



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

May 6, 1975

Mr. R. E. Van Ingen
Manager Manufacturing
Environmental Conservation Department
Shell Oil Company
P. O. Box 2463
Houston, Texas 77001

MANUFACTURING Environmental Conservation Department RECEIVED MAY 12 1975			
ROUTING	REL.	DISC.	INFO
<i>[Signature]</i>			
DUE DATE			
FILE <i>PC-24</i>			

Dear Mr. Van Ingen:

This letter is in response to your letter to Mr. Don R. Goodwin of April 16, 1973, regarding incineration costs at vinyl chloride monomer plants. Since your letter addresses a subject that falls within my area of responsibility, Mr. Goodwin has requested that I respond to you.

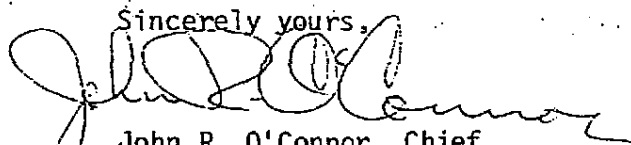
I have attached a copy of the specifications that our contractor used to develop his estimate of incineration costs for a 700 million lb/yr. vinyl chloride monomer plant as well as one copy of the final incinerator capital cost estimate of \$921,750. In addition, we have attempted to reconcile the differences between our estimate and Shell's estimate by trying to put both estimates on a comparable basis. While it has not been possible to precisely reconcile all cost differences, it does appear that the major area where differences exist is in the "other cost" section - engineering, field changes, and start-up costs specifically. While differences in the areas of purchased equipment and installation also exist, it would appear that these differences might partially be explained by the inclusion of an acid recovery system in the Shell estimate. The EPA estimate included neutralization of the acid, not recovery.

Whereas we cannot dispute the fact that Shell has actually expended the amount in question - \$1,768,000 - we still believe that this amount would not necessarily be duplicated at some other installation. In particular, we believe the amounts expended for engineering, field changes, and start-up costs appear to be extraordinary.

Another area in which differences exist is in the escalation of the original capital expenditure to a value representative of the EPA model plant. The Shell methodology is to take the original value of \$1,768,000, multiply it by a factor of 1.67 to account for inflation,

add \$260,000 for an acid mist eliminator, and then multiply the sum by a factor of 1.4 to account for the increased gas volume that must be treated. This methodology results in a total capital cost estimate of \$4,500,000. EPA, on the other hand, believes that an inflation factor of 1.29 is more appropriate based upon the values of the CE Index in January 1973, and January 1975. Also, EPA does not believe that an acid mist eliminator of the size included in the Shell estimate would be required. EPA has included a mist eliminator in its original equipment estimate as is noted on the attached reconciliatory sheet. Finally, we believe that a volume scaling factor of 1.15 is the appropriate factor to use. This factor is based upon scaling the original gas volume at the burner exit of 60,000 SCFM to 73,000 SCFM at the 0.7 power. The EPA methodology, then, gives a value of \$2,600,000 as opposed to the Shell estimate of \$4,500,000. We realize that even this value, however, is considerably in excess of the EPA capital estimate of \$922,000. Whereas we believe that part of the discrepancy is due to factors mentioned before - acid recovery cost, engineering, field changes, and start-up costs - we feel that more analysis in this area is needed. I hope that we will be able to discuss these matters with you and other Shell employees in order to obtain mutually agreeable cost estimates for control of emissions at vinyl chloride monomer plants.

Sincerely yours,



John R. O'Connor, Chief
Standards and Cost Analysis Branch
Strategies and Air Standards Division

Enclosure

The thermal incineration systems specified for VCM control under this task consist of a thermal incinerator and a caustic scrubber system to remove from the incinerator exhaust gases the HCl made in the incinerator. Cost information for these systems was developed from a conceptual design basis of an 1800°F incineration temperature and a 2 second residence time to achieve 99% removal of VCM. This is felt to be a conservative basis but it is not based upon operating data.

The installed cost data presented herein is of necessity based on a model situation and must be adjusted by the reader to meet his particular situation. To help in this adjustment, various cost bases used in this study are listed below:

- 1) 5% caustic solution is available within 50 feet of unit battery limits.
- 2) Cost of caustic is 35¢/# which includes delivery, unloading and surcharge from existing facilities.
- 3) An adequate supply of natural gas auxiliary fuel is available at \$2.00/MM Btu.
- 4) Caustic scrubber effluent will be processed in existing treatment facilities. Existing chemical sewer tie-in is within 25 feet.
- 5) The equipment will be placed on a concrete pad sized for equipment only. Soil bearing pressure is 2000 psf. Backfill, piling, etc., is not included.

- 6) Area classification will be Class I, Group D, Division II. Motors will be TEFC. Arcing controls will be NEMA 7, nonarcing controls will be NEMA 4, control cabinets will be pressurized and purged NEMA 4. Existing electrical power supply 440, 220 and 110 volts is adequate.
- 7) Incinerator will be designed for the 2 seconds residence time at 1800°F. Fuel consumption will be based on anticipated operating temperature of 1600°F but system will be capable of 1800°F operating temperature. Air will be added in excess of that required for fuel combustion to assure a 1% O₂ concentration in incinerator outlet gases, for VCM balanced operation.
- 8) Scrubber presaturator will be designed for 0.3 sec residence time. Material of construction will be suitable for service. Process water will be used for cooling. Fire water is available for backup emergency cooling.
- 9) The scrubber will be designed for 95%+ HCl removal efficiency. Caustic scrubber effluent will go directly to chemical sewer on scrubber sump level control.
- 10) Pumps will be spared and material of constructions will be C.S. for caustic pump and epoxy FRP for scrubber liquor.
- 11) In the absence of specific available experience, operating labor cost estimates will be projected from general incinerator and scrubber knowledge.

- 12) Process vent stream conditions supplied to the control system are summarized in cost data tables.
- 13) Maintenance and repairs will be figured at 5% of fixed capital investment.
- 14) Stack will discharge at 100' above grade.

ESTIMATED CAPITAL COST DATA
(COSTS IN DOLLARS)

THERMAL INCINERATOR FOR BALANCED
VINYL CHLORIDE MONOMER PLANT (700 MM 1b/yr)
(OXYCHLORINATION, "LIGHTENDS," AND VINYL FINISHING COLUMN VENTS)

Effluent Gas Flow	
ACFM	12,000
°F	70
SCFM	12,000

Effluent Contaminant Loading	
(ppm) VCM	1,625
1b/hr VCM	189

Cleaned Gas Flow	
ACFM	36,000
°F	175
SCFM	30,000

Cleaned Gas Contaminant Loading	
(ppm) VCM	2.17
1b/hr VCM	1.89
Cleaning Efficiency, % *	99

(1) Gas Cleaning Device Cost	245,000
(2) Auxiliaries Cost	73,500
(a) Fan(s)	46,500
(b) Pump(s)	9,000
(c) Damper(s)	9,000
(d) Condition, (Incl. Inst.) Equipment	9,000
(e) Dust Disposal Equipment	
(3) Installation Cost	603,250
(a) Engineering	71,250
(b) Foundations & Support	285,000
Ductwork & Stack - 100' above	28,500
Electrical (Incl. Inst.)	38,000
Piping	38,000
Insulation	61,750
Painting	23,750
Supervision	9,500
Startup	9,500
Performance Test	9,500
Other	28,500
(4) Total Cost	921,750

*99% for VCM, 95% for HCl

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ANNUAL OPERATING COST DATA
(COSTS IN \$/YEAR)

THERMAL INCINERATOR FOR BALANCED
VINYL CHLORIDE MONOMER PLANT (700 MM lb/yr)
(OXYCHLORINATION, LIGHT ENDS, AND VINYL FINISHING COLUMN VENTS)

Operating Cost Item	Unit Cost	
Operating Factor, Hr/Year	8,000	
Operating Labor (if any)	\$6/Hr	\$ 12,600
Operator	\$8/Hr	8,400
Total Operating Labor		21,000
Maintenance		
Labor		\$
Materials		
Total Maintenance & Replacement		46,100
Parts		
Replacement Parts		
Total Replacement Parts		
Utilities		
Electric Power	\$.03/Kwhr	\$ 34,200
Fuel	\$2/MM Btu	592,000
Water (Process)	\$.25/Mgal	8,000
Water (Cooling)	\$.05/Mgal	0
Caustic Soda	\$.35/lb	309,900
Total Utilities		944,100
Total Direct Cost		\$1,011,200
Annualized Capital Charges		113,200
Total Annualized Cost		\$1,184,400

COMPARISON OF INCINERATOR CAPITAL COSTS - SHELL VS. EPA

	Shell (Norco, La.) M\$	EPA Estimate M\$
A. PURCHASED EQUIPMENT		
1. Incinerator	113	245 ^a
2. Blower & Driver	43	46.5
3. FRP Equipment & Duct Work incl. column	67	(Incl. in Item B2)
4. Exchanger	10	None
5. Pumps	19	9.0
6. Filters	1	None
7. Tanks (less lining)	25	--
8. Instruments	63	(Incl. in Item B3)
9. Electrical	15	(Incl. in Item B4)
10. FRP Piping	33	(Incl. in Item B2)
11. Valves	36	None
12. Structural Steel	62	(Incl. in Item B1)
13. Column Packing	1	(Incl. in Item A1)
14. Piping Labels	1	
15. Freight	6	None
16. Conditioning Equipment ^b	--	9
17. Dampers	--	9
Subtotal	495	318.5
B. CONSTRUCTION CONTRACTS		
1. Piling & Foundations	170	285 ^c
2. Mechanical & Piping	270	152 ^d
3. Instrumentation	76	(Incl. in Item B4)
4. Electrical	60	38
Subtotal	576	475
C. OTHER COSTS		
1. Engineering (Contractor)	229	71.3
2. Sales Tax	20	None
3. Shell Engineering	102	(Incl. in Item C1)
4. Field Changes	195	None
5. Start-up Costs	151	19 ^e
6. Supervision	--	9.5
7. Other (Contingencies, etc.)	--	28.5
Subtotal	697	128.3
GRAND TOTAL	\$1,768M	\$922M

^aIncludes burner and burner controls, combustion chamber, and scrubber (includes mist eliminator). Cost is FOB vendor.

^bIncludes cost of quencher and quencher controls.

^cIncludes cost of foundations and support and labor to install them.

^dIncludes cost of: duct work and stack (100'), piping, insulation, and painting materials and labor.

^eIncludes cost of: startup and performance test.