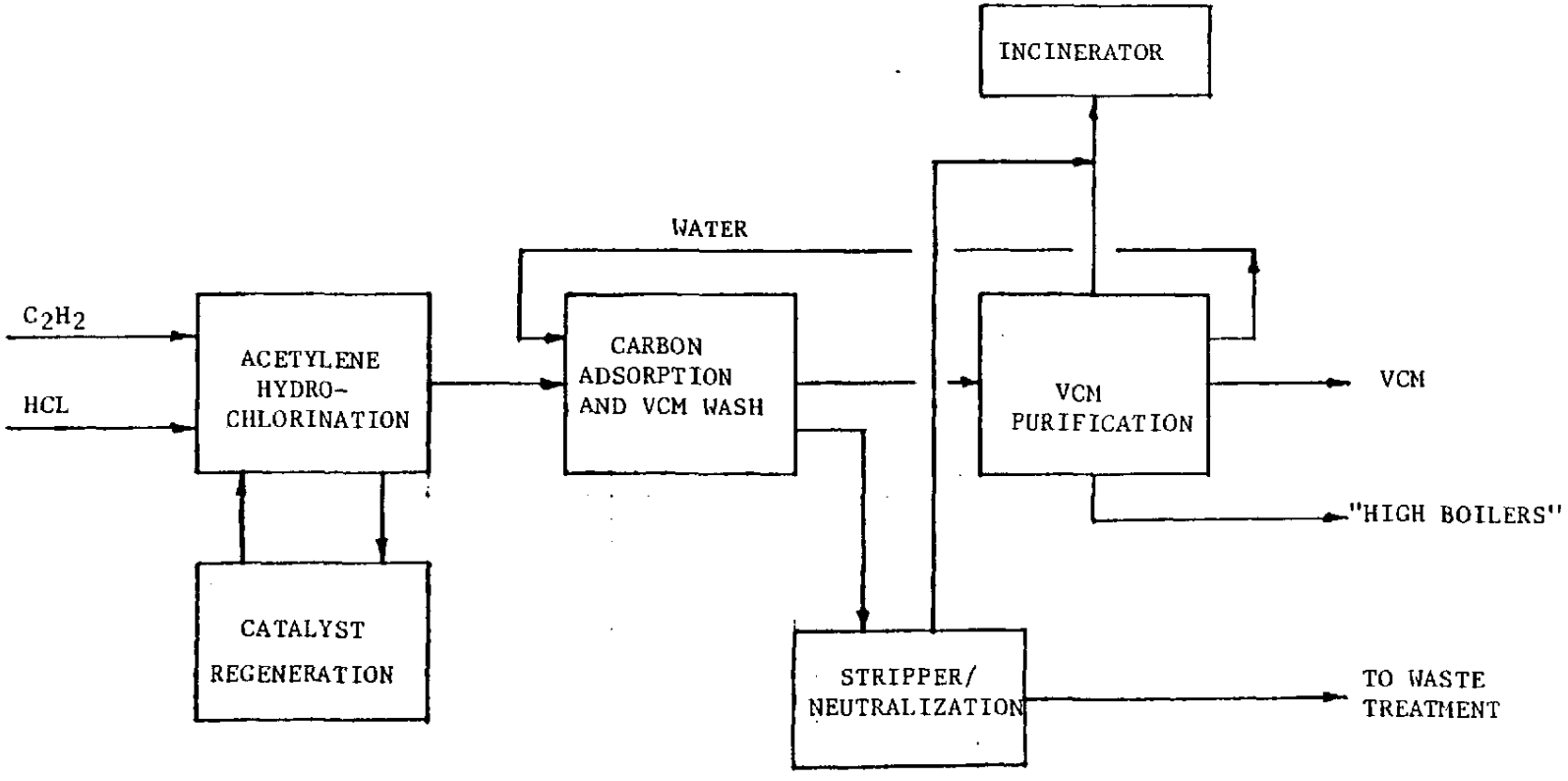
Acetylene	Captive (Geismar, Louisiana).[29] The facility has a limited supply of low price natural gas.
Hydrochloric Acid	Probably obtained by both burning chlorine and use of captive by-product from the adjacent Borden ethylene-based VCM plant.[30]
Product Use	All product is used captively for PVC production (Geismar, Louisiana; Illiopolis, Illinois; Leominster, Massachusetts).[30] The production rate was 33 percent of capacity during 1983.

TECHNOLOGY/EQUIPMENT[2]

Acetylene hydrochlorination technology with fixed bed reactors using mercury (on carbon) catalyst. This technology is considered obsolete because of rising acetylene prices and future availability. Future existence of plant is undoubtedly related to the reginal availability of acetylene based upon low energy costs and the variable costs of incremental production.

FIGURE 1

VCM COST PROFILES
BLOCK FLOW DIAGRAM
BORDEN (ACETYLENE FEED)
GEISMAR, LOUISIANA[2]



MANUFACTURING COST: Borden(acetylene)@Geismar, LA
Capacity: 300 MM lbs VCM/year $fixed and variable costs only

	units	units/ lb VCM	cents/ unit	MM units/ year	M $ per year	cents/ lb VCM	ref codes	
RAW MATERIALS								
Acetylene	lb	0.4217	50.0000	126.51	63256.5	21.0855	1	(1)
Chlorine	lb	0.0001	5.8337	0.02	1.1	0.0004	1	
HCl	lb	0.6172	4.2843	185.16	7932.7	2.6442	1	
SUBTOTAL					71190.2	23.7301		
BYPRODUCTS								
Steam	Mlbs	0.0000	480.4822	0.00	0.0	0.0000	1	
Light Ends	lb	-0.0241	1.4760	-7.23	-106.7	-0.0356	1	
Tars	lb	0.0000	-1.7500	0.00	0.0	0.0000	1	
SUBTOTAL					-106.7	-0.0356		
PROCESSING SUPPLIES								
Catalyst	lb	0.0005	1000.0000	0.15	1475.7	0.4919	2	
Caustic	lb	0.0044	12.1123	1.32	159.9	0.0533	1	
Nitrogen	MSCF	.0000	70.2443	.00	3.0	0.0010	1	
Ammonia-Amine	lb	0.0000	108.8134	0.00	0.0	0.0000	1	
Sulfuric Acid	lb	0.0000	3.2810	0.00	0.0	0.0000	1	
Limestone	lb	0.0158	0.9293	4.74	44.0	0.0147	1	
Cooling Water Chems	lb	0.0000	108.2571	0.00	0.0	0.0000	1	
Wastewater Treatmnt				0.00	0.0	0.0000	1	
Gas Waste Treatment	mscf				0.0	0.0000	1	
Carbon	lb	0.0010	125.0000	0.30	371.3	0.1238	1	
Misc Chem & Supplis				0.00	0.0	0.0248	2	
SUBTOTAL					2053.8	0.7094		
UTILITIES								
Electricity	kWh	0.0450	3.7223	13.50	502.5	0.1675	1	
Steam	Mlbs	0.0001	480.4822	0.02	72.1	0.0240	1	
Natural Gas	MSCF	.0000	293.6351	.00	2.8	0.0009	1	
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000		
Water	Mgal	0.0040	52.4000	1.19	623.5	0.2078	1	
SUBTOTAL					1200.9	0.4003		
VARIABLE COST SUBTOTAL					74338.2	24.8042		
LABOR								
Salaried					888.0	0.2960	1	
Operating					1074.0	0.3580	1	
Maintenance					300.0	0.1000	1	
Benefits					368.4	0.1228	1	
SUBTOTAL					2630.4	0.8768		
MISCELLANEOUS								
Operating Supplies					286.3	0.0954	1	
Maint Materials					480.0	0.1600	1	
Contract Labor					180.0	0.0600	1	
Insurance					76.2	0.0254	2	
Clearances					340.5	0.1135	2	
Taxes					247.2	0.0824	2	
Miscellaneous					201.3	0.0671	2	
SUBTOTAL					1811.5	0.6038		
FIXED COST SUBTOTAL					4441.8	1.4806		
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					78780.0	26.2848		

(1) Actual acetylene price for Borden is undoubtedly far less than the value shown. Actual price is probably related to low energy prices and incremental variable costs of an adjacent acetylene plant.

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

BORDEN (ACETYLENE FEED)

GEISMAR, LOUISIANA

1. SRI Process Economics Program, "Vinyl Chloride."

2. Same as Conoco O2-based VCM Plant.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

BORDEN (ETHYLENE FEED)

GEISMAR, LOUISIANA

BACKGROUND DATA

Startup Year	1975[31,32,34]
Capacity	300 MM Lbs VCM/Yr[6]
Expansions/Conversions	The plant has added organic recovery/ incineration facilities to meet environmental emissions regulations.[33] An expansion and conversion of oxychlorination to oxygen feedstock is planned (Stauffer technology design).[8]
Environmental Status	Plant incineration of oxychlorination vent stream.[8]

MARKET POSITION

Feedstocks/Supplies

Ethylene	Purchased (Exxon or Shell)[30]
Chlorine	Purchased (Olin, Occidental)[30]

Product Use

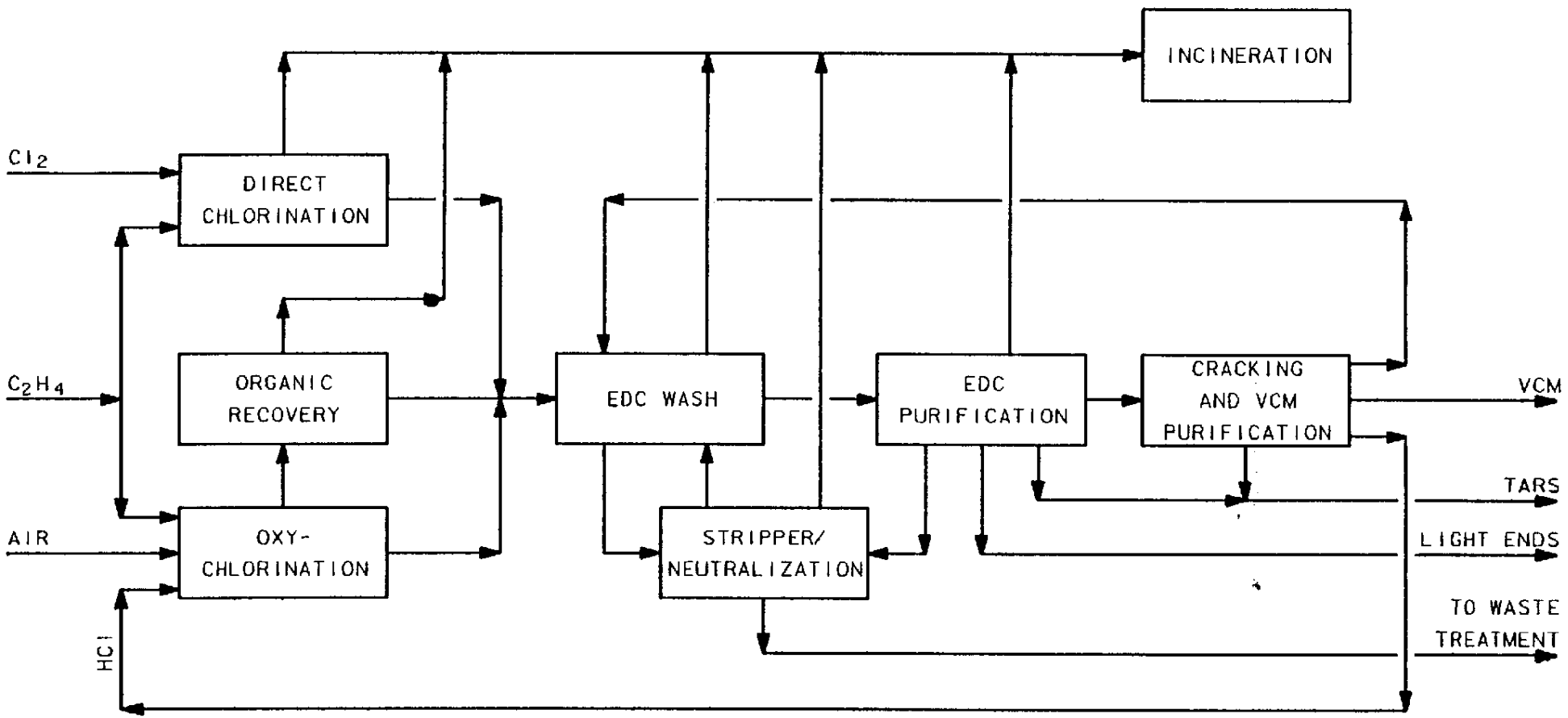
All product is used captively for PVC production (Geismar, Louisiana; Illiopolis, Illinois; Leominster, Massachusetts).[30] The production rate was 97 percent of capacity during 1983.[1]

Plant Information
Borden (Ethylene Feed)
Geismar, Louisiana

TECHNOLOGY/EQUIPMENT[8,30]

Section	Technology	Type	Trains	Notes
Direct	Stauffer	Subcooled	1	-
Oxychlorination	Stauffer	Fixed Bed Air Feed	1	-
Oxy Vent[33]	Jacobs/Rhone-Poulenc	-	1	The oxychlorination vent undergoes EDC recovery and incineration.
Wash	Stauffer	-	1	-
EDC Purification	Stauffer	-	1	-
Cracking[34]	Foster Wheeler	-	1	-
VCM Purification	Stauffer	-	1	-
Incineration[35]	-	-	1	These are in addition to the oxychlorination vent incinerator.

FIGURE 2
VCM COST PROFILES
BLOCK FLOW DIAGRAM
BORDEN (ETHYLENE FEED)
GEISMAR, LOUISIANA[3,33]



MANUFACTURING COST: Borden(ethylene)Geismar, LA
Capacity: 300 MM lbs VCM/year $fixed and variable costs only

	units	units/ lb VCM	cents/ unit	MM units/ year	M $ per year	cents/ lb VCM	ref codes
RAW MATERIALS							
Ethylene	lb	0.4750	20.7440	142.50	29560.2	9.8534	1
Chlorine	lb	0.6602	5.8337	198.06	11554.2	3.8514	1
Oxygen	lb	0.0000	1.4449	0.00	0.0	0.0000	1
SUBTOTAL					41114.4	13.7048	
BYPRODUCTS							
Steam	Mlbs	-0.0009	480.4822	-0.26	-1251.3	-0.4171	1
Light Ends	lb	-0.0082	1.4760	-2.47	-36.5	-0.0122	1
Tars	lb	-0.0154	-1.7500	-4.61	80.6	0.0269	1
SUBTOTAL					-1207.2	-0.4024	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	579.0000	0.04	251.4	0.0838	1
Caustic	lb	0.0167	8.5013	5.01	426.3	0.1421	1
Nitrogen	MSCF	0.0005	70.2443	0.14	98.0	0.0327	1
Ammonia-Amine	lb	.0000	108.8134	.00	2.6	0.0009	1
Sulfuric Acid	lb	0.0005	3.2810	0.15	5.0	0.0017	1
Limestone	lb	0.0132	0.9293	3.97	36.9	0.0123	1
Cooling Water Chems	lb	0.0003	108.2571	0.08	87.6	0.0292	1
Wastewater Treatment				0.00	0.0	0.0000	1
Gas Waste Treatment	mscf				53.9	0.1796	2
Hydrogen	lb	0.0000	16.3838	0.00	0.0	0.0000	3
Misc Chem & Suppls				0.00	0.0	0.0424	1
SUBTOTAL					961.6	0.3246	
UTILITIES							
Electricity	kWh	0.0820	3.7223	24.61	916.2	0.3054	1
Steam	Mlbs	0.0021	480.4822	0.63	3048.5	1.0162	4
Natural Gas	MSCF	0.0013	293.6351	0.38	1122.3	0.3741	1
Fuel Oil	MBal	0.0000	0.0000	0.00	0.0	0.0000	
Water	Mgal	0.0009	22.6924	0.26	59.7	0.0199	1
SUBTOTAL					5146.7	1.7156	
VARIABLE COST SUBTOTAL					46015.5	15.5425	
LABOR							
Salaried					1227.8	0.4093	5
Operating					1648.9	0.5496	5
Maintenance					1176.6	0.3922	5
Benefits					740.2	0.2467	5
SUBTOTAL					4793.4	1.5978	
MISCELLANEOUS							
Operating Supplies					439.5	0.1465	5
Maint Materials					792.3	0.2641	5
Contract Labor					1340.7	0.4469	5
Insurance					76.2	0.0254	1
Clearances					340.5	0.1135	1
Taxes					247.2	0.0824	1
Miscellaneous					201.3	0.0671	1
SUBTOTAL					3437.6	1.1459	
FIXED COST SUBTOTAL					8231.1	2.7437	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					54246.6	18.2862	

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

BORDEN (ETHYLENE FEED)

GEISMAR, LOUISIANA

1. Same as the Conoco air-based VCM plant.
2. The plant also incinerates the oxy vent stream. No steam or HCl recovery.
3. No acetylene hydrogenation.
4. No recycle EDC bypass.
5. Four less operators. Maintenance factors scaled from Conoco air-based plant costs.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

CONOCO

LAKE CHARLES, LOUISIANA

BACKGROUND DATA

Startup Year	1968 (originally a Stauffer-Conoco joint venture with Stauffer operators)[6]
Capacity	670 MM Lbs VCM/Yr[6]
Expansions/Modernizations	Conversion of oxychlorination section to oxygen feedstock in 1983. Plans for expansion to 1,000 MM pounds per year were canceled September 1981.[12]
Environmental Status	Met through oxychlorination conversion to oxygen feedstock process.

MARKET POSITION

Feedstocks/Supplies

Ethylene	The plant uses a captive source (Lake Charles, Louisiana).[75] The ethylene is lower than pipeline grade.
Chlorine	Contract with PPG (Lake Charles, Louisiana) Negotiating a contract with Diamond Shamrock (Deer Park, Texas).[45]
Oxygen	Obtained by contract with Big Three.

By-Products

Light ends are sold to Vulcan Materials (Geismar, Louisiana). Tars are shipped to PPG (we pay them to dispose)(Lake Charles, Louisiana). Some anhydrous HCl is used in production of MeCl. Aqueous HCl (muriatic acid) is sold as reagent.

Product Use

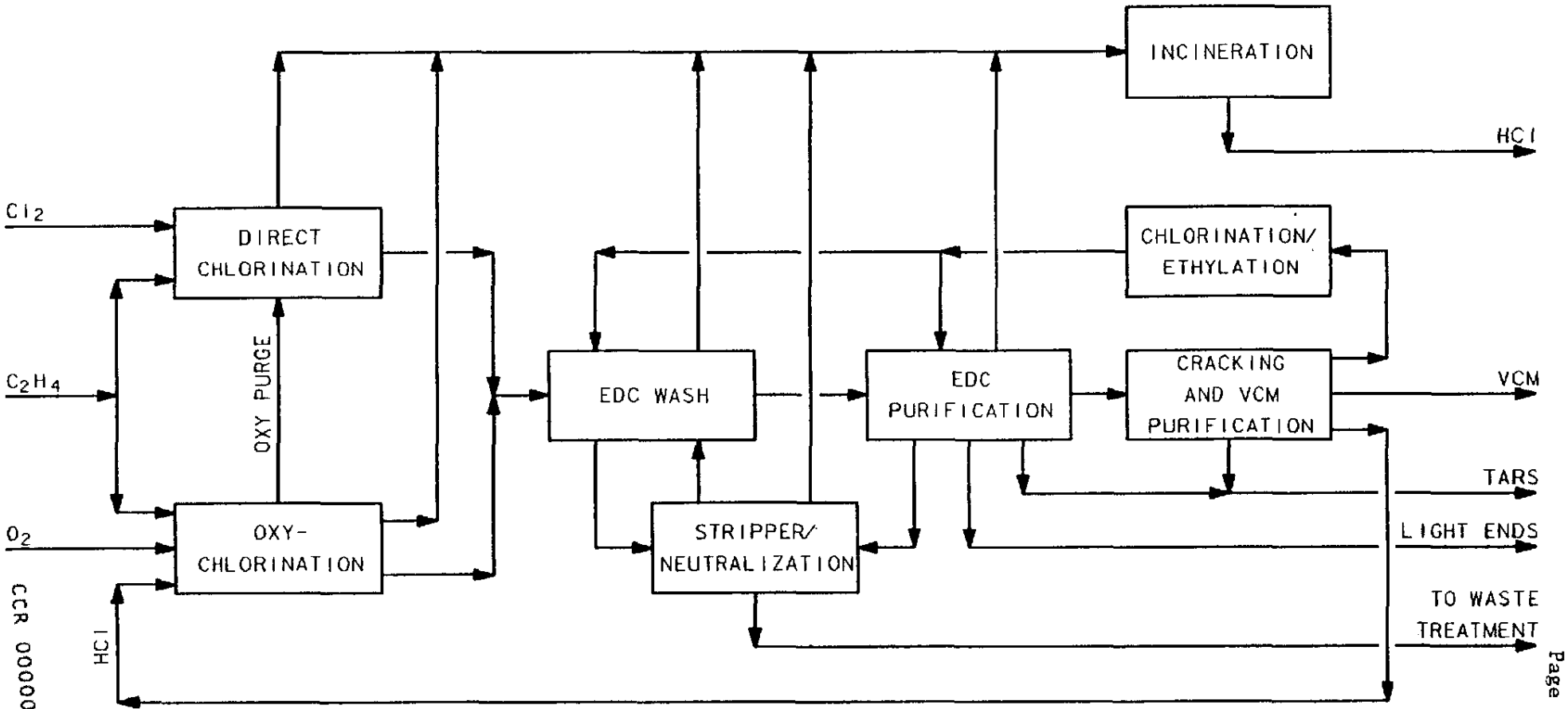
All VCM is used captively for PVC production (Aberdeen, Mississippi, and Oklahoma City, Oklahoma). The plant production rate was 75 percent of capacity during 1983.[1] The plant was shut down two months during 1983 for conversion of the oxychlorination section to oxygen feedstock.

Plant Information
Conoco
Lake Charles, Louisiana

TECHNOLOGY/EQUIPMENT

Section	Technology	Type	Trains	Notes
Direct	Stauffer	Subcooled	1	
Oxychlorination[12]	Stauffer	Fixed Bed Oxygen Feed	1	Fixed speed recycle ethylene compressor.
Wash	Stauffer	-	1	Oxy EDC bypasses acid wash.
EDC Purification	Stauffer	-	1	Recycle EDC bypass of light ends column (approximately 80 percent).
Cracking[37]	Selas	-	2	
VCM Purification	Stauffer	-	1	Caustic VCM dryer.
Incineration[12]	Conoco	-	2	Recover steam, muriatic acid. One serves as standby.
C_2H_2 Hydrogenation	BFG	-	1	-
Secondary Waste Water Treatment[37]	Conoco	-	1	pH, BOD, and solids controlled.

FIGURE 3
VCM COST PROFILES
BLOCK FLOW DIAGRAM
CONOCO [25]
LAKE CHARLES, LOUISIANA



MANUFACTURING COST: Conoco(o2based) Lake Charles,LA
Capacity: 670 MM lbs VCM/year $fixed and variable costs only

		units/	cents/	MM units/	M $ per	cents/	ref
RAW MATERIALS	units	lb VCM	unit	year	year	lb VCM	codes
Ethylene	lb	0.4430	20.7440	311.55	64627.9	9.6460	1
Chlorine	lb	0.6127	5.8337	410.51	23947.9	3.5743	1
Oxygen	lb	0.1501	1.4449	100.57	1453.1	0.2169	1
SUBTOTAL					90028.9	13.4371	
BYPRODUCTS							
Steam	Mlb	-0.0008	480.4822	-0.52	-2492.0	-0.3719	7
Light Ends	lb	-0.0053	1.4760	-3.57	-52.7	-0.0079	1
Tars	lb	-0.0129	-1.7500	-8.66	151.6	0.0226	1
SUBTOTAL					-2393.1	-0.3572	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	687.8000	0.07	495.8	0.0740	6
Caustic	lb	0.0060	12.1123	4.04	489.4	0.0730	1
Nitrogen	MSCF	0.0007	70.2443	0.46	324.8	0.0485	1
Ammonia-Amine	lb	.0000	108.8134	0.02	23.6	0.0035	1
Sulfuric Acid	lb	0.0004	3.2810	0.28	9.0	0.0013	1
Limestone	lb	0.0043	0.9293	2.86	26.6	0.0040	1
Cooling Water Chems	lb	0.0002	108.2571	0.15	167.4	0.0250	1
Wastewater Treatmnt				0.00	0.0	0.0000	9
Gas Waste Treatment	mscf			576.00	6.8	0.0102	8
Hydrogen	lb	0.0002	16.3838	0.11	17.6	0.0026	1
Misc Chem & Supplx				0.00	0.0	0.0248	1
SUBTOTAL					1561.0	0.2670	
UTILITIES							
Electricity	kWh	0.0818	3.7223	54.84	2041.2	0.3047	1
Steam	Mlbs	0.0021	480.4822	1.40	6713.7	1.0020	7
Natural Gas	MSCF	0.0014	293.6351	0.92	2707.9	0.4042	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	
Water	Mgal	0.0008	22.6924	0.56	128.1	0.0191	1
SUBTOTAL					11590.9	1.7300	
VARIABLE COST SUBTOTAL					100787.7	15.0769	
LABOR							
Salaried					1466.8	0.2189	1
Operating					1773.0	0.2646	1
Maintenance					1146.4	0.1711	3
Benefits					687.3	0.1026	2
SUBTOTAL					5073.5	0.7572	
MISCELLANEOUS							
Operating Supplies					472.6	0.0705	1
Maint Materials					1352.4	0.2019	3
Contract Labor					1918.8	0.2864	3
Insurance					169.9	0.0254	1
Clearances					760.6	0.1135	3
Taxes					552.2	0.0824	4
Miscellaneous					449.4	0.0671	5
SUBTOTAL					5675.8	0.8471	
FIXED COST SUBTOTAL					10749.3	1.6044	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					111537.0	16.6813	

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

CONOCO (OXYGEN-BASED)

LAKE CHARLES, LOUISIANA

1. The actual value was taken from the September 1983 operating statement.

2. The September 1983 operating statement shows benefits are 15.67 percent of permanent payroll.

3. Manufacturing costs were prorated for 48 weeks at the September 1983 rate and four weeks at the turnaround rate. Turnaround maintenance costs were obtained from J. R. Holcomb and J. H. Brunson, Lake Charles VCM Plant.

4. Based on the average of August and September 1983 operating statement values.

5. From the July 1983 operating statement.

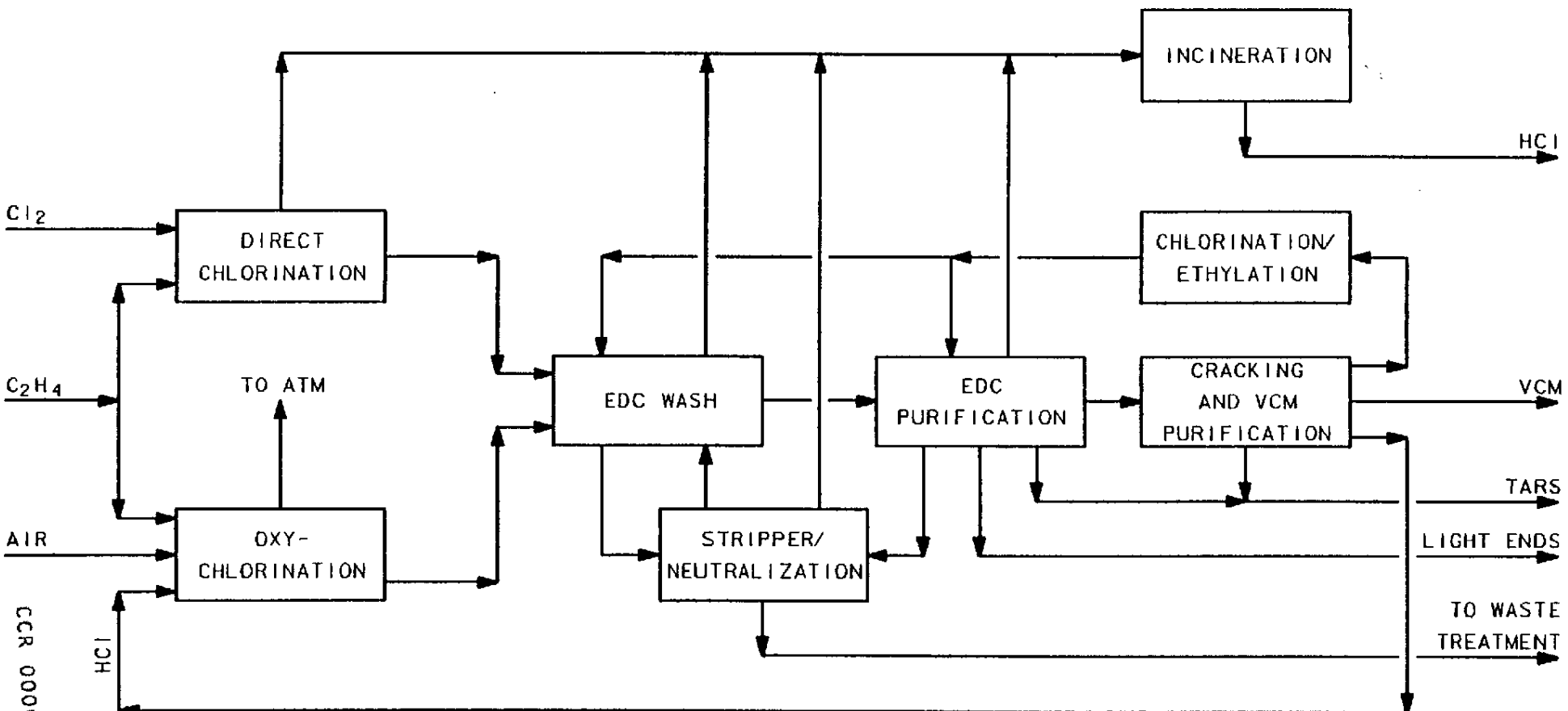
6. Catalyst requirements and price from S. J. Reynolds, Lake Charles VCM Plant.

7. The total steam consumption. Includes the purchased steam value from the September 1983 operating statement, the incinerator steam production of 14,000 pounds per hour, and the oxychlorination steam production rate of 0.0007741 M pounds per pound VCM from "Process Flow Diagrams--VCM Modernization Project," A. G. Loudon, December 3, 1982.

8. The value was calculated from the September 1983 operating statement, including credit for 14,000 pounds per hour of steam production. The effective recovered HCl value is zero.

9. The secondary waste water treatment chemicals costs were included in the operating supplies fixed costs. They should be valued at approximately 0.0060 cent per pound VCM, according to J. H. Brunson, Lake Charles VCM Plant.

FIGURE 4
VCM COST PROFILES
BLOCK FLOW DIAGRAM
CONOCO (AIR-BASED)
LAKE CHARLES, LOUISIANA



MANUFACTURING COSTS Conoco(airbased)Lake Charles,LA
Capacity: 670 MM lbs VCM/year $fixed and variable costs only

	units	units/ lb VCM	cents/ unit	MM units/ year	M $ per year	cents/ lb VCM	ref codes
RAW MATERIALS							
Ethylene	lb	0.4750	20.7440	318.25	66017.8	9.8534	1
Chlorine	lb	0.6602	5.8337	442.33	25804.4	3.8514	1
Oxygen	lb	0.0000	1.4449	0.00	0.0	0.0000	1
SUBTOTAL					91822.2	13.7048	
BYPRODUCTS							
Steam	Mlb	-0.0009	480.4822	-0.58	-2794.6	-0.4171	2
Light Ends	lb	-0.0082	1.4760	-5.52	-81.5	-0.0122	1
Tars	lb	-0.0154	-1.7500	-10.29	180.0	0.0269	1
SUBTOTAL					-2696.1	-0.4024	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	579.0000	0.10	561.4	0.0838	3
Caustic	lb	0.0167	8.5013	11.20	952.1	0.1421	1
Nitrogen	MSCF	0.0005	70.2443	0.31	218.8	0.0327	1
Ammonia-Amine	lb	.0000	108.8134	0.01	5.8	0.0009	1
Sulfuric Acid	lb	0.0005	3.2810	0.34	11.3	0.0017	1
Limestone	lb	0.0132	0.9293	8.87	82.4	0.0123	1
Cooling Water Chems	lb	0.0003	108.2571	0.18	195.6	0.0292	1
Wastewater Treatmt				0.00	0.0	0.0000	6
Gas Waste Treatment	mscf				-18.3	-0.0273	4
Hydrogen	lb	0.0002	16.3838	0.11	17.6	0.0026	1
Misc Chem & Supplx				0.00	0.0	0.0424	1
SUBTOTAL					2026.6	0.3203	
UTILITIES							
Electricity	kWh	0.0820	3.7223	54.97	2046.2	0.3054	1
Steam	Mlbs	0.0020	480.4822	1.33	6411.2	0.9569	5
Natural Gas	MSCF	0.0013	293.6351	0.85	2506.4	0.3741	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	
Water	Mgal	0.0009	22.6924	0.59	133.3	0.0199	1
SUBTOTAL					11097.0	1.6563	
VARIABLE COST SUBTOTAL					102249.8	15.2790	
LABOR							
Salaried					1466.8	0.2189	2
Operating					1773.0	0.2646	2
Maintenance					1146.4	0.1711	2
Benefits					687.3	0.1026	2
SUBTOTAL					5073.5	0.7572	
MISCELLANEOUS							
Operating Supplies					472.6	0.0705	2
Maint Materials					1352.4	0.2019	2
Contract Labor					1918.8	0.2864	2
Insurance					169.9	0.0254	2
Clearances					760.6	0.1135	2
Taxes					552.2	0.0824	2
Miscellaneous					449.4	0.0671	2
SUBTOTAL					5675.8	0.8471	
FIXED COST SUBTOTAL					10749.3	1.6044	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					112999.1	16.8834	

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

CONOCO (AIR-BASED)

LAKE CHARLES, LOUISIANA

1. Based on the 1980 operating statement cumulative value.

2. Based on the Conoco oxygen-based value and an IOC by J. G. Cole, "Variable Cost--Oxychlorination Revamp," April 16, 1982.

3. The catalyst loading and price were obtained from S. J. Reynolds, Lake Charles VCM Plant, and the 1980 operating statement.

4. The value was calculated using the 1980 operating statement (Blue Book), and a value for waste heat boiler steam recovery of 14,000 pounds per hour. No net value for HCl was recovered.

5. Based on 1980 operating statement figure adjusted for a credit for the 80 percent recycle EDC bypass steam.

6. The secondary waste water treatment chemicals costs was included in the operating supplies fixed costs. It was valued at approximately 0.0060 cents per pound VCM according to J. H. Brunson, Lake Charles VCM Plant.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

DOW

FREEPORT, TEXAS

BACKGROUND DATA

Startup Year	Between 1950 and 1957[27,42]
Capacity	200 MM Lbs VCM/Yr[6]
Expansions/Modernizations	The plant initially produced EDC only by direct chlorination. HCl by-product from cracking was used in chlorinated hydrocarbon production or sold to acetylene-feedstock VCM producers.[7] Considerable EDC capacity along with oxychlorination have been added since startup.[30] The oxychlorination system has probably been converted to oxygen feedstock process.[8]
Environmental Status	Probably met through conversion of the oxychlorination process to oxygen feedstock.

MARKET POSITION

Feedstocks/Supplies

Ethylene	Captive (Freeport, Texas)[30]
Chlorine	Captive (Freeport, Texas)[30]
Caustic	Captive (Freeport, Texas)

By-Products

1,300 MM pounds per year of additional EDC capacity are available for captive use and merchant sales.[5] EDC production continued after VCM was shut down. Chlorinated hydrocarbon and HCl by-products can be used captively in solvent production.

Product Use

No major captive use for VCM.[30] Plant production was at 45 percent of capacity the first three quarters of 1983.[1] VCM production was shut down September 1983. This shutdown is probably permanent.

Plant Information
Dow
Freeport, Texas

TECHNOLOGY/EQUIPMENT[6]

Section	Technology	Type	Trains	Notes
Direct	Stauffer or Dow	Subcooled	1	-
Oxychlorination[8]	Dow	Fixed Bed Oxygen Feed	1	May have originally been Stauffer oxy technology. Oxygen feedstock conversion is Dow technology.
Wash	Stauffer or Dow	-	1	-
EDC Purification[10]	Stauffer or Dow	-	1	Hydrogenation of chloroprene over palladium catalyst.
VCM Purification[9]	Stauffer or Dow	-	1	Aluminum chloride reactor and separation column for removal of butadiene.
Cracking[37]	Selas	-	2	-
Incineration[41]	-	-	2	Freeport has several interchangeable incinerators present. Steam and HCl recovery.
C_2H_2 Hydrogenation[40]	Dow	-	1	Actually use a noncatalytic process with oxygen addition, converting C_2H_2 to VCM.

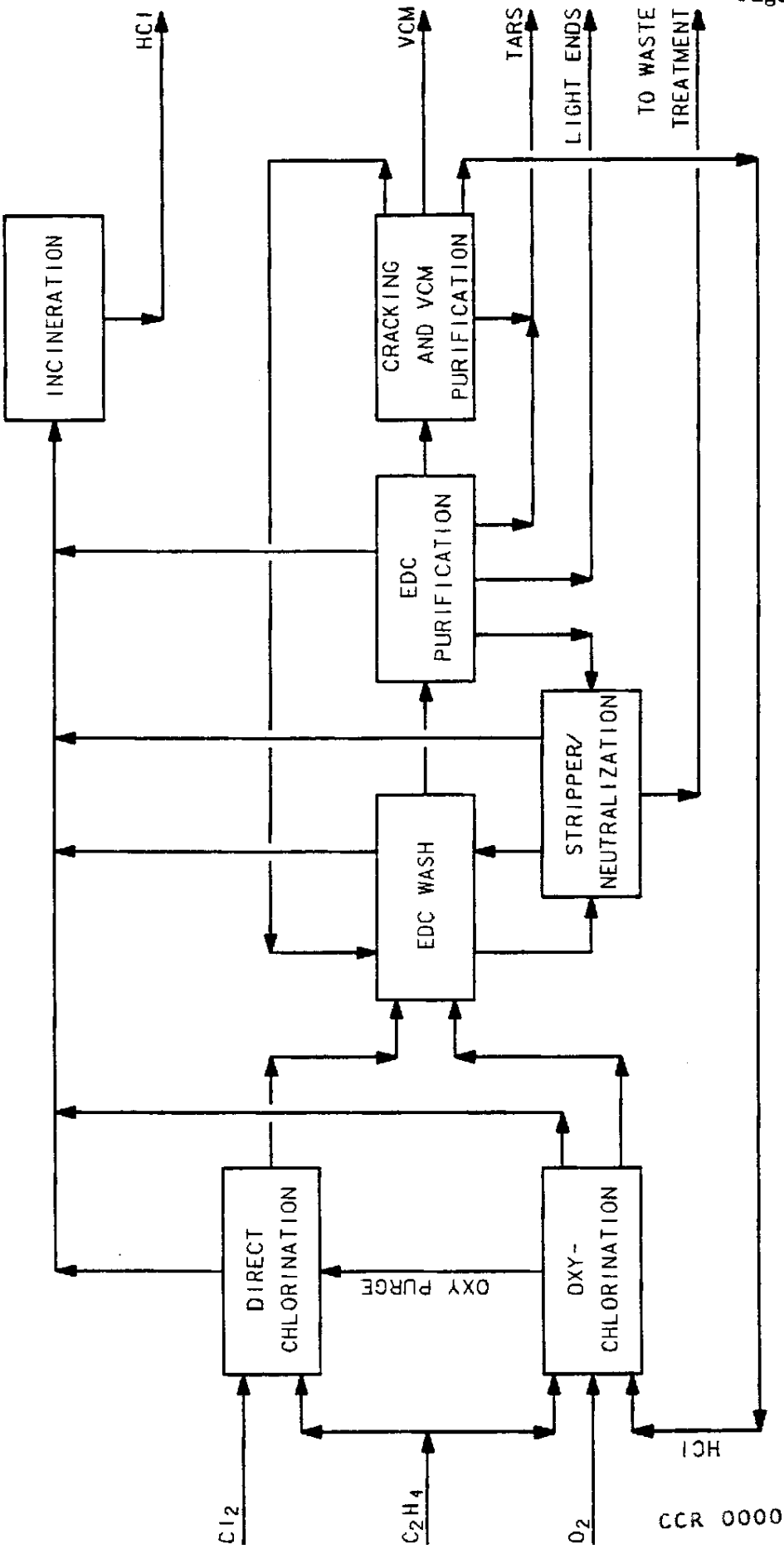


FIGURE 5
VCM COST PROFILES
BLOCK FLOW DIAGRAM
DOW[25]
FREEPORT, TEXAS

MANUFACTURING COST: Dow Freeport, TX
Capacity: 200 MM lbs VCM/year $fixed and variable costs only

RAW MATERIALS	units	units/ lb VCM	cents/ unit	MM units/ year	M $ per year	cents/ lb VCM	ref codes
Ethylene	lb	0.4650	20.7440	93.00	19291.9	9.6460	1
Chlorine	lb	0.6127	5.8337	122.54	7148.6	3.5743	1
Oxygen	lb	0.1501	1.4449	30.02	433.8	0.2169	1
SUBTOTAL					26874.3	13.4371	
BYPRODUCTS							
Steam	Mlbs	-0.0008	480.4822	-0.15	-743.9	-0.3719	1
Light Ends	lb	-0.0053	1.4760	-1.07	-15.7	-0.0079	1
Tars	lb	-0.0129	-1.7500	-2.59	45.3	0.0226	1
SUBTOTAL					-714.4	-0.3572	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	687.8000	0.02	148.0	0.0740	1
Caustic	lb	0.0060	12.1123	1.21	146.1	0.0730	1
Nitrogen	MSCF	0.0007	70.2443	0.14	96.9	0.0485	1
Ammonia-Amine	lb	.0000	108.8134	0.01	7.0	0.0035	1
Sulfuric Acid	lb	0.0004	3.2810	0.08	2.7	0.0013	1
Limestone	lb	0.0043	0.9293	0.85	7.9	0.0040	1
Cooling Water Chems	lb	0.0002	108.2571	0.05	50.0	0.0250	1
Wastewater Treatmt				0.00	0.0	0.0000	1
Gas Waste Treatment	scf				2.0	0.0102	1
Hydrogen	lb	0.0002	16.3838	0.03	5.2	0.0026	1
Misc Chem & Supplx				0.00	0.0	0.0248	1
SUBTOTAL					466.0	0.2670	
UTILITIES							
Electricity	kWh	0.0818	3.7223	16.37	609.3	0.3047	1
Steam	Mlbs	0.0022	480.4822	0.44	2122.7	1.0613	2
Natural Gas	MSCF	0.0014	293.6351	0.28	808.3	0.4042	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	1
Water	Mgal	0.0008	22.6924	0.17	38.2	0.0191	1
SUBTOTAL					3578.6	1.7893	
VARIABLE COST SUBTOTAL					30204.5	15.1362	
LABOR							
Salaried					1011.9	0.5060	3
Operating					1359.1	0.6795	3
Maintenance					1089.5	0.5448	3
Benefits					640.9	0.3205	3
SUBTOTAL					4101.4	2.0507	
MISCELLANEOUS							
Operating Supplies					379.0	0.1895	3
Maint Materials					640.9	0.3204	3
Contract Labor					1258.9	0.6295	3
Insurance					50.8	0.0254	1
Clearances					227.0	0.1135	1
Taxes					164.8	0.0824	1
Miscellaneous					134.2	0.0671	1
SUBTOTAL					2855.7	1.4278	
FIXED COST SUBTOTAL					6957.1	3.4785	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					37161.5	18.6147	

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

DOW

FREEPORT, TEXAS

1. Same as the Conoco oxygen-based VCM plant.

2. No recycle bypass steam.

3. Thirteen less operators. Maintenance costs were scaled from the Conoco VCM Plant.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

DOW

OYSTER CREEK, TEXAS

BACKGROUND DATA

Startup Year	1969[3]
Capacity	700 MM Lbs VCM/Yr[3]
Expansions/Modernizations	The oxychlorination system was modernized from air-based to oxygen-based feedstock.[8,41]
Environmental Status	Compliance was met through the oxychlorination conversion to the oxygen feedstock process.

MARKET POSITION

Feedstocks/Supplies

Ethylene	Captive (Freeport, Texas)[30]
Chlorine	Captive (Oyster Creek, Texas, and Freeport, Texas)[30]
Caustic	Captive (Oyster Creek, Texas)

By-Products

The plant produces chlorinated hydrocarbon by-products which are used captively in solvent production.

Product Use

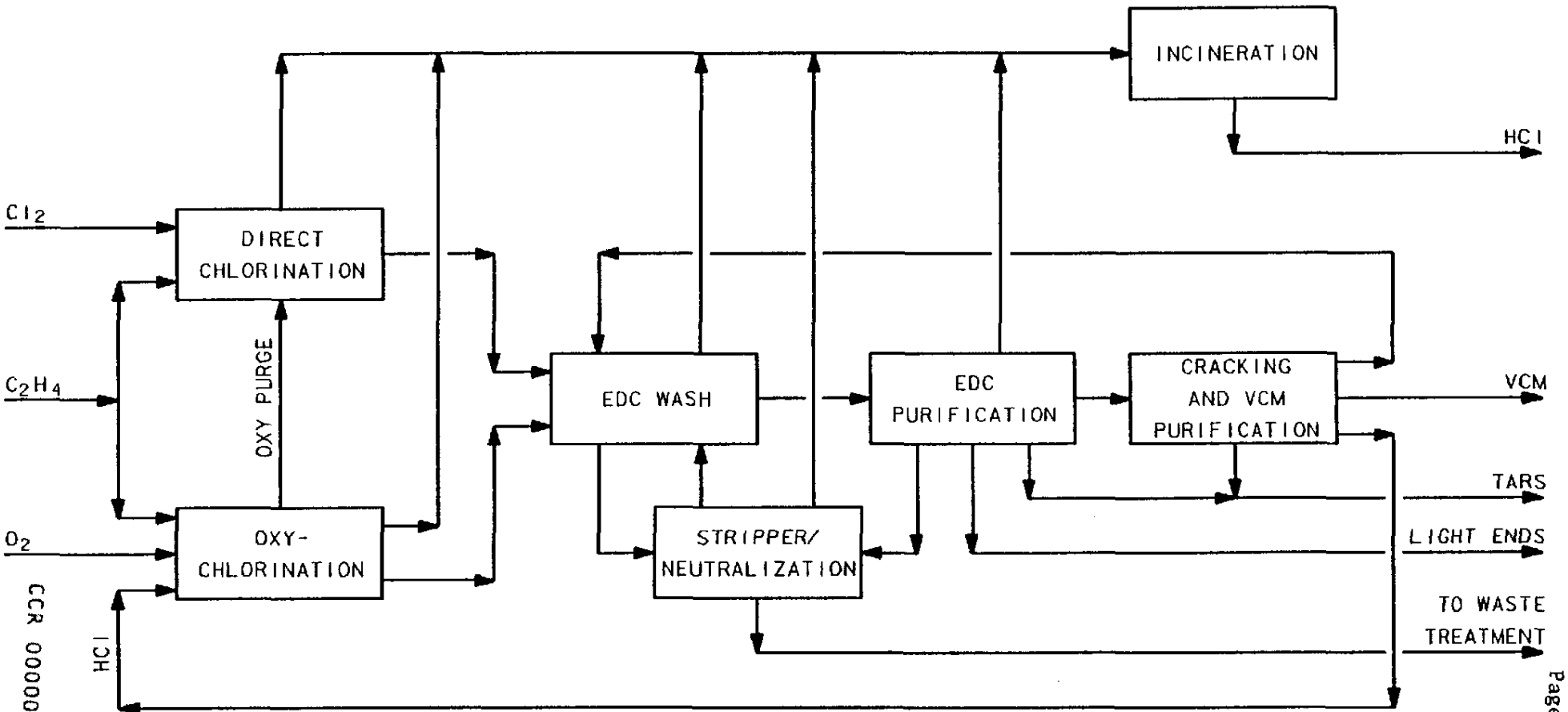
They have no major captive use for VCM.[30] The 1983 production rate was 73 percent of plant capacity.[1]

Plant Information
Dow
Oyster Creek, Texas

TECHNOLOGY/EQUIPMENT[6]

Section	Technology	Type	Trains	Notes
Direct	Dow	Subcooled	2	-
Oxychlorination[8]	Dow	Fixed Bed Oxygen Feed	2	-
Wash	Dow	-	1 or 2	-
EDC Purification[10]	Dow	-	1 or 2	Hydrogenation of chloroprene over palladium catalyst.
VCM Purification[9]	Dow	-	1 or 2	Aluminum chloride reactor for removal of butadiene.
Cracking[37]	Selas	-	4	-
Incineration	-	-	2+	Oyster Creek has several interchangeable incinerators present. Steam and HCl recovery.
C_2H_2 Hydrogenation[40]	Dow	-	1 or 2	Have patented a noncatalytic process with oxygen addition, converting C_2H_2 to VCM.

FIGURE 6
VCM COST PROFILES
BLOCK FLOW DIAGRAM
DOW[25]
OYSTER CREEK, TEXAS



MANUFACTURING COST: Dow Oyster Creek, TX
Capacity: 700 MM lbs VCM/year $fixed and variable costs only

		units/	cents/	MM units/	M $ per	cents/	ref
RAW MATERIALS	units	lb VCM	unit	year	year	lb VCM	codes
Ethylene	lb	0.4650	20.7440	325.50	67521.7	9.6460	1
Chlorine	lb	0.6127	5.8337	428.89	25020.2	3.5743	1
Oxygen	lb	0.1501	1.4449	105.07	1518.2	0.2169	1
SUBTOTAL					94060.0	13.4371	
BYPRODUCTS							
Steam	Mlbs	-0.0008	480.4822	-0.54	-2603.6	-0.3719	1
Light Ends	lb	-0.0053	1.4760	-3.73	-55.1	-0.0079	1
Tars	lb	-0.0129	-1.7500	-9.05	158.4	0.0226	1
SUBTOTAL					-2500.3	-0.3572	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	687.8000	0.08	518.1	0.0740	1
Caustic	lb	0.0060	12.1123	4.22	511.3	0.0730	1
Nitrogen	MSCF	0.0007	70.2443	0.48	339.3	0.0485	1
Ammonia-Amine	lb	.0000	108.8134	0.02	24.6	0.0035	1
Sulfuric Acid	lb	0.0004	3.2810	0.29	9.4	0.0013	1
Limestone	lb	0.0043	0.9293	2.99	27.8	0.0040	1
Cooling Water Chems	lb	0.0002	108.2571	0.16	174.9	0.0250	1
Wastewater Treatment				0.00	0.0	0.0000	1
Gas Waste Treatment	mscf				7.1	0.0102	1
Hydrogen	lb	0.0002	16.3838	0.11	18.3	0.0026	1
Misc Chem & Supply				0.00	0.0	0.0248	1
SUBTOTAL					1630.9	0.2670	
UTILITIES							
Electricity	kWh	0.0818	3.7223	57.29	2132.6	0.3047	1
Steam	Mlbs	0.0022	480.4822	1.55	7429.4	1.0613	2
Natural Gas	MSCF	0.0014	293.6351	0.96	2829.1	0.4042	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	1
Water	Mgal	0.0008	22.6924	0.59	133.9	0.0191	1
SUBTOTAL					12524.9	1.7893	
VARIABLE COST SUBTOTAL					105715.6	15.1362	
LABOR							
Salaried					1609.3	0.2299	3
Operating					2161.2	0.3087	3
Maintenance					2267.0	0.3239	3
Benefits					1151.3	0.1645	3
SUBTOTAL					7188.8	1.0270	
MISCELLANEOUS							
Operating Supplies					696.3	0.0995	3
Maint Materials					1694.3	0.2420	3
Contract Labor					2619.6	0.3742	3
Insurance					177.8	0.0254	1
Clearances					794.5	0.1135	1
Taxes					576.8	0.0824	1
Miscellaneous					469.7	0.0671	1
SUBTOTAL					7029.0	1.0041	
FIXED COST SUBTOTAL					14217.8	2.0311	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					119933.4	17.1673	

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

DOW

OYSTER CREEK, TEXAS

1. Same as the Conoco oxygen-based VCM plant.
2. No recycle bypass steam.
3. Maintenance costs were scaled from the Conoco VCM Plant.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

DOW

PLAQUEMINE, LOUISIANA

BACKGROUND DATA

Startup Year	Between 1957 and 1965.[27,28]
Capacity	1,250 MM Lbs VCM/Yr, expanded From 250 MM Lbs/Yr[2,30,7]
Expansions/Conversions	The original plant sold by-product HCl to an acetylene-based VCM producer in the area.[7] An oxychlorination section was added, and VCM capacity was increased to 450 MM pounds per year by 1978.[3,7,37] Expansion to 1,250 MM pounds VCM per year and conversion of oxychlorination to oxygen feedstock also occurred in 1978.[3,4] This expansion included partial completion of an additional 400 MM pounds per year of VCM capacity to be brought on stream "when the market is right."[38]
Environmental Status	Met through conversion of oxychlorination to oxygen feedstock process.[9]

MARKET POSITION

Feedstocks/Supplies

Ethylene	Captive (Plaquemine, Louisiana)[30]
Chlorine	Captive (Plaquemine, Louisiana)[30]
Caustic	Captive (Plaquemine, Louisiana)

Captive feedstocks are also available for the additional 400 MM pounds VCM per year capacity.[30]

By-Products

EDC is produced for captive use (PCE/TCE, vinylidine chloride)[30] and merchant sales. Chlorinated hydrocarbon by-products are also used captively in solvent production.

Plant Information
Dow
Plaquemine, Louisiana

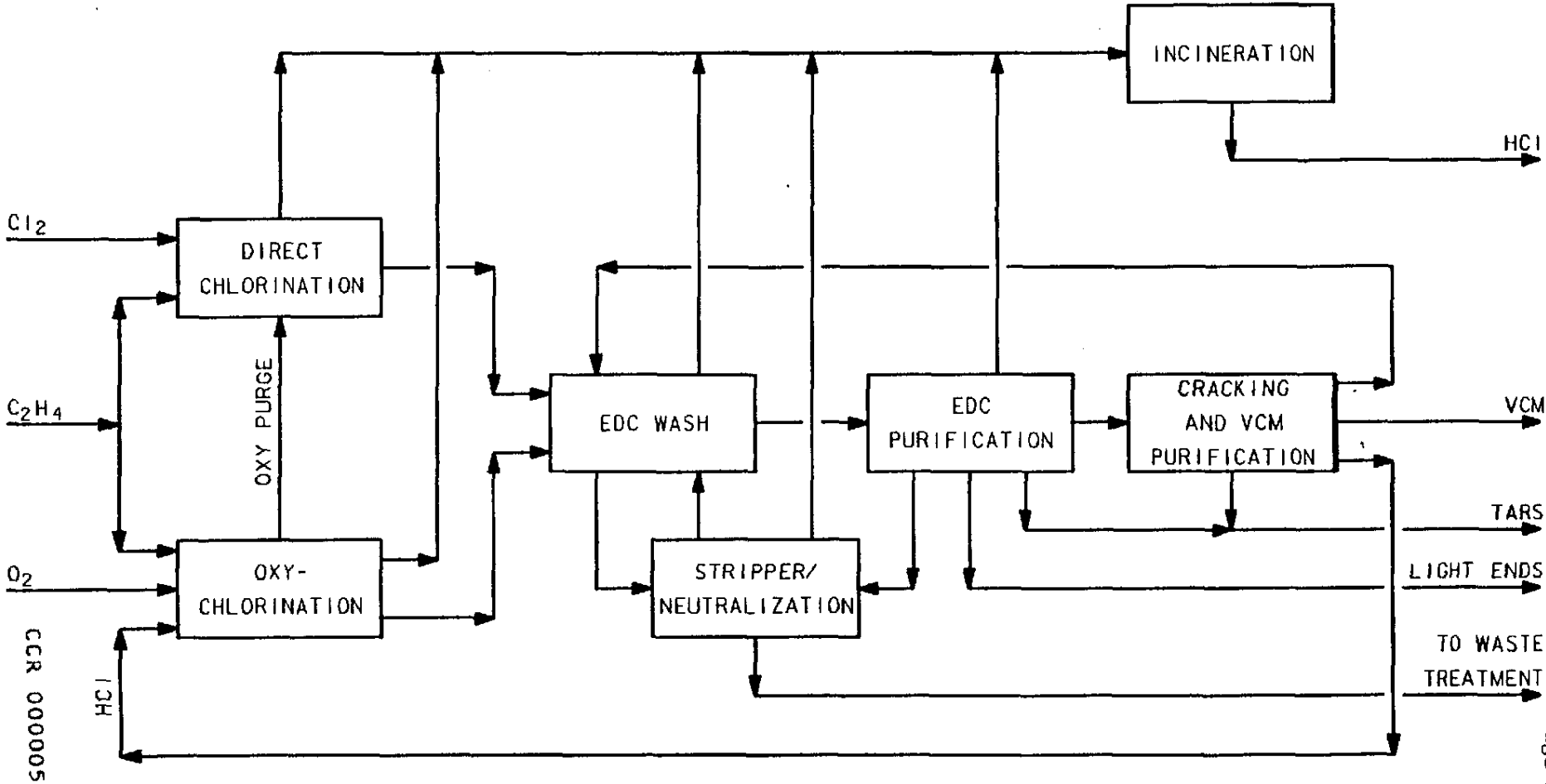
Product Use

They have no major captive use for VCM.[30] The production rate was 83 percent of capacity in 1983.[1]

TECHNOLOGY/EQUIPMENT[4,6,7,2]

Section	Technology	Type	Trains	Notes
Direct	Dow	Subcooled	3	-
Oxychlorination[8]	Dow	Fixed Bed Oxygen Feed	3	-
Wash	Dow	-	2	-
EDC Purification[10]	Dow	-	2	Hydrogenation of chloroprene over palladium catalyst.
VCM Purification[9]	Dow	-	2	Aluminum chloride reactor for removal of butadiene.
Cracking[34,37]	Selas/Foster Wheeler	-	7	Selas built five cracking furnaces in 1964, 1965, and 1967. Foster Wheeler built two furnaces for 1978 expansion.
Incineration[39,41]	Dow	-	3 or 4	All units are interchangeable between steam and HCl recovery.
C_2H_2 Hydrogenation[40]	Dow	-	2	Steam and HCl recovery have patented a noncatalytic process with oxygen addition, converting C_2H_2 to VCM.

FIGURE 7
VCM COST PROFILES
BLOCK FLOW DIAGRAM
DOW[25]
PLAQUEMINE, LOUISIANA



MANUFACTURING COST: Dow Plaquemine,LA
Capacity: 1250 MM lbs VCM/year $fixed and variable costs only

		units/	cents/	MM units/	M $ per	cents/	ref
RAW MATERIALS	units	lb VCM	unit	year	year	lb VCM	codes
Ethylene	lb	0.4650	20.7440	581.25	120574.5	9.6460	1
Chlorine	lb	0.6127	5.8337	765.88	44678.8	3.5743	1
Oxygen	lb	0.1501	1.4449	187.63	2711.0	0.2169	1
SUBTOTAL					167964.3	13.4371	
BYPRODUCTS							
Steam	Mlbs	-0.0008	480.4822	-0.97	-4649.3	-0.3719	1
Light Ends	lb	-0.0053	1.4760	-6.67	-98.4	-0.0079	1
Tars	lb	-0.0129	-1.7500	-16.16	282.8	0.0226	1
SUBTOTAL					-4464.8	-0.3572	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	687.8000	0.13	925.1	0.0740	1
Caustic	lb	0.0060	12.1123	7.54	913.1	0.0730	1
Nitrogen	MSCF	0.0007	70.2443	0.86	605.9	0.0485	1
Ammonia-Amine	lb	.0000	108.8134	0.04	44.0	0.0035	1
Sulfuric Acid	lb	0.0004	3.2810	0.51	16.8	0.0013	1
Limestone	lb	0.0043	0.9293	5.34	49.7	0.0040	1
Cooling Water Chems	lb	0.0002	108.2571	0.29	312.3	0.0250	1
Wastewater Treatment				0.00	0.0	0.0000	1
Gas Waste Treatment	mscf				12.8	0.0102	1
Hydrogen	lb	0.0002	16.3838	0.20	32.8	0.0026	1
Misc Chem & Suppls				0.00	0.0	0.0248	1
SUBTOTAL					2912.3	0.2670	
UTILITIES							
Electricity	kWh	0.0818	3.7223	102.31	3808.2	0.3047	1
Steam	Mlbs	0.0022	480.4822	2.76	13266.7	1.0613	2
Natural Gas	MSCF	0.0014	293.6351	1.72	5052.0	0.4042	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	1
Water	Mgal	0.0008	22.6924	1.05	239.0	0.0191	1
SUBTOTAL					22366.0	1.7893	
VARIABLE COST SUBTOTAL					188777.8	15.1362	
LABOR							
Salaried					1903.3	0.1523	3
Operating					2556.1	0.2045	3
Maintenance					2635.8	0.2109	3
Benefits					1350.4	0.1080	3
SUBTOTAL					8445.6	0.6756	
MISCELLANEOUS							
Operating Supplies					681.3	0.0545	3
Maint Materials					2507.0	0.2006	3
Contract Labor					3045.7	0.2437	3
Insurance					317.5	0.0254	1
Clearances					1418.8	0.1135	1
Taxes					1030.0	0.0824	1
Miscellaneous					838.8	0.0671	1
SUBTOTAL					9838.9	0.7871	
FIXED COST SUBTOTAL					18284.5	1.4628	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					207062.3	16.5990	

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

DOW

PLAQUEMINE, LOUISIANA

1. Same as the Conoco oxygen-based VCM plant.
2. No recycle bypass steam.
3. Maintenance costs were scaled from the Conoco VCM Plant.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

ETHYL

BATON ROUGE, LOUISIANA

BACKGROUND DATA

Startup Year	1948[6]
Capacity	300 MM Lbs VCM/Yr[6]
Expansions/Modernizations	EDC production began in 1948 through direct chlorination. An EDC expansion and the start of VCM production began in 1958. Another EDC expansion (oxychlorination startup) and VCM expansion occurred in 1966.[6]
Environmental Status	This plant is not in hydrocarbon emission compliance. Incineration of oxychlorination vent is required.[7] This may have been a factor in their decision to shut down.

MARKET POSITION

Feedstocks/Supplies

Ethylene	Purchased from Exxon or Shell.[30]
Chlorine	Captive (Baton Rouge, Louisiana)[43]
Caustic	Captive (Baton Rouge, Louisiana)

By-Products

Anhydrous HCl is used for methyl chloride and tetraethyl lead production (oxy unit does not operate).[30] Chlorinated hydrocarbons are used in solvent production. Merchant EDC sales continue after shutdown.[4]

Product Use

Formerly had 275 MM pounds per year of captive VCM use. 175 MM pounds per year Baton Rouge PVC Plant (S/D November 1983) and 100 MM pounds per year Delaware City, Delaware plant (sold to Georgia Pacific September 1983).[30] Production was at 65 percent of capacity until it was shut down November 1983.[1] This shutdown is probably permanent.

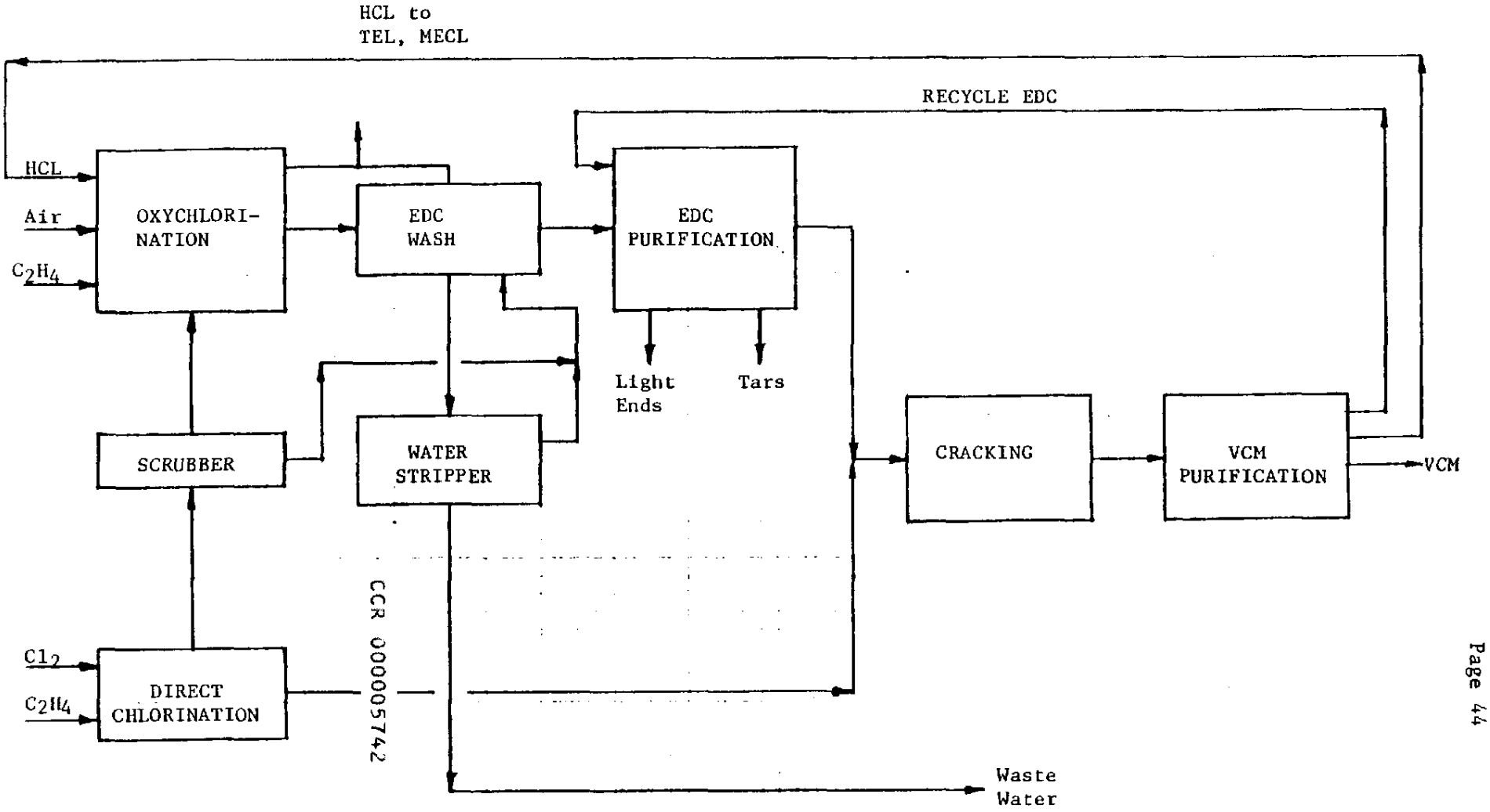
Plant Information
Ethyl
Baton Rouge, Louisiana

TECHNOLOGY/EQUIPMENT[3]

Section	Technology	Type	Trains	Notes
Direct	Ethyl	Subcooled	2	-
Oxychlorination[30]	Ethyl	Fluidized Bed Air Feed	2	This unit does not normally operate. HCl from cracking is used in MeCl/TEL production. The oxy vent stream is not in compliance with EPA emissions regulations.
Wash	Ethyl	-	-	-
EDC Purification	Ethyl	-	-	-
VCM Purification[39]	Ethyl	-	-	Alumina VCM drying.
Cracking[34]	Foster-Wheeler	-	1	May be using CCl_4 or other cracking reaction promoter.
Incineration	-	-	2	Probably run two incinerators with one as a standby.
C_2H_2 Hydrogenation	-	-	None	-

FIGURE 8

VCM COST PROFILES
BLOCK FLOW DIAGRAM
ETHYL--BATON ROUGE, LOUISIANA[3]



MANUFACTURING COST: ETHYL Baton Rouge,LA
Capacity: 300 MM lbs VCM/year $fixed and variable costs only

	units	units/ lb VCM	cents/ unit	MM units/ year	M $ per year	cents/ lb VCM	ref codes
RAW MATERIALS							
Ethylene	lb	0.4835	20.7440	145.05	30089.2	10.0297	1
Chlorine	lb	0.6125	5.8337	183.75	10719.4	3.5731	1
Oxygen	lb	0.0000	1.4449	0.00	0.0	0.0000	
SUBTOTAL					40808.6	13.6029	
BYPRODUCTS							
Steam	Mlbs	-0.0010	480.4822	-0.29	-1404.4	-0.4681	1
Light Ends	lb	-0.0211	1.4760	-6.33	-93.4	-0.0311	1
Tars	lb	-0.0222	-1.7500	-6.66	116.6	0.0389	1
SUBTOTAL					-1381.3	-0.4604	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	414.5833	0.04	172.9	0.0576	5
Caustic	lb	0.0055	10.6720	1.65	176.1	0.0587	1
Nitrogen	MSCF	0.0007	70.2443	0.21	145.4	0.0485	1
Ammonia-Amine	lb	.0000	108.8134	0.01	9.8	0.0033	1
Sulfuric Acid	lb	0.0004	3.2810	0.12	4.0	0.0013	1
Limestone	lb	0.0000	0.9293	0.00	0.0	0.0000	2
Cooling Water Chems	lb	0.0003	108.2571	0.08	87.7	0.0292	1
Wastewater Treatmt		0.4124		123.72	14.9	0.0496	3
Gas Waste Treatment				0.00	2.0	0.0066	1
Hydrogen	lb	0.0000	17.3800	0.00	0.0	0.0000	1
Misc Chem & Suppls				0.00	0.0	0.0458	1
SUBTOTAL					612.8	0.3006	
UTILITIES							
Electricity	kWh	0.0903	3.7223	27.15	1010.6	0.3369	1
Steam	Mlbs	0.0023	480.4822	0.69	3331.2	1.1104	1
Natural Gas	MSCF	0.0021	293.6351	0.63	1858.7	0.6196	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	
Water	Mgal	0.0010	22.6924	0.30	68.1	0.0227	1
SUBTOTAL					6268.6	2.0895	
VARIABLE COST SUBTOTAL					46308.6	15.5326	
LABOR							
Salaried					941.2	0.3137	4
Operating					1259.9	0.4200	4
Maintenance					1458.4	0.4861	4
Benefits					635.5	0.2118	4
SUBTOTAL					4295.0	1.4317	
MISCELLANEOUS							
Operating Supplies					340.2	0.1134	4
Maint Materials					927.0	0.3090	4
Contract Labor					1584.3	0.5281	4
Insurance					76.2	0.0254	5
Clearances					340.5	0.1135	5
Taxes					247.2	0.0824	5
Miscellaneous					135.6	0.0452	5
SUBTOTAL					3650.9	1.2170	
FIXED COST SUBTOTAL					7945.9	2.6486	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					54254.5	18.1812	

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURINGS COSTS

ETHYL

BATON ROUGE, LOUISIANA

1. Same as the BFG plant in Calvert City.
2. The steam stripper runs basic. No limestone is required.
3. No steam recovery system.
4. Factored from the BFG plant in LaPorte, Texas.
5. Same as the Conoco VCM Plant.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

FPC

POINT COMFORT, TEXAS

BACKGROUND DATA

Startup Year	1982[44]
Capacity	530 MM Lbs/Yr[19]
Expansions/Modernizations	A chlorine/EDC/VCM complex in Baton Rouge is under consideration.[45]
Environmental Status	Compliance is provided by incineration of all vent gas streams and waste water stripping.[19]

MARKET POSITION

Feedstocks/Supplies[30]

Ethylene	Purchased from Arco for the oxychlorination process only.
EDC	Purchased from Arco to supplement captive EDC from the Baton Rouge plant.
Caustic	Captive source for process and waste neutralization.

Product Use

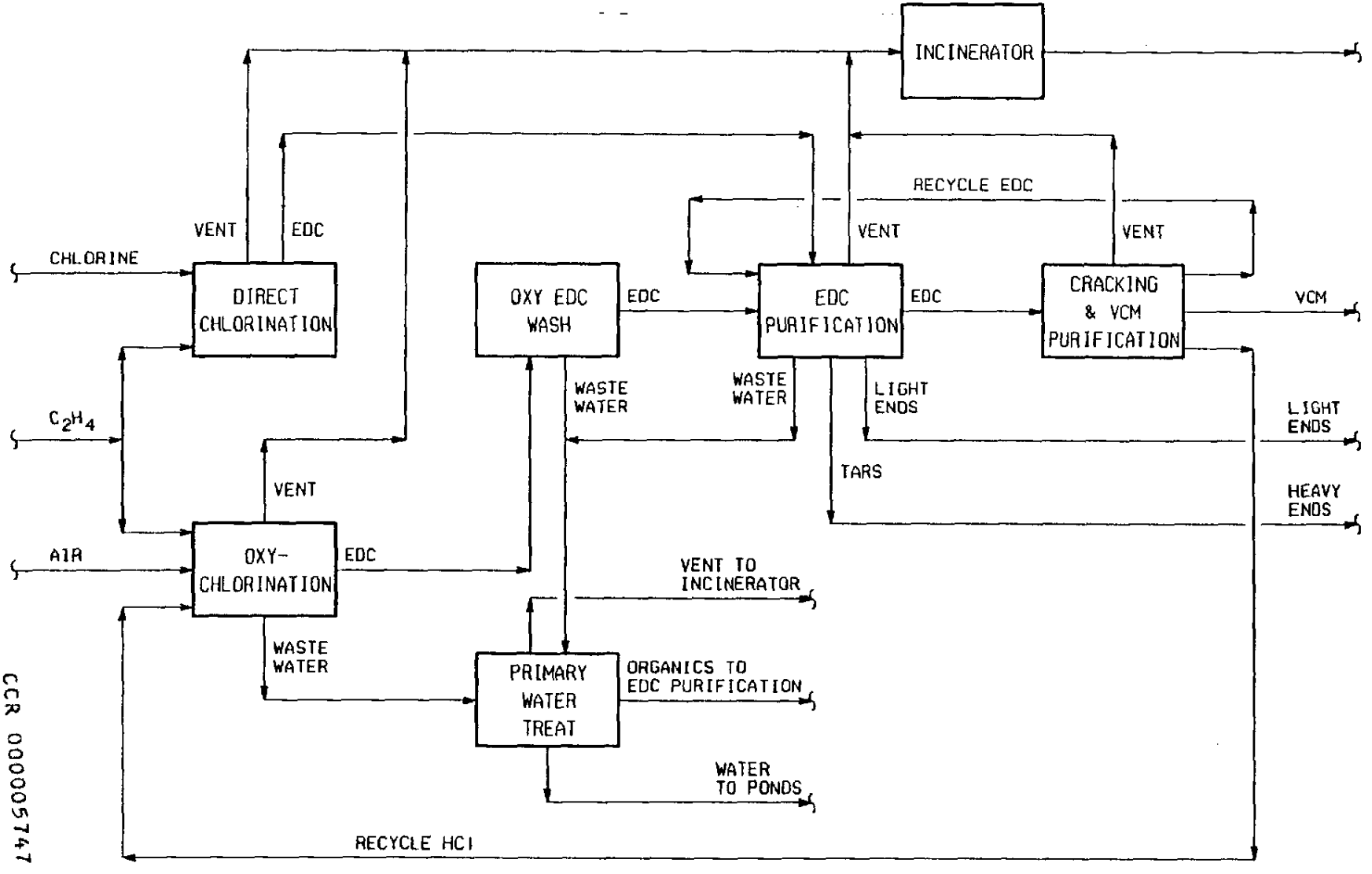
All VCM is used captively at Point Comfort and Delaware City, Delaware. The VCM plant operated at 55 percent of nameplate capacity in 1983.

Plant Information
FPC
Point Comfort, Texas

TECHNOLOGY/EQUIPMENT[19,20]

Section	Technology	Type	Trains	Notes
Direct Chlorination[30]	Mitsui Toatsu	BLR	1	This unit did not operate in 1983.
Oxychlorination	Mitsui Toatsu Oxygen	Fluidized Bed Oxygen Bed	1	-
EDC Wash	Mitsui Toatsu	Caustic	1	Only oxy EDC is washed. Washed EDC is dried by azeotrope distillation before purification.
EDC Purification	Mitsui Toatsu	-	1	-
EDC Cracking	-	-	-	Can burn No. 2 fuel oil.
VCM Purification	Mitsui Toatsu	-	1	-
Incineration	Trane	-	1	No waste heat or HCl recovery. One of the steam plant boilers is set up as a backup incinerator.
Water Treatment	-	-	-	Primary treatment consists of catalyst precipitation and steam stripping. Secondary treatment facilities include biological treatment.

FIGURE 9
VCM COST PROFILES
BLOCK FLOW DIAGRAM
FPC [19]
POINT COMFORT, TEXAS



CCR 000005747

MANUFACTURING COST: FORMOSA PLASTICS Point Comfort, TX
Capacity: 530 MM lbs VCM/year $fixed and variable costs only

	units	units/ lb VCM	cents/ unit	MM units/ year	M $ per year	cents/ lb VCM	ref codes
RAW MATERIALS							
Ethylene	lb	0.4694	20.7440	248.78	51607.3	9.7372	1
Chlorine	lb	0.6002	5.8337	318.11	18557.3	3.5014	1
Oxygen	lb	0.1428	1.4449	75.68	1093.6	0.2063	
SUBTOTAL					71258.2	13.4450	
BYPRODUCTS							
Steam	Mlbs	-0.0010	480.4822	-0.54	-2572.0	-0.4853	2
Light Ends	lb	-0.0121	1.4760	-6.42	-94.8	-0.0179	3
Tars	lb	-0.0136	-1.7500	-7.21	126.1	0.0238	3
SUBTOTAL					-2540.7	-0.4794	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	365.7000	0.05	193.8	0.0366	4
Caustic	lb	0.0153	7.8105	8.11	633.4	0.1195	5
Nitrogen	MSCF	0.0007	70.2443	0.37	256.9	0.0485	6
Ammonia-Amine	lb	.0000	108.8134	0.02	17.3	0.0033	6
Sulfuric Acid	lb	0.0004	3.2810	0.22	7.1	0.0013	6
Limestone	lb	0.0000	0.9293	0.00	0.0	0.0000	
Cooling Water Chems	lb	0.0002	108.2571	0.12	132.0	0.0249	6
Wastewater Treatmt		0.0000		0.00	0.0	0.0000	7
Gas Waste Treatment		0.0000		0.00	0.0	0.0000	8
Hydrogen	lb	0.0000	16.3838	0.00	0.0	0.0000	6
Misc Chem & Suppls				0.00	0.0	0.0248	9
SUBTOTAL					1240.5	0.2588	
UTILITIES							
Electricity	kWh	0.0793	3.7223	42.04	1565.0	0.2953	10
Steam	Mlbs	0.0025	480.4822	1.33	6366.4	1.2012	1
Natural Gas	MSCF	0.0020	293.6351	1.05	3081.4	0.5814	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	
Water	Mgal	0.0009	22.6924	0.48	108.2	0.0204	1
SUBTOTAL					11121.1	2.0983	
VARIABLE COST SUBTOTAL					81079.1	15.3227	
LABOR							
Salaried					1433.1	0.2704	11
Operating					1726.6	0.3258	12
Maintenance					1222.7	0.2307	13
Benefits					686.7	0.1296	14
SUBTOTAL					5069.1	0.9564	
MISCELLANEOUS							
Operating Supplies					466.2	0.0880	19
Maint Materials					1136.0	0.2143	15
Contract Labor					1356.8	0.2560	16
Insurance					134.6	0.0254	17
Clearances					601.6	0.1135	17
Taxes					436.7	0.0824	17
Miscellaneous					432.5	0.0816	18
SUBTOTAL					4564.4	0.8612	
FIXED COST SUBTOTAL					9633.5	1.8176	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					90712.6	17.1404	

Notes for Manufacturing Costs
FPC
Point Comfort, Texas

16. Includes $938,000 yearly maintenance costs, $277,000 casual turnaround labor, and $197,000 for turnaround contract costs.

17. Same as Conoco VCM Plant.

18. Conoco miscellaneous charge minus the difference in turnaround rental charges.

19. Twenty-seven percent of operating labor based on the Conoco plant (includes 0.006 cent per pound for secondary waste water treatment).

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

FPC

BATON ROUGE, LOUISIANA

BACKGROUND DATA

Startup Year	1968[6]
Capacity	300 MM Lbs/Yr[6]
Expansions/Modernizations	This plant was built in 1968 by Allied Chemical Company using BFG technology. ICI purchased the plant from Allied in 1976.[46] ICI was planning a modernization for 1981 until they sold the plant to FPC in 1980.[47,48]
Environmental Status	This plant may still be out of compliance regarding hydrocarbon emission regulations.[5,71] During the first quarter in 1983, $25 MM of improvements were made at the Baton Rouge complex.[25] This work may have included improvements for pollution control.

MARKET POSITION

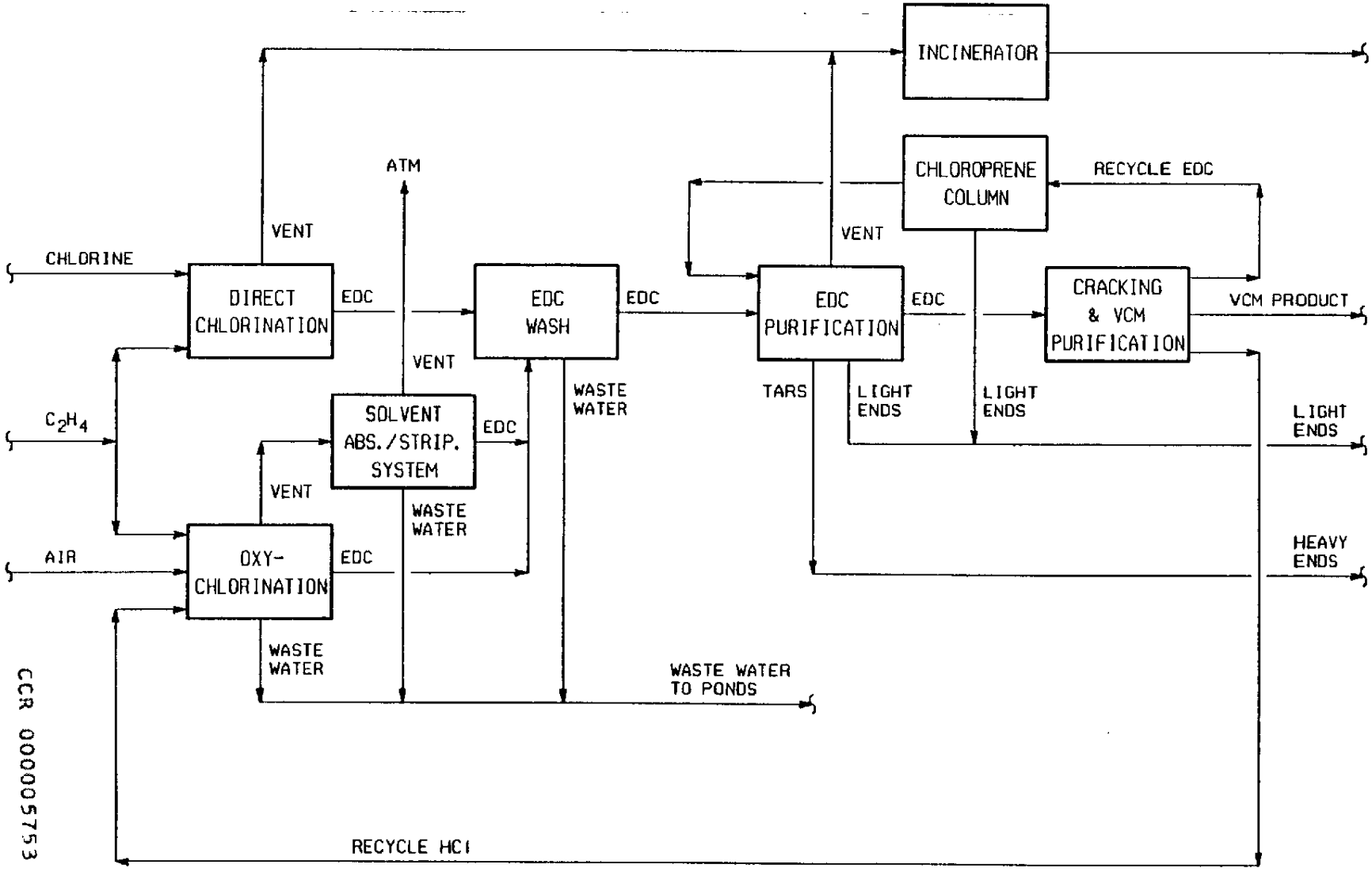
Feedstocks/Supplies

Ethylene	Purchased from Exxon.[30]
Chlorine	Captive (Baton Rouge, Louisiana)[30]
Caustic	Captive (Baton Rouge, Louisiana)

Product Use

Excess EDC is transferred to the Point Comfort plant. All product VCM is used captively.[30]

FIGURE 10
VCM COST PROFILES
BLOCK FLOW DIAGRAM
FPC 50
BATON ROUGE, LOUISIANA



VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

FPC

BATON ROUGE, LOUISIANA

1. These values were taken from the BFG Calvert City cost buildup unless noted otherwise.

2. Based on BFG "Oxy Process: Standard Economic Data," August 1979, and Norsk Hydro VCM Evaluation, March 1974.

3. Neutralization Cost: 0.0009 Lb 100 percent NaOH at 7.5 Cents/Lb.

4. Assumed no vent gas incineration.

5. Subtracted 0.0064 KWH per pound VCM from Calvert City rate for no catoxid process.

6. Eighty-three percent of operating labor.

7. Based on seven OSBL/ISBL operators, three miscellaneous personnel, and two lab analysts per shift.

8. Based on thirty OSBL/ISBL maintenance men (82 percent of Conoco maintenance labor).

9. 15.67 percent of payroll. Includes benefits for 75 percent of casual turnaround labor for roving crew benefits.

10. Twenty-seven percent of operating labor. Subtracted 0.005 cent per pound VCM for not having biological treatment facilities.

11. Fifty-nine percent of Conoco maintenance material.

12. Includes $820,000 yearly maintenance, $243,000 turnaround labor, and $129,000 contract labor.

13. Based on the Conoco plant.

14. Subtracted 0.09 pound steam per pound VCM from the Calvert City buildup for not having a waste water stripper.

15. Conoco miscellaneous charge minus the difference in turnaround rental costs.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

GEORGIA PACIFIC

PLAQUEMINE, LOUISIANA

BACKGROUND DATA

Startup Year	1981[6]
Capacity	1,000 MM Lbs/Yr[6]
Expansions/Modernizations	None
Environmental Status	Compliance is provided by incineration of all vent gas streams and waste water stripping.[51]

MARKET POSITION

Feedstocks

Ethylene	Purchased from Shell and Dow.[30]
Chlorine	Captive source from the Plaquemine chlorine plant.[30]

Supplies

Caustic	Captive source of caustic for process and waste neutralization.
Fuel Gas	Georgia Pacific possibly has long-term low price gas contract.[68] This will significantly reduce steam costs.
Utilities	The Plaquemine complex contains chlorine, caustic, VCM, PVC, methanol, phenol, acetone, and ammonia operations.[51,52] Utilities are common among various units.

By-Products

Heavy Organics	PPG is paid to dispose of tars from Georgia Pacific.[53]

Plant Information
Georgia Pacific
Plaquemine, Louisiana

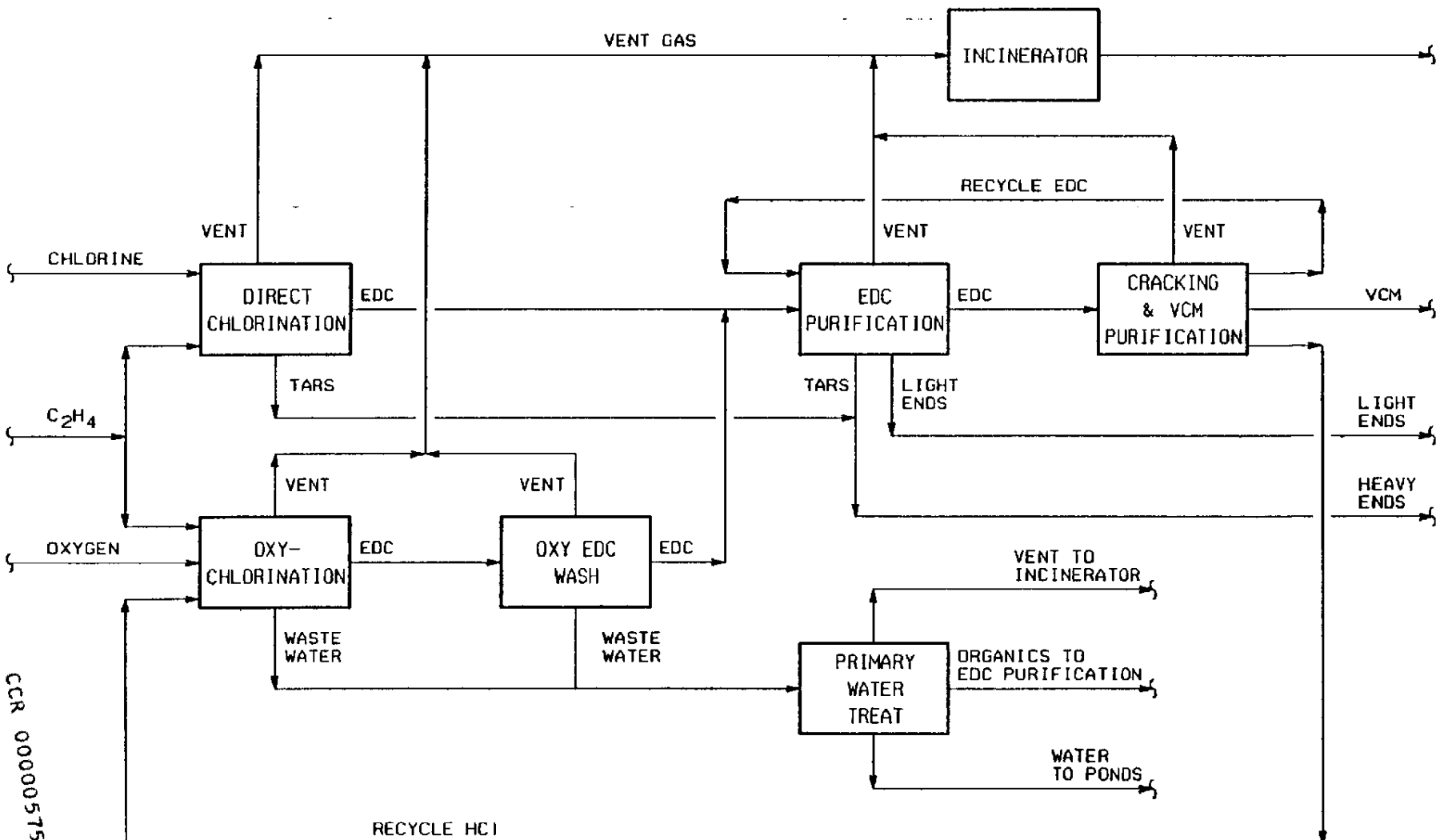
Product

At full PVC production, 70 percent of the VCM is used captively for PVC feedstock. The remainder is sold in the merchant market.[50] In 1983, Georgia Pacific controlled 10.5 percent of the VCM merchant market share while operating at 60 percent of plant capacity.[4]

TECHNOLOGY/EQUIPMENT[54]

Section	Technology[6]	Type	Trains	Notes
Direct Chlorination[55]	PPG	BLR	1	High alloy construction.
Oxychlorination	PPG	Fluidized Bed Oxygen Feed	2	Reactors are of inconel construction. Recycle ethylene is caustic scrubbed.
EDC Wash[51,52]	PPG	Caustic	2	Only oxy EDC is washed. Washed EDC is dried by azeotrope distillation before purification.
EDC Purification[51,52]	PPG	-	1	-
EDC Cracking[51,52]	-	-	4	Have four cracking furnaces and two quench columns.
VCM Purification	PPG	-	1	HCl is removed by a two column absorber-stripper system.
Incineration	-	-	2	One vent gas and one liquid waste incinerator.
Primary Water Treating	-	-	-	Water is neutralized before steam stripping.

FIGURE 11
VCM COST PROFILES
BLOCK FLOW DIAGRAM
GEORGIA PACIFIC [54]
PLAQUEMINE, LOUISIANA



MANUFACTURING COST: GEORGIA PACIFIC Plaquemine, LA
Capacity: 1000 MM lbs VCM/year Fixed and variable costs only

	units	units/ lb VCM	cents/ unit	MM units/ year	M $ per year	cents/ lb VCM	ref codes
RAW MATERIALS							
Ethylene	lb	0.4754	20.7440	475.40	98617.0	9.8617	1
Chlorine	lb	0.6326	5.8337	632.60	36904.0	3.6904	1
Oxygen	lb	0.1367	1.4449	136.70	1975.2	0.1975	
SUBTOTAL					137496.1	13.7496	
BYPRODUCTS							
Steam	Mlbs	-0.0010	480.4822	-0.99	-4756.8	-0.4757	1
Light Ends	lb	-0.0208	1.4760	-20.80	-307.0	-0.0307	1
Tars	lb	-0.0126	-1.7500	-12.60	220.5	0.0221	1
SUBTOTAL					-4843.3	-0.4843	
PROCESSING SUPPLIES							
Catalyst	lb	0.0007	72.5000	0.70	507.5	0.0508	1
Caustic	lb	0.0051	8.8431	5.10	451.0	0.0451	1
Nitrogen	MSCF	0.0007	70.2443	0.69	484.7	0.0485	1
Ammonia-Amine	lb	.0000	108.8134	0.03	32.6	0.0033	1
Sulfuric Acid	lb	0.0004	3.2810	0.41	13.5	0.0013	1
Limestone	lb	0.0000	0.9293	0.00	0.0	0.0000	
Cooling Water Chems	lb	0.0002	108.2571	0.20	216.5	0.0217	1
Wastewater Treatant		0.2457		245.70	39.0	0.0390	1
Gas Waste Treatment		0.0236		23.60	77.3	0.0773	1
Calcium Chloride	lb	0.0013	17.3800	1.30	225.9	0.0226	1
Misc Chem & Supplş				0.00	0.0	0.0248	1
SUBTOTAL					2048.0	0.3343	
UTILITIES							
Electricity	kWh	0.0757	3.7223	75.73	2818.9	0.2819	1
Steam	Mlbs	0.0028	480.4822	2.82	13549.6	1.3550	1
Natural Gas	MSCF	0.0019	293.6351	1.90	5579.1	0.5579	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	
Water	Mgal	0.0008	22.6924	0.84	190.6	0.0191	1
SUBTOTAL					22138.2	2.2138	
VARIABLE COST SUBTOTAL					156839.1	15.8134	
LABOR							
Salaried					1433.1	0.1433	2
Operating					1726.6	0.1727	3
Maintenance					1474.6	0.1475	4
Benefits					764.4	0.0764	5
SUBTOTAL					5398.7	0.5399	
MISCELLANEOUS							
Operating Supplies					466.2	0.0466	6
Maint Materials					1758.1	0.1758	7
Contract Labor					1927.5	0.1928	8
Insurance					254.0	0.0254	9
Clearances					1135.0	0.1135	9
Taxes					824.0	0.0824	9
Miscellaneous					452.4	0.0452	10
SUBTOTAL					6817.2	0.6817	
FIXED COST SUBTOTAL					12215.9	1.2216	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					169055.0	17.0350	

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

B. F. GOODRICH

CALVERT CITY, KENTUCKY

BACKGROUND DATA

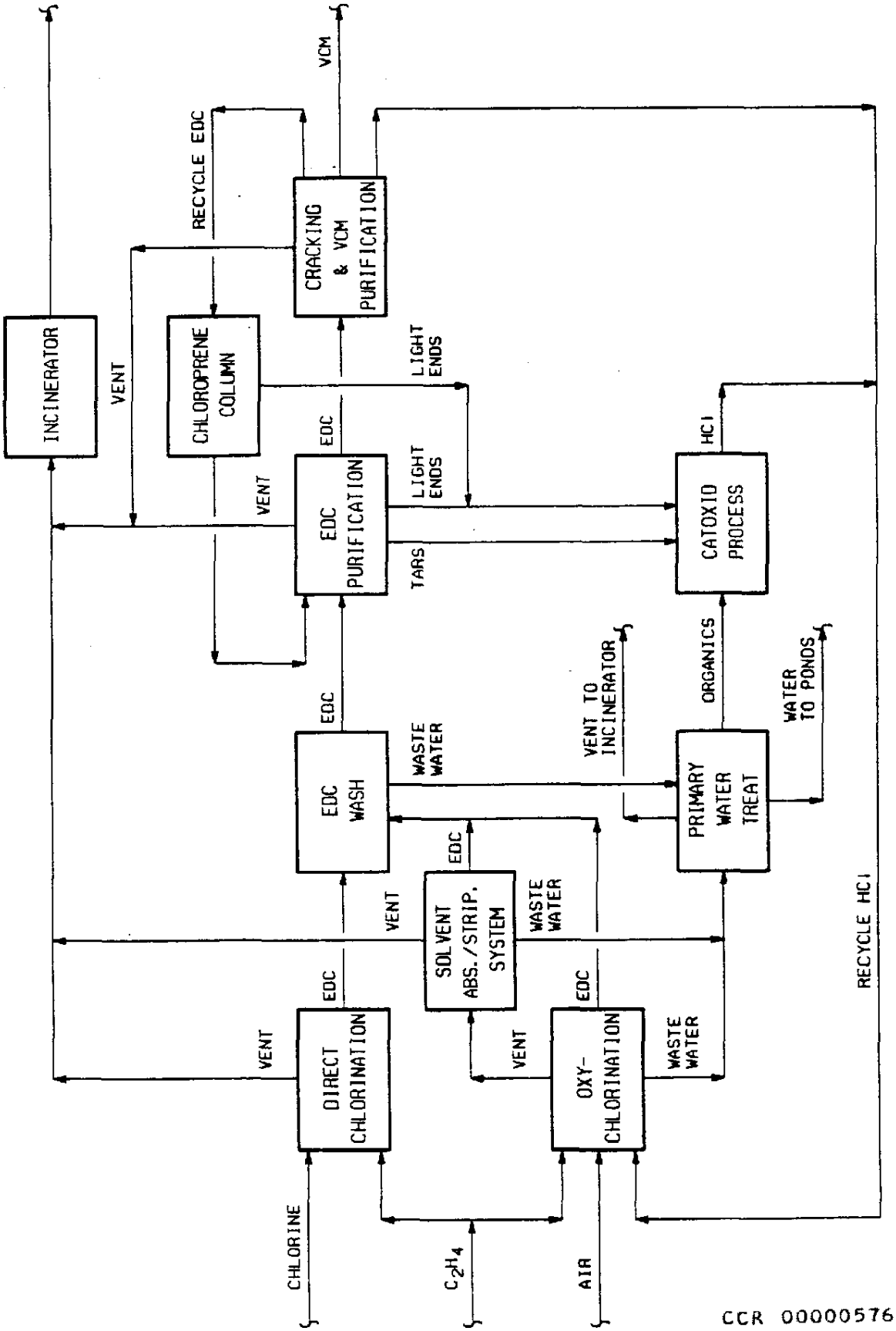
Startup Year	1964[6]
Capacity	1,000 MM Lbs/Yr[6]
Expansions/Modernizations	Integrated EDC/VCM production began at Calvert City in 1964. The original plant produced 280 MM pounds per year VCM. This plant was expanded in 1966, 1968, and 1975 to give a current capacity of 1,000 MM pounds per year VCM.[56,18] A modernization of EDC/VCM facilities was scheduled for 1983. In 1981, BFG completed chlorine and EDC plants at Convert, Louisiana. This was the first phase of a chlorine/VCM/PVC complex. In 1983, the VCM and PVC facilities were postponed indefinitely during initial construction.[57]
Environmental Status	Vent gas[58] and liquid organic[59] waste streams are catalytically incinerated. Process waste water is steam stripped.

MARKET POSITION

Feedstocks/Supplies[30]

Ethylene	Captive (Calvert City, Kentucky)[30]
Chlorine	Captive (Calvert City, Kentucky)[30]
Caustic	Captive (Calvert City, Kentucky)
EDC	Up to 20 percent is imported captively from the Convent, Louisiana, EDC Plant.[30]

FIGURE 12
VCM COST PROFILES
BLOCK FLOW DIAGRAM
B.F. GOODRICH[18]
CALVERT CITY, KENTUCKY



MANUFACTURING COST: B. F. Goodrich Calvert City, KY

Capacity: 1000 MM lbs VCM/year Ofixed and variable costs only

	units	units/ lb VCM	cents/ unit	MM units/ year	M $ per year	costs/ lb VCM	ref codes
RAW MATERIALS							
Ethylene	lb	0.4804	20.7440	480.40	99654.2	9.9654	1
Chlorine	lb	0.6092	5.8337	609.20	35538.9	3.5539	1
Oxygen	lb	0.0000	1.4449	0.00	0.0	0.0000	
SUBTOTAL					135193.1	13.5193	
BYPRODUCTS							
Steam	Mlbs	-0.0013	480.4822	-1.27	-6102.1	-0.6102	2
Light Ends	lb	0.0000	1.4760	0.00	0.0	0.0000	3
Tars	lb	0.0000	-1.7500	0.00	0.0	0.0000	3
SUBTOTAL					-6102.1	-0.6102	
PROCESSING SUPPLIES							
Catalyst	lb	0.0001	414.5833	0.14	576.3	0.0576	4
Caustic	lb	0.0063	10.6720	6.25	667.0	0.0667	5
Nitrogen	MSCF	0.0007	70.2443	0.69	484.7	0.0485	6
Ammonia-Amine	lb	0.0001	108.8134	0.05	54.4	0.0054	6
Sulfuric Acid	lb	0.0004	3.2810	0.41	13.5	0.0013	6
Limestone	lb	0.0000	0.9293	0.00	0.0	0.0000	
Cooling Water Chems	lb	0.0003	108.2571	0.27	292.3	0.0292	6
Wastewater Treatmt		0.4124		412.40	6.6	0.0066	7
Gas Waste Treatment		0.7182		718.20	156.2	0.1562	8
Hydrogen	lb	0.0003	16.3838	0.28	45.9	0.0046	6
Misc Chem & Supplis				0.00	0.0	0.0458	9
SUBTOTAL					2296.8	0.4220	
UTILITIES							
Electricity	kWh	0.0970	3.7223	96.99	3610.3	0.3610	10
Steam	Mlbs	0.0023	480.4822	2.31	11099.1	1.1099	1
Natural Gas	MSCF	0.0021	293.6351	2.11	6195.7	0.6196	1
Fuel Oil	MGal	0.0000	0.0000	0.00	0.0	0.0000	
Water	Mgal	0.0010	22.6924	1.00	226.9	0.0227	1
SUBTOTAL					21132.0	2.1132	
VARIABLE COST SUBTOTAL					152519.8	15.4443	
LABOR							
Salaried					2204.8	0.2205	11
Operating					2656.4	0.2656	12
Maintenance					2302.0	0.2302	13
Benefits					1183.0	0.1183	14
SUBTOTAL					8346.2	0.8346	
MISCELLANEOUS							
Operating Supplies					657.0	0.0657	19
Maint Materials					2143.6	0.2144	15
Contract Labor					2536.6	0.2537	16
Insurance					254.0	0.0254	17
Clearances					1135.0	0.1135	17
Taxes					824.0	0.0824	17
Miscellaneous					464.7	0.0465	18
SUBTOTAL					8014.9	0.8015	
FIXED COST SUBTOTAL					16361.1	1.6361	
PLANT MANUFACTURING COST EXCLUDING DEP & AMORT					168880.9	17.0804	

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

B. F. GOODRICH

CALVERT CITY, KENTUCKY

1. Values obtained from the Norsk Hydro evaluation (March 1974) and Badger Design (May 1974) unless noted otherwise. Chlorine conversion includes recycle HCl from Catoxid Unit.

2. Includes 0.974 pound steam from oxy, 0.118 pound from catoxid, and 0.18 pound returned to battery limits.

3. All chlorinated hydrocarbon waste are sent to Catoxid for HCl recovery and recycle to the oxy reactors. Catoxid yield for HCl recovery equals 67 percent.

4. Includes 0.00013 pound oxy catalyst at 365.7 cents per pound plus 8.71×10^{-6} pounds dehydrogenation catalyst at $11.95 per pound.

5. 0.005 pound 100 percent solution at 7.501 cents per pound plus 0.00125 pound flake at 23.35 cents per pound.

6. Usage based on the Conoco plant.

7. Caustic Cost for Neutralization: 0.0009 Pound 100 Percent Caustic at 7.501 Cents/Pound.

8. Includes 0.0038 cents per pound VCM for $CaCO_3$ neutralization, 0.0676 cent per pound VCM for incinerator operating cost, and 0.0848 cent per pound VCM for fuel gas. Incinerators do not have waste heat recovery.

9. Solvent for Vent Gas Absorber/Stripper System: 0.00014 Gallon Aromatic Solvent at 150 Cents/Gallon plus 0.0248 Cent/Pound VCM for Conoco Miscellaneous Costs.

10. Includes 0.0064 KWH for catoxid process, 0.0186 KWH for cooling water tower offsites, and 0.0085 KWH for lighting and building utilities. BFG has large refrigeration duty on vent condensers due to air-based process.

11. Eighty-three percent of operating labor.

12. Based on twelve ISBL, three OSBL, and three miscellaneous operators per shift plus two lab analysts per shift.

13. One-hundred Seventy-four percent of Conoco maintenance labor due to multiple trains.

Notes for Manufacturing Costs
B. F. Goodrich
Calvert City, Kentucky

14. Includes 15.67 percent of the turnaround labor under contract maintenance as benefits for a roving crew.

15. One-hundred fifty-nine percent of Conoco's maintenance material.

16. Includes $1,745.7 M yearly maintenance, $516.8 M casual turnaround labor, and $274.1 M for turnaround contract costs.

17. Based on cents per pound VCM from Conoco plant.

18. Includes turnaround rentals.

VCM PRODUCERS

VCM COST PROFILES

PLANT INFORMATION

B. F. GOODRICH

LaPORTE, TEXAS

BACKGROUND DATA

Startup Year	1978[6]
Capacity	1,000 MM Lbs/Yr[6]
Expansions/Modernizations	BFG purchased this plant from Diamond-Shamrock in 1981.[57] Expansion to 1,500 MM pounds per year is under consideration.[45,64,65]
Environmental Status	Compliance is provided by vent gas incineration and waste water stripping.

MARKET POSITION

Feedstocks[30]

Ethylene	Purchased from Phillips.
Chlorine	Supplied by Diamond-Shamrock.

By-Products

Heavy Organics	PPG is paid for disposing of heavy organics.[53]

Product Use

Merchant sales account for 30 percent of the VCM product use. The plant operated at 82 percent of capacity in 1983 prior to a November-December shutdown for inventory control.[63] They are negotiating toll processing for other companies.

VCM PRODUCERS

VCM COST PROFILES

NOTES FOR MANUFACTURING COSTS

GEORGIA PACIFIC

PLAQUEMINE, LOUISIANA

1. Variable costs are the same as for the 1981 PPG 500 MM pound per year plant.

2. Eight-three percent of operating labor, based on the Conoco plant.

3. Based on eight ISBL/OSBL operators, three miscellaneous personnel, and two lab analysts per shift.

4. Based on 41 maintenance men.

5. 15.67 percent of payroll, plus benefits for 75 percent of the casual turnaround labor for roving crew.

6. Twenty-seven percent of operating labor plus 0.006 cent per pound VCM for secondary waste water treatment facilities.

7. One-hundred-thirty percent of Conoco maintenance materials.

8. Includes $1,429,000 yearly maintenance, $325,000 for casual turnaround labor, and $173,000 for turnaround contract costs.

9. Based on the Conoco plant.

10. Conoco miscellaneous charge minus the difference in turnaround rental charges.