

TENNECO CHEMICALS, INC.

COPY TO

COLORITE 019653

D. Goodman

July 7, 1980

NEW DEVICE TO REMOVE VCM FROM LOW
CONCENTRATION EFFLUENT AIR STREAMS

DISTRIBUTION:

D. C. Coldiron
H. R. Johnson
F. S. Klopp
P. A. Lobo
R. S. Miller
M. K. Rosen
W. Rupp
W. R. Sorenson

~~W. R. Sorenson~~

VINYL CHLORIDE REMOVAL^{*}

D. H. Douglas-Hamilton

May 30, 1980

AVCO EVERETT RESEARCH LABORATORY, INC.
a Subsidiary of Avco Corporation
2385 Revere Beach Parkway
Everett, Massachusetts 02149

^{*} Patent Pending

COLORITE 019655

AVCO EVERETT RESEARCH LABORATORY, INC.

PERSONNEL :

PHD LEVEL: 100

TOTAL : 700

EXPERTISE :

GAS DYNAMICS

LASER RESEARCH

ELECTRICAL DISCHARGES IN GASES

ATOMIC & MOLECULAR KINETICS

MHD

OPTICS

HEART ASSIST BALLOON PUMP

INDUSTRIAL LASERS

CURRENT INTEREST:

APPLICATION OF OUR BACKGROUND IN
PHYSICS TO SOLVING PROBLEMS IN INDUSTRY

J5186

VINYL CHLORIDE MONOMER

- SOURCE: VCM AND PVC MANUFACTURE

EMISSION LIMITS TO ATMOSPHERE :

- EPA (1976) : 10 ppm AT STACK
- CALIFORNIA AQB (1980) : 10 ppb AT BOUNDARY
50 g/hr FROM SOURCE

- CONVENTIONAL REMOVAL:

- CARBON BED
 - INCINERATOR
- } ECONOMICAL ONLY FOR HIGH CONCENTRATION

- AERL REMOVAL:

- ION-CATALYSED *
DESTRUCTION
- } ECONOMICAL ONLY FOR LOW CONCENTRATION

* PATENT PENDING

J5184

CARBON BED

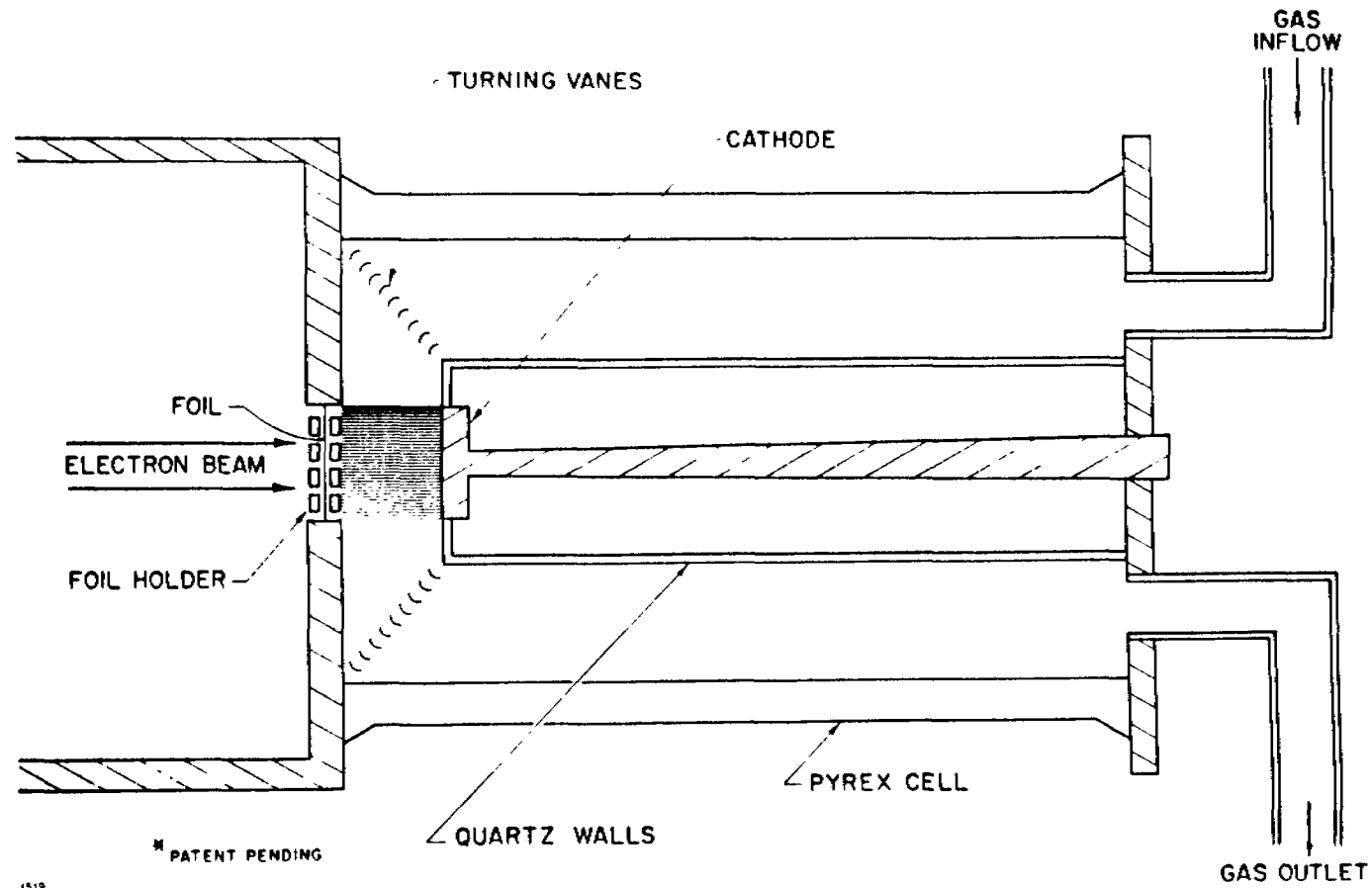
FLOW	< 500 cfm
INPUT CONCENTRATION	~ 38,000 ppm VCM IN N ₂
OUTPUT CONCENTRATION	~ 5 ppm VCM IN N ₂
RECOVERED PRODUCT	90% VCM AS VAPOR
COST	\$293,000
FOR 50,000 cfm COST WOULD BE ~ \$5M	

INCINERATOR

FOR 50,000 cfm, ANNUAL FUEL COST WOULD BE ~ \$5.5M

J5183

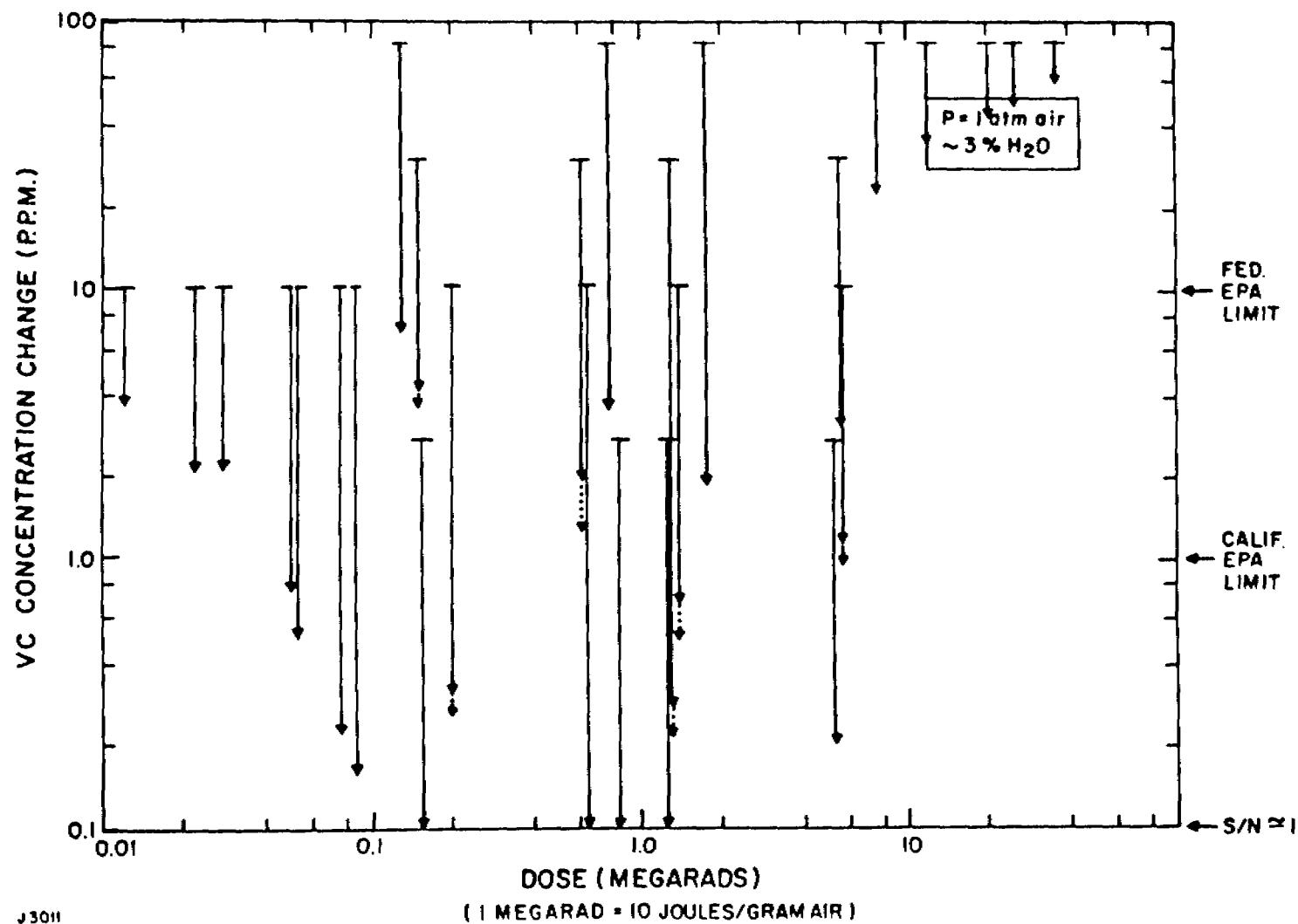
DISCHARGE CELL*



-4-

AVCO EVERETT
COLORITE 019659

VC REMOVAL vs DOSE



J3011

-5-

AVCO EVERETT

COLORITE 019660

REACTION PRODUCTS

GAS: VCM IN N₂

PRODUCTS: HCl : 50% – 75%

POLYMERIZED
POWDER : > 1%

CHLORINATED
HYDROCARBONS : NEGLIGIBLE

NO MASS SPEC PEAKS DETECTED FOR M > 63

J5187

KINETIC EQUATIONS

$$\frac{d[VC]}{dt} = -k_1 [e] [VC] - \gamma_1 [N_2^+] [VC]$$

$$\therefore \frac{d[VC]}{dt} = -[VC] \left[k_1 [e] + \gamma_1 [N_2^+] \right]$$

ATTACHMENT AND CHARGE TRANSFER DOMINATE:

$$\therefore [e] = \frac{S}{k_1 [VC] + k_2 [Cl]} \quad , \quad [N_2^+] = \frac{S}{\gamma_1 [VC] + \gamma_2 [X]}$$

CONSERVATION OF MASS:

$$[VC] + [Cl] = [VC]_0$$

$$[VC] + [X] = [VC]_0$$

ASSUME $k_1 = k_2$, $\gamma_1 = \gamma_2$; EQUATION REDUCES TO:

$$\frac{d[VC]}{dt} = - \frac{2[VC]}{[VC]_0} \cdot S$$

HENCE: $\frac{[VC]}{[VC]_0} = e^{-kD/\psi}$, WHERE $\psi = [VC]_0$.

J5190

EXPERIMENTAL RESULTS

1. FOR INITIAL CONCENTRATION $3 < \psi < 500$ ppm :

VCM IS REMOVED FROM	N_2	DRY & WET
	AIR	DRY & WET
	ARGON	DRY

2. GAS TEMPERATURE RISE $\Delta T = 1^\circ C$ FOR REMOVAL 5 ppm VCM

3. REACTION PRODUCTS: HCl (~ 70%) AND POLYMERIZED POWDER

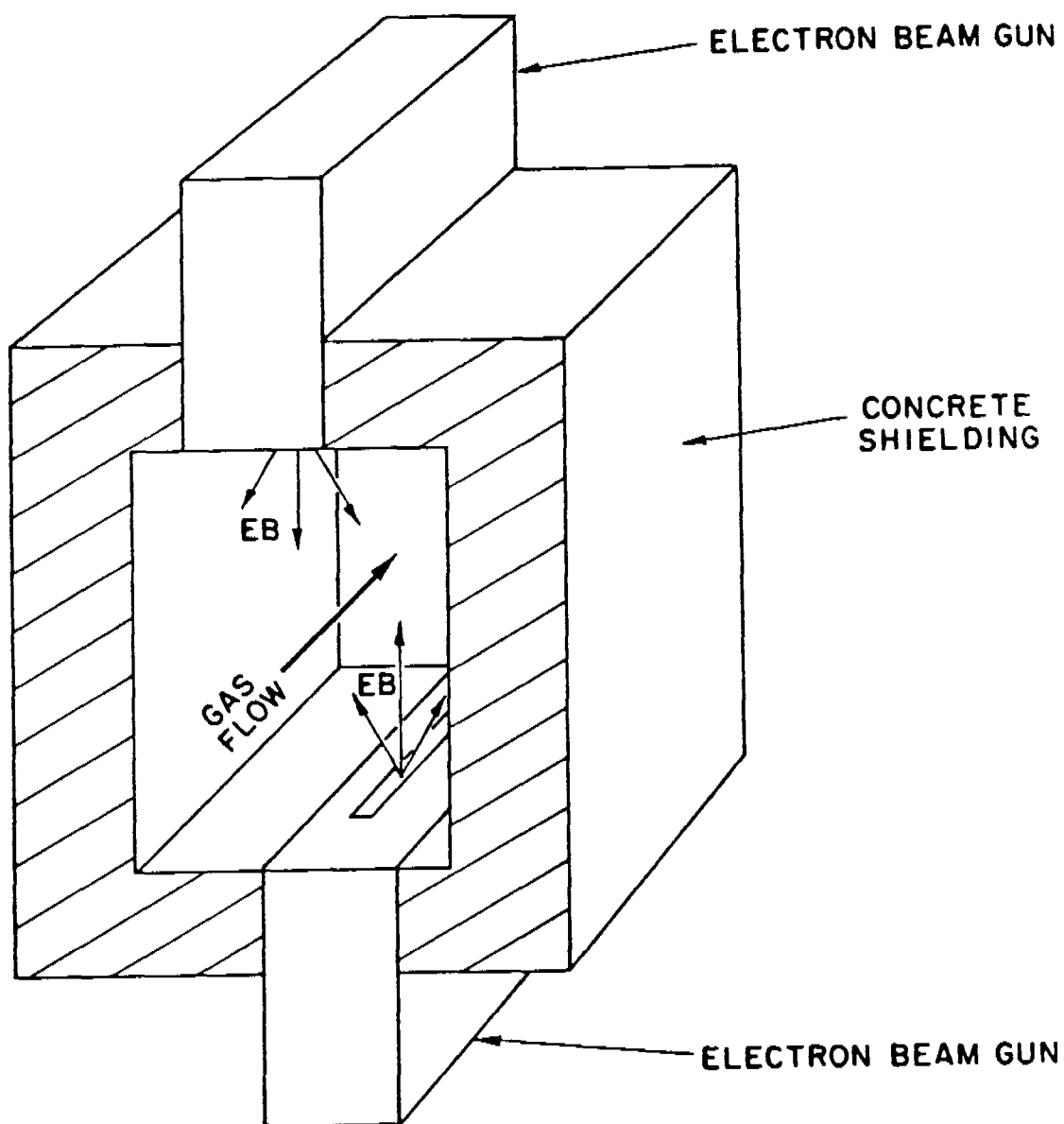
4. FRACTION REMAINING AFTER D MEGARADS IS

$$x = e^{-kD/\psi}$$

WHERE $k = 269$ ppm PER MEGARAD

J5189

EB INCINERATOR* IRRADIATION CELL



J1947

* PATENT PENDING

REMOVAL OF VCM

1. POINT DESIGN

AIR FLOW : 50,000 cfm
INPUT VCM : 5 ppm
OUTPUT VCM : < 0.1 ppm

2. EBI SYSTEM

IRRADIATION CHAMBER : 7.5' x 2' x 2'
RESIDENCE TIME : 36 millisec
GAS VELOCITY : 56 ft / sec
EB VOLTAGE : 300 kV
EB SHIELDING : BUILT-IN LEAD LAYER
EB POWER : 50 kW

3. COSTING

CAPITAL \$510,000

INCLUDING CHAMBER
DUCTING
EB SYSTEM
SHIELDING
CONTROLS

ANNUAL \$180,000

INCLUDING POWER
MAINTENANCE
AMORT. (5 YR., 15%)

NOTE: CAPITAL AND ANNUAL COSTS INCREASE AS $\log_e$ [INPUT VCM]

E.G.: FOR INPUT VCM = 50 ppm, COSTS INCREASE ~ 2.6 TIMES

J5188

SUMMARY

1. DEMONSTRATED ECONOMICAL PROCESS* FOR REMOVING VCM IN LOW CONCENTRATION FROM LARGE FLOWS
2. DEMONSTRATED PREDICTABILITY FOR SCALE-UP OF PROCESS
3. PRELIMINARY COST ANALYSIS PERFORMED
4. POTENTIAL APPLICATIONS IN PVC PLANT DRIERS AND FUGITIVE EMISSIONS

J5185

*PATENT PENDING