CHEMICALS INDUSTRIES

INTEROFFICE / LAKE CHARLES

TO	See Distribution	DATE	November 5, 1975
FROM	M. Wood/E. Garton	SUBJECT	HCB-HCBD Survey

On September 4th and 5th Midwest Research Institute conducted an HCB-HCBD Survey in and around the Lake Charles Plant. In addition to assisting the MRI team, the Laboratory also sampled and analyzed air, water, soil, and stream sediment for HCB and HCBD. A more detailed description of sampling and analytical procedure will be prepared in ~~LD-1604~~.

Following are sample location nomenclature used in the appended data:

AX - Air sample adsorbed on Tenax

AD - Air sample adsorbed in Decane

AC - Air sample adsorbed on Carbon

W - Water Sample

D - Soil Sample (Composite)

S - Sediment Sample

Numerical notations refer to locations on the attached map.

MW:EG:rw

Att.

Distribution

H. J. Hoenes, Jr.
T. Taylor
C. A. Burns

SL 049342

HCB and HCBD in Environmental Samples

Air*

Location	Date/Time	HCB, μg/M³	HCBD, μg/M³	Other, μg/M³
**2 AX	9-4-75/1130 thru	< 0.02, < 0.02	< 0.02, < 0.02	
**2 AD	9-5-75/1130	0.09, 0.09	4.2, 3.6	
2 AC				EDC 60 MC 75 Tri 60 Per 65 Total 260
**5 AX	9-4-75/1106 thru	< 0.02, < 0.02	< 0.02, < 0.02	
**5 AD	9-5-75/1138	0.05, 0.10	1.3, 1.0	
5 AC				VDC 25 EDC 30 MC 55 Tri 30 TCE 35 Per 30 Total 205

* Weather data available in LD-1604
** Duplicate analyses.

Water (9-4-75)

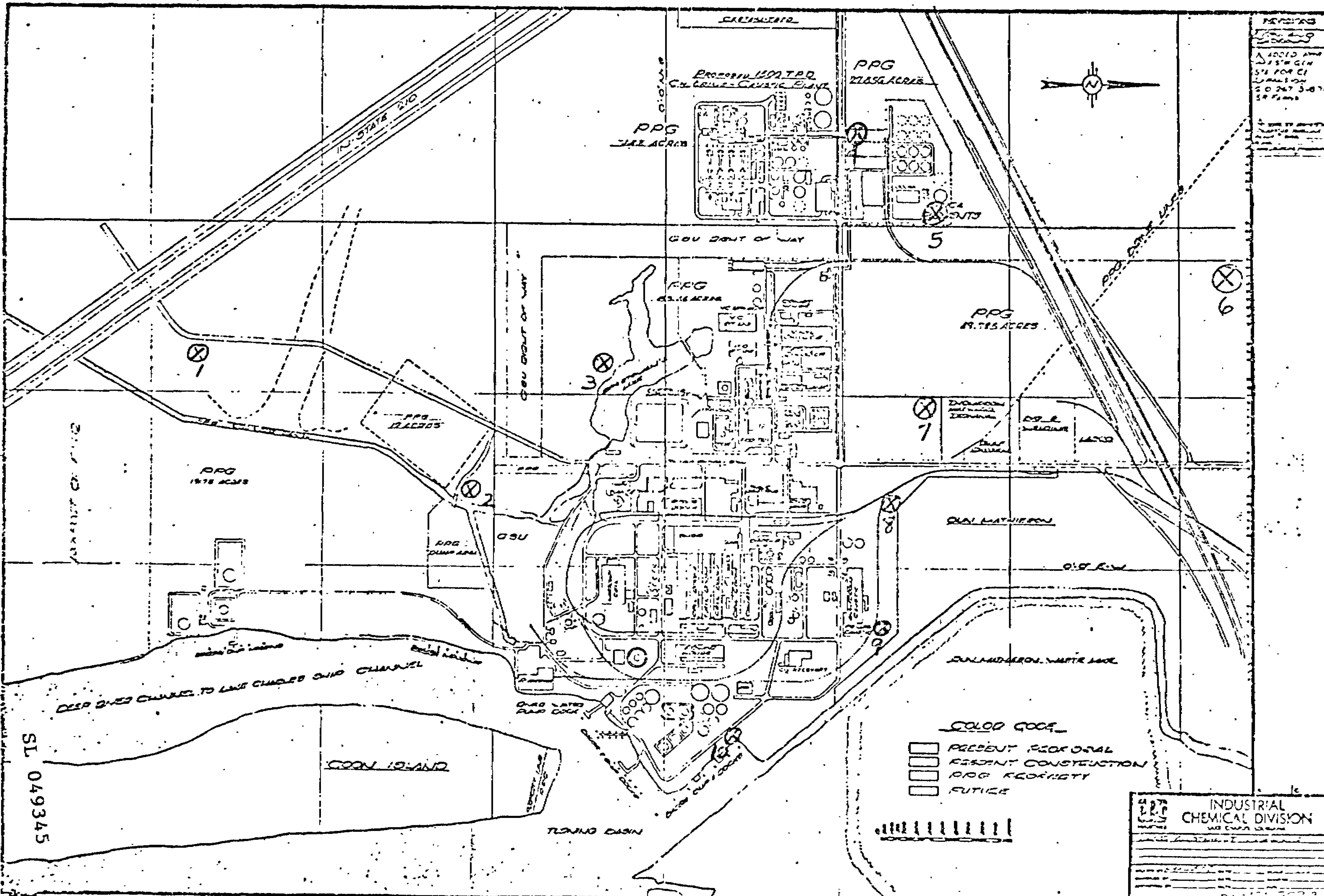
Description	HCB, ppb	HCBD, ppb
Water into Incinerator Scrubber	None Detected	None Detected
Incinerator Scrubber Effluent Outfall	9	None Detected
PPG Canal at Mobil Bridge No. 1	2	12
Area "B" Effluent into Trap	22	16
Area "B" Effluent Outfall	22	14
PPG Barge Slip	None Detected	0.4
Surface Water Over NE Landfill	104	22

Soil (9-4-75)

Description	HCB, ppb w/w	HCBD, ppb w/w
Landfill Area Composite	50,000	1,400
4D, 5D, 7D Composite	120	600
8D, 9D, 10D Composite	28	129
Columbia-Southern Road Right-of-Way, South of PPG - Composite	194	45,000

Sediment (9-4-75)

Description	HCB, ppb w/w	HCBD, ppb w/w
PPG Canal Sediment at Mobil Bridge No. 2	120	120
Area "B" Effluent Sediment at Outfall	1,100	444
PPG Barge Ship Sediment at West Bank	None Detected	46


PPG
PPG
27.85 ACRES
GSU RIGHT OF WAY
5
PPG
PPG
3
1
PPG
2
GSU
7
6
OLIN MATHIESON
OLIN MATHIESON WASTE LAKE
COON ISLAND
TURNING BASIN
COLOR CODE
PRESENT PROPOSAL
PRESENT CONSTRUCTION
PPG PROPERTY
FUTURE
INDUSTRIAL
CHEMICAL DIVISION

SL 049345

Heeners/Gordon ...

Sampling Methods

Air, water, soil, sediment, and aquatic organisms will be considered as potential sampling media. The production process and waste disposal techniques used will determine which of the above media will be sampled.

Air Sampling - Ground-level area sources such as open lagoons will be sampled at two or three points along the downwind boundary of the source using vertical line grids of three samplers each. The shape of measured downwind concentration profiles will be analyzed to determine if the downwind boundary of the source is, in fact, the point of maximum ground level air quality impact.

During each test, source activity and meteorological conditions will be monitored on site. Wind speed and direction will be measured continuously. Other meteorological measurements will be made as required for the determination of atmospheric stability by the method of Turner. Descriptions of source activity will include the amount of waste material transferred to the disposal site or processed by the disposal technique. Samples of waste material will be collected for laboratory determination of physical and chemical properties.

The sampling train for collection of HCB and HCBD in the ambient air will consist of the following items assembled in the order given: (a) probe (directed into the wind); (b) membrane filter for collection of particulate matter; (c) column of Tenax® GC resin for collection of vapor; (d) calibrated flow meter; and (e) pump. The filter and Tenax® plug will be self contained in holders which can be easily disconnected from the sampling train and replaced with unused media. Several sampling heads positioned in relatively close proximity to each other may be operated from a single pump. Portable gasoline-powered generators or battery powered pumps will be used to move the air through the sampling trains.

Samplers will be positioned in any array downwind of the source and at a location upwind to determine the background concentration. Spatial distribution of samplers will depend upon the source configuration. All samplers will be operated simultaneously during a given run. Sampling time will be as short as possible (1/2 to 2 hr) to allow for the conduct of a test under relatively constant meteorological conditions. Sampling rates will be set to allow collection of detectable mass from atmospheres containing minimal concentrations of HCB and/or HCBD.

In the case of an elevated point source such as an incinerator stack, samplers will be positioned laterally in groups of three (with intakes at 2 m above grade) at two or three distances downwind in the vicinity of the maximum receptor point. The location of the maximum receptor point will be estimated by the application of a mathematical model which describes the dispersion of the source effluent under the prevailing meteorological conditions.

Mathematical models of atmospheric dispersion phenomena will be used to estimate the maximum ground level pollutant concentration which may occur in the vicinity of the disposal sites. In other words, the model will be used to predict the intensity of possible pollution episodes. (An episode is defined as a period greater than 1 day during which atmospheric ventilation is at a minimum.) For an assumed (constant) rate of emissions the model extrapolates the set of measured concentrations and corresponding meteorological conditions to predicted concentrations corresponding to meteorological conditions of highest pollution potential for the geographical area. MRI has available in-house EPA's UNAMAP system of models recommended for various source configurations, concentration averaging times, and conditions of restricted dispersion.

Water Sampling - If wastes are channeled into rivers, streams, or lakes following treatment, or simply disposal of wastes in sealed lagoons is employed, the water will be sampled to establish the concentration gradient from the source. Sampling stations will be set up at upstream and downstream, i.e., above and below the waste inflow. Samples collected from upstream will be used as controls. If time and budget allow, it is desirable to locate two or three sampling stations above the waste inflow to establish the rate at which unstable material, if any, is changing. A series of sampling stations will be set up downstream so as to establish the course of contamination of HCB and HCBD throughout a reach of the stream. Stations will be spread at intervals based on time-of-water travel rather than distance. Surface floats or organic dyes, such as Rhodamine WT, can be followed downstream and timed for known distances to determine time-of-water travel. Sampling station(s) will also be set at marked changes in physical characteristics of the stream.

Water will be sampled directly with a commercial sampler (Sirco Portable Sampler Model No. MK-VS7) or by passing the water through Amberlite XAD-4 resin at a metered flow rate. As recommended by Kittrell, samples will be taken at either 5 ft or mid-depth, whichever is less. The collection of quiet or even stagnant water of a quality that does not represent that of the main flow will be avoided. Sampling points usually are established at approximate quarter points, or equal intervals across the width of the stream. The equal intervals will be across the main current rather than across the entire width of the river. If a stream is too wide, such as the Mississippi, Missouri, Ohio, or Tennessee, sampling may prove to be time-consuming; a single sample at the midpoint of the main current will be adequate.

Sampling frequency per sampling station will be determined by the waste discharge rate, current velocity, temperature stability, and other relevant factors. All these can only be determined after the presampling visit to the particular industrial plant. In general, an ideal schedule would be hourly sampling for a 24-hr period. This would provide 24 samples at each station. These samples can be combined prior to analysis to achieve maximum information concerning pollutant discharge within the time-cost limitations of the program.

Sediment Sampling - Sediment samples will be collected at each point where water samples are taken. A modified Peterson dredge will be used for collecting sediment samples. This sampling device essentially picks up surface sediment up to 6 in. deep. It is believed that penetration of chlorinated organic hydrocarbons such as HCB and HCBD should not go beyond 6 in.

Soil Sampling - Soil samples will be taken to assess HCB and HCBD levels due to landfill waste disposal techniques, particulate settling, vapor condensation from ground or elevated sources, and contamination from runoff of surface water or open waste ditches.

A number of core samples will be taken to determine the vertical concentration profile of the pollutants. It is not probable that HCB and HCBD migrate into the soil because of their low water solubility. Surface sampling (to 6 in.) will probably be satisfactory, but this will be verified by the analysis of selected core samples.

Where possible, soil samples will be taken to correspond with air samples. Soil upwind (controls) and downwind of ground level and elevated sources will be sampled.

Sample Handling

No matter what sampling medium is employed, the samples will be kept at 4 to 6°C to preserve the integrity of HCB and HCBD. Upon receipt of the samples at MRI, they will be stored in a refrigerated storage room, at a constant temperature of 5°C, until ready for analysis.

Water samples will be stored in 1-liter glass bottles with Teflon-lined caps. The bottles will be marked, dated, and individually kept in Styrofoam containers to prevent breakage. If an Amberlite XAD-4® column is used for water sampling, the column will be capped and stored intact until ready to be analyzed. Sediment and soil samples, like water samples, will be stored in glass bottles and treated exactly as water samples. Aquatic samples will be wrapped in aluminum foil, and kept frozen until analysis.

Sample Analysis

For each air sample, the millipore filter, as well as the Tenax® GC resin are extracted separately in an ultrasonic bath, each with three portions (20, 20, 10 ml) of pesticide grade n-hexane (Matheson, Coleman, and Bell) for a period of 10 min, and made up to the mark of a 50 ml volumetric flask.

The soil samples are first sifted on a U.S. Standard No. 18 sieve to remove stones and other foreign material. A known amount of each of the samples is then weighed and extracted with n-hexane in a Soxhlet overnight. Each extract is made up and stored in 100 ml volumetric flasks.

For water samples, the grab samples are extracted with two 20-ml volumes of n-hexane followed by one 10-ml volume of n-hexane using a 500 ml separatory funnel. The three extracts are combined and made up to the mark in a 50 ml volumetric flask.

Amberlite XAD-4® resin is Soxhlet extracted three times, each with 500 ml of n-hexane. The first two volumes are combined for analysis and the third is analyzed separately to check whether the extraction was complete.

During the analysis dilution or concentration of the samples is performed, if necessary, in order to bring the instrument response to within the linear range of the calibration curve.

Instrumentation

A Microtek-2000R gas chromatograph equipped with an electron capture detector (tritium) is used. The output of the gas chromatograph is connected to a Hewlett-Packard 3380A integrator-recorder, which features the printout of the chromatogram with integrated areas of individual peaks and respective retention times. A 4 ft x 1/4 in. glass column packed with 1.5% OV-17/1.95% SF-1 coated on 100/120 mesh Supelcoport is used as the primary column for the analysis, while a 6 ft x 1/4 in. glass column packed with 3% XE-60 coated on 80/100 mesh chromosorb WHP is used to verify and differentiate HCB from α-BHC.

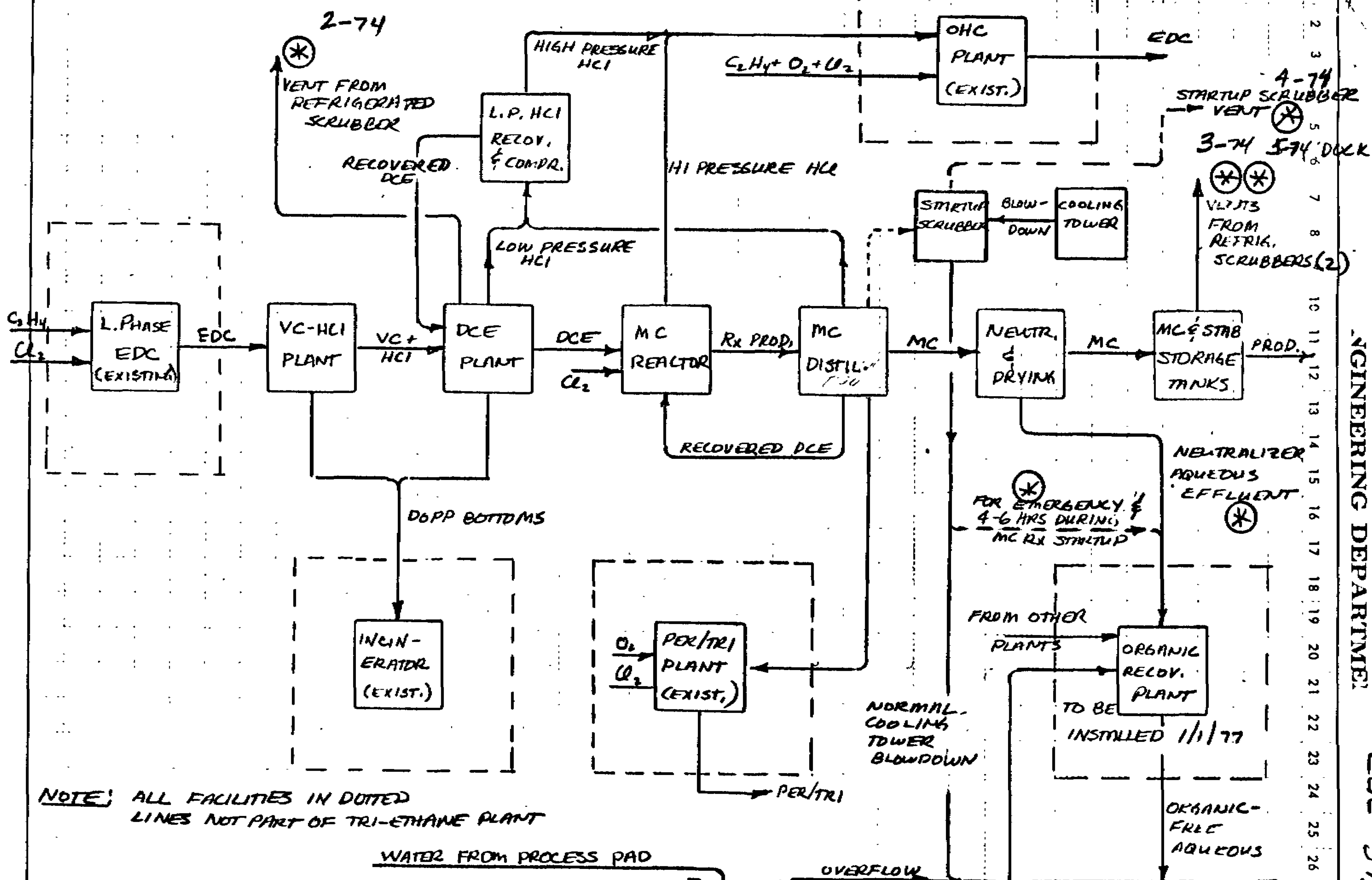
For HCBD analysis, the chromatographic operating conditions are: injector temperature, 200°C; column temperature, 100°C; detector temperature, 180°C; carrier flow rate, 50 ml/min N_2; purge flow rate, 90 ml/min N_2; and detector voltage, 10 V DC.

For HCB analysis, the chromatographic operating conditions are the same as those for the analysis of HCBD except that the column temperature is maintained at 150°C; carrier flow rate, 100 ml/min N_2; and purge flow rate, 90 ml/min N_2.

Calibration Curves

A 10 ng/ml composite standard solution of HCB and HCBD is used to obtain the calibration curve. The standard solution is prepared by dilution of a stock solution made up from EPA reference standards obtained from Pesticides and Toxic Substances Effects Laboratory, National Environmental Research Center, Research Triangle Park, North Carolina. Concentration ranges chosen for the calibration curve are from 10 to 60 pg, and linearity is observed.

RE:



TRI-ETHANE II

BASIC FLOW SCHEME

(SHOWING SOURCES OF EFFLUENTS) EBL 4/29/74

EBL 5/3/74

ENGINEERING DEPARTMENT

Job No. SL 049412

RE:

ENGINEERING DEPARTMENT

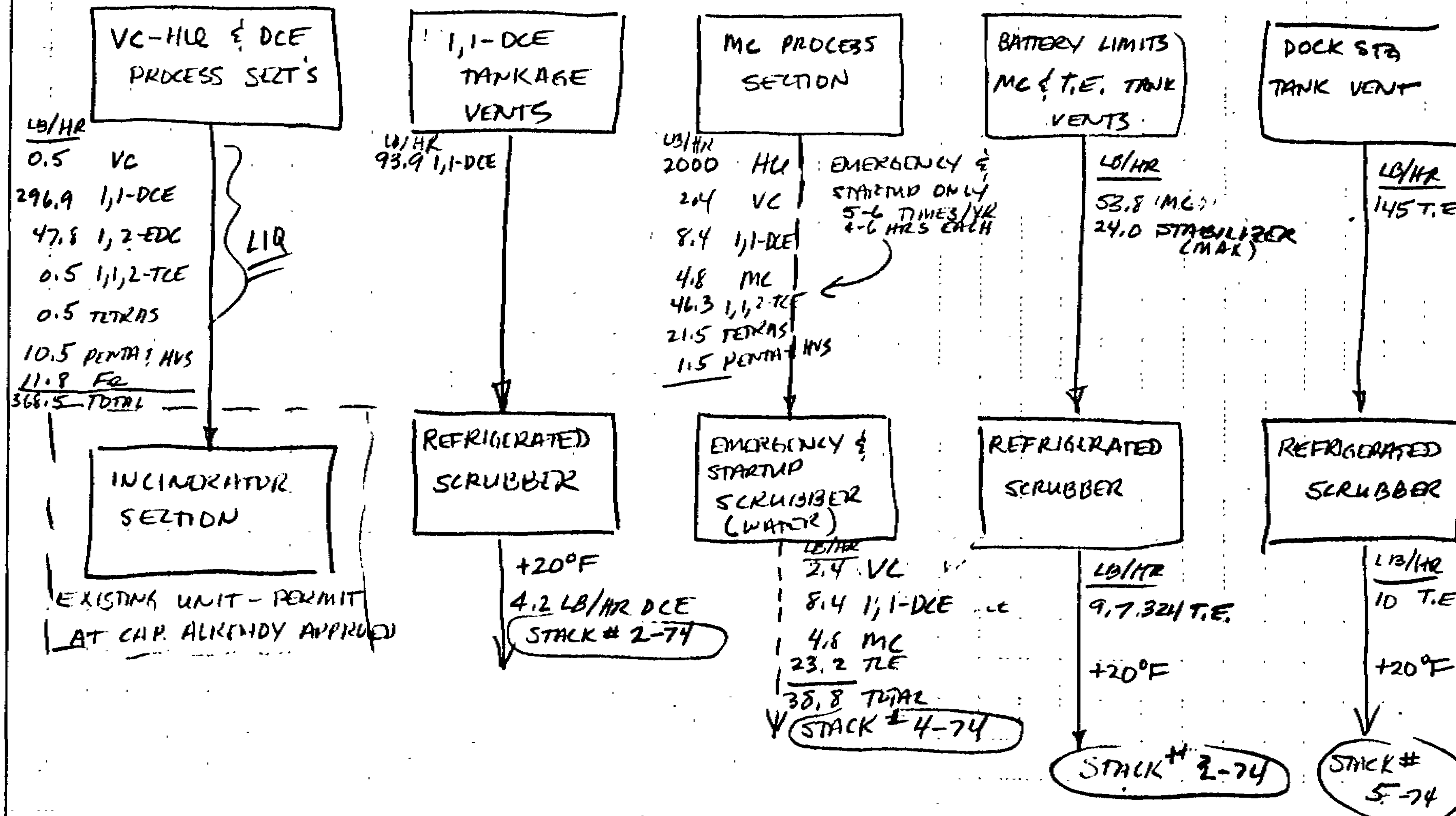


EXHIBIT III 450 TPD TRI-ETHANE PLANT

SCHEMATIC DIAGRAM SHOWING SOURCES AND DISPOSITION OF AIR CONTAMINANTS AT PEAK CONDITIONS

EBL 5/3/74

Job No. SL 049413

INDUSTRIES

ENGINEERING DEPARTMENT

EGL 5/3/74

STORAGE TANK VENT SUMMARY (IF REFRIG. VENT SCRUBBERS USED

#1 = DCE SCRUBBER
#2 = STABILIZER & MC SCRUBBER

TANK DESCRIPTION	VENT SCRUBBER	FILL FREQUENCY	EFFLUENT LB/FILL* OR LB/HR	MAT'L DISCHARGED
TOLUENE STG	NONE (EXEMPT)	1/5 DAYS	6.5 LB/FILL	
BTE (METHYL ETHYL KEYTONE)	~~#2~~ 3-74	1/FOUR DAYS	6.4 LB/FILL 1.33 HRS	324 T.E.
~~NRE (NITROMETHANE)**~~	~~#2~~	~~1/DAY~~	~~6.5 LB/FILL~~	~~"~~
DOL-IBL MIX (DIOXOLANE ISOBUTANOL)	~~#2~~ 3-74	1/2 DAYS	6.6 LB/FILL	"
BLM (BUTYLENE OXIDE)	~~#2~~ 3-74	1/8 DAYS	4.9 LB/FILL	"
DCE STG	#2-74 ~~#1~~	CONTINUOUS	4.22 LB/HR	DCE
MC STABILIZING TANKS	3-74 ~~#2~~	CONTINUOUS	4.07 LB/HR	324 T.E
DAY TANKS	3-74 ~~#2~~	"	0 (EQUALLIZED TO STAB TANKS)	0
DOCK TANK	5-74 #3	1/DAY	45 LB/FILL (4.5 HRS)	324 T.E

VENT FROM SCRUBBER #1 - 4.22 LB/HR DCE

VENT FROM SCRUBBER #2 - ASSUME ONLY 1 STABILIZER SHIPMENT BEING UNLOADED AT A TIME

SO PEAK LOAD = 5.0 LB/HR 324 T.E FR. STABILIZER
4.7 LB/HR STAB + KS
9.7 LB/HR 324 T.E.

VENT FROM SCRUBBER #3 - PEAK LOAD IS 10 LB/HR

* ON STABILIZER STORAGE, A 4000 GAL FILL LASTS 1.33 HRS (50 GPM UNLOADING RATE)

** NOT VENTED AT ALL - TRUCK & TANK EQUALLIZED

RE:

Job No. SL 049414

STORAGE TANK VENT SUMMARY (IF NO VENT RECOVERY ON MC TANKAGE)

TANK DESCRIPTION	VENT SCRUBBER	FILL FREQ.	EFFLUENT LB/FILL* OR LB/HR	MAT'L DISCHG'D
TOLUENE STG	NONE	1/5 DAYS	6.5 LB/FILL	1.33 HR FILL
BTE	#2	1/4 DAYS	6.4 LB/FILL	324 T.E.
~~NRE**~~	~~#2~~	~~1/DAY~~	~~6.5 LB/FILL~~	"
DOL-IBL	#2	1/2 DAYS	6.6 LB/FILL	"
BLM	#2	1/8 DAYS	4.9 LB/FILL	"
DCE STG	#1	"CONT."	4.22 LB/HR	DCE
MC STABILIZING TKS	NONE	"CONT."	53.8 LB/HR	324 T.E.
DAY TANKS	NONE	"CONT."	EQUALIZED TO STAB.	—
DOCK TANK	NONE	1/DAY	656 LB/FILL	324 T.E

SCRUBBER #1 — 4.22 LB/HR DCE

SCRUBBER #2 — ASSUME 1 STABILIZER BEING UNLOADED AT A TIME
PEAK LOAD = 5 LB/HR

MC STAB TANKS — 53.8 LB/HR CONTINUOUS

DOCK TANK — 145.8 LB/HR FOR 4.5 HRS EACH DAY

* ON STABILIZER STORAGE, A 4000 GAL FILL LASTS 1.33 HRS @ 50 GPM
** NRE NOT VENTED AT ALL — TRUCK & TANK EQUALIZED

RE: ______________________

Job No. SL 049415

PPG INDUSTRIES

ENGINEERING DEPARTMENT

EGL 5/3/74 5

TO INCINERATOR

	VC BOTTOMS	DCE EOPP BOTTOMS	TOTAL
VC	–	0.5	0.5
1,1-DCE	–	296.9	296.9
1,2-EDC	47.3	0.5	47.8
1,1,2-TCE	–	0.5	0.5
U-TETRA	–	0.3	0.3
S-TETRA	–	0.2	0.2
PENTA + HVS	5.2	5.3	10.5
Fe (SOLID)	–	34.4	34.4
	52.5	338.6	391.1

356.7 ORGANICS
11.8 Fe

(FROM WATER CALC'S)

TO VENT SCRUBBER AT 10% PLANT CAPACITY (5-10 TIMES/YR FOR 4-6 HRS

	LB/HR
HCl	~~2000~~ 1814
~~VC~~	
1,1-DCE	~~8.4~~ 7.4 SAY ALL ORGANICS IN VENT
MC	~~4.1~~ 3.7 EXCEPT TETRAS, PENTA & HEAVIES, HCl
1,1,2-TCE	~~[illegible]~~ 46.6 HALF OF TCE
TETRAS	~~[illegible]~~ 17.7
~~[illegible]~~	

OUT VENT = ~~[illegible]~~

7.4 ~~8.4~~ 1,1-DCE
3.7 ~~4.5~~ MC
23.3 ~~[illegible]~~ TCE

RE:

Job No. SL 049416

FORM CS-4 REV. 10/1/54

PPG INDUSTRIES

EBL 5/3/74 6

ENGINEERING DEPARTMENT

CALCULATION OF SCFH TO & FROM SCRUBBERS

(SCFH = STD FT^3/HR AT 70°F, 14.7 PSIA)

DCE TANK VENTS – SCRUBBER STACK #2-74

TO SCRUBBER $\left(553.9\ SCFH_{32°F}\right)\left(\frac{530}{492}\right) = \underline{596\ SCFH_{70°F}}$

FROM SCRUBBER $(213.2 + 15.3)(1.08) = \underline{246.1\ SCFH_{70°F}}$

0.068 SCF/sec

MC STABILIZING TANKS – TO SCRUBBER STACK #3-74

TO SCRUBBER $(415\ SCFH_{32°F})(1.08) = \underline{448\ SCFH_{70°F}}$

FROM SCRUBBER $(269.7 + 10.9)(1.08) = \underline{303\ SCFH_{70°F}}$

0.084 SCF/sec

ALL STABILIZER STB TANKS (ONE AT A TIME – TREAT AS 1 SOURCE)

TO SCRUBBER (1 LB MOL/HR)(387 FT^3/MOL) = $\underline{387\ SCFH_{70°F}}$

FROM SCRUBBER – USE BTE (WORST CASE)

$\left(\frac{0.667\ MOLES/HR\ N_2}{0.96\ MOL\ FR\ N_2}\right)(387\ FT^3/MOL) = 269\ SCFH_{70°F}$

0.074 SCF/sec

STARTUP SCRUBBER

N_2 CONCENTRATION UNKNOWN – USE 10:1 RATIO HCl : N_2 (VOL) SCRUBBER AS N_2 FOR CALC. PURPOSES

$\left(\frac{2000\ LB/HR\ HCl}{36.465}\right) = 54.8$ LB MOLES HCl ∴ 5.5 MOLES N_2

~SCFH TO SCRUBBER ≅ (60 LB MOLS)(387 FT^3/MOL) = 23,220

N_2 plus organics

~ SCFH FROM SCRUBBER ≅ ($\cancel{5.5}$ 5.8)(387) = ~~2129~~ 2245 $SCFH_{70°F}$

0.62 SCF/sec

DOCK TANK SCRUBBER

FROM SCRUBBER $\left(\frac{1.99\ MOLES/HR\ N_2}{0.96\ FR\ N_2}\right)$ 387 FT^3/MOL = 802 $SCFH_{70°}$

0.22 SCF/sec

RE:

Job No. SL 049417

FLOWS TO B/L MC & TE SCRUBBER

MC STABILIZING TANKS – 53.8 LB/HR MC
1.15 LB MOLES/HR

ONLY 1 AT A TIME FROM STABILIZER STG

TOLUENE – 4.9 LB/HR TOLUENE
1 LB MOL/HR FROM TANK } NOT TO SCRUBBER

BTE – (1 LB MOL/HR)(0.133 FR BTE)(72.1 MW) = 9.6 LB/HR

NRE – ~~(1 LB MOL/HR)(0.0726 FR MC)(133.4) =~~
~~(")(0.0524 FR NRE) (61) =~~ NOT VENTED

DOL-IBL – (1 LB MOL/HR)(0.1)(74.1) = 7.41 LB/HR DOL
(0.011)(74.1) = 0.7 LB/HR IBL

BLM (1 LB MOL/HR)(0.333)(72.1) = 24.0 LB/HR BLM ← MAX
1 LB MOL/HR FROM TANKS

MC DAY TANKS – EQUALIZED TO STABILIZING TANKS

∴ PEAK FLOW TO B/L MC & TE SCRUBBER

53.8 LB/HR MC (STABILIZING TANKS)
24.0 LB/HR BLM (MAX FLOW FROM STAB. STG VENT)
77.8 LB/HR TOT

RE: ____________________

Job No. SL 049418

ENGINEERING DEPARTMENT

EMISSION SOURCES – VAPORS

1. TANK VENT SCRUBBERS (CONT)

(c) DAY TANKS

STABILIZED MC WILL BE TRANSFERRED TO DAY TANKS FROM STABILIZER TANKS. THESE WILL BE CONNECTED TO THE MC/STABILIZER VENT SCRUBBER AS ARE THE STABILIZER TANKS. THEREFORE THERE WILL BE EQUALLIZATION BETWEEN AND NO NET EFFLUENT TO ATMOSPHERE.

(d) NRE (NITROMETHANE STABILIZER TANK)

FREQUENCY OF FILLING –

C. Muery (3488 gal/d) – 50-50 MC shipment

(450 TPD)(2%) = (9 TPD)(2000 LB/T)(GAL/9.48 LB) – 1898 GAL/D × 2 = 3796

100°
90°

IF 4000 gal SHIPMENTS – ABOUT 1 SHIPMENT/DAY AT CAP.

50-50

(e) DOL-IBL STG TANK (DIOXOLANE – ISOBUTANOL)

C. Muery 1879 gal/day

(450 TPD)(1.9%) – (8.55 TPD)(2000 LB/T)(GAL/8.04 AVG LB) = 2127 G

1 SHIPMENT OF 4000 GAL EVERY TWO DAYS

(f) BLM (BUTYLENE OXIDE)

C. Muery 453 gal/d.

(450)(0.35%) = (1.58 TPD)(2000)(GAL/6.87 LB) = 460 GAL/D

1 SHIPMENT OF 4000 GAL EVERY 8 DAYS

RE: EGL / 4/29/74

FORM. CS-4 REV. 10/1/54

EGL 5/3/74

PPG INDUSTRIES

ENGINEERING DEPARTMENT

EMISSION SOURCES

(1.) TANK VENT SCRUBBERS (CONT)

(g) TLE STORAGE (TOLUENE)

C. Maury (843 gal/d)

(450) (0.6%) = (2.7 TPD)(2000)(GAL / 7.21 LB) = 749 gal/D

1 - 4000 GAL SHIPMENT EVERY 5 DAYS

(h) BTE STORAGE (METHYL ETHYL KEYTONE)

C. Maury 844 gal/d

(450)(0.8%) = (3.6 TPD)(2000)(GAL / 6.71 LB) = 1073 gal/D

1 - 4000 GAL SHIPMENT EVERY 4 DAYS

i.)

RE: EGL

SL 049420

FORM CS-4 REV. 10/1/54

PPG INDUSTRIES

EGL 5/3/74

ENGINEERING DEPARTMENT

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

Phys Properties - Vapor pressure of Stabilizers - G. Bedenbaugh Phone 5/1/7

VP. 20°C 27.8 mm } NRE ✓
101.2°C 760 mm

20°C 79 mm } DOL
75.6°C 760 mm

} NPL Normal propanol
41% wt in mix

60 10 psia
25 4.0 psia } BLM
0 1.4 psia
62-64.5°C 760 mm

~~TLE~~

20°C 70.6 mm } BTE ✓
79.6°C 760.

100°F 1.0 psia } TLE ✓
110.4°C 231.9°F dry point

RE:

Job No. SL 049421

FORM. CS-4 REV. 10/1/54

PPG INDUSTRIES

EGL 5/3/74

ENGINEERING DEPARTMENT

AIR CONTROL CALCULATIONS

EMISSION SOURCES

(1.) TANK VENT SCRUBBERS

(a.) DCE STG TANKS

80 GPM FLOW TO TANK DISPLACES THIS MUCH N_2 SAT'D WITH DCE VAPOR AT 110°F

9.226 PSI VAP PRESS IN TANK

MC FREEZING PT
- -31°C
- -32.2°C
- -32.7
- -32.96

$\left(\frac{9.226}{15}\right) = 61.6\%$ DCE TO VENT SCRUBBER

$\left(80\,GPM\right)\left(\frac{60\,MIN}{HR}\right)\left(\frac{FT^3}{7.48\,GAL}\right)\left(\frac{492}{570}\right) = 553.9\,SCFH$

$(0.615)(554) = 340.6\,SCFH\ DCE / 359\ (98.96) = 93$

$213.2\,SCFH\ N_2 / 359 = 0.59$ MOL

DCE FREEZING PT
- -97.4°C
- -96.5

IN SCRUBBER, N_2 COOLS TO 20°F

$\frac{(6.7\times10^{4})(98.96)}{22.4} =$ VOL % DCE AT THIS TEMP $= \frac{1\,PSI}{15} = \underline{6.7\%}$

$\mu g / m^3 =$

$(213.2\,SCFH)\frac{(0.067\ PARTS\ DCE)}{(0.933\ PARTS\ N_2)} = 15.3\,SCFH$ 1,1-DC

$(15.3)\left(\frac{98.97\,LB}{359\,SCF}\right) = \underline{4.22\,LB/HR\ DCE}$

$(213.2\,SCFH\,N_2)\left(\frac{28}{359}\right) = \underline{16.6\,LB/HR\ N_2}$

(b) MC STABILIZING TANKS –

$(60\,GPM\ FLOW)\left(\frac{FT^3}{7.48\,GAL}\right)(60)\left(\frac{492}{570}\right) = 415\,SCFH_{32°F}$

IF NO VENT SCRUBBER, $FLOW = \frac{(415\,SCFH)(0.35)(133)}{(359)} = 53.8\,LB/HR$

AT 110°F V.P. MC = 5.32 PSIA ; VOL % MC $= \frac{5.32}{15} = 35\%$

IN SCRUBBER N_2 COOLS TO 20°F VOL % MC $= \frac{0.58}{15} = 3.$

$(415\,SCFH)(0.35) = 145\,SCFH\ MC$ & $269.7\,SCFH\ N_2$

1.16 LB MOLS/HR

$(269.7\,SCFH\,N_2)\frac{(0.039\ PARTS\ MC)}{(0.961\ PARTS\ N_2)} = 10.9\,SCFH\ MC$

$(10.9)\frac{(133.4)}{(359)} = \underline{4.07\,LB/HR\ MC}$

$(269.7\,SCFH\,N_2)\frac{28}{359} = \underline{21.0\,LB/HR\ N_2}$

RE: EGL

Job No. SL 049422

MC DOCK TANK

(160 GPM FILL RATE) $\left(\frac{60}{7.48}\right)$ = 1283 FT^3/HR

AT 110°F VP. MC = 5.32 PSIA

VOL % N_2 = $\frac{15 - 5.32}{15}$ = 64.5%

ACT $\frac{FT^3}{MOL}$ AT 110°F = (359) $\left(\frac{570}{492}\right)$ = 416 FT^3/MOL

$\left(1283 \frac{FT^3}{HR}\right)\left(\frac{LB\ MOL}{416\ FT^3}\right)$ = 3.08 LB MOLES VAP/HR

(3.08)(0.645) = 1.99 LB MOLES N_2/HR

AT 20°F, VP. MC = 0.583 PSIA

(1.99) $\left(\frac{0.583}{14.417}\right)$ (133.4) = 10 LB/HR MC OUT SCRUBBER

SAY HALF OF SHIPMENTS GO TO DOCK STG

(60 GPM PRODUCTION RATE)(50% TO DOCK) = 30 GPM AVG

DAILY RATE = (30 GPM)(24)(60) = 43,200 GAL

@ 160 GPM THIS IS

$\frac{43,000}{160}$ = 268 MIN = 4.5 HRS OF TRANSFER

(10 LB/HR)(4.5) = 45 LB/D MC

IF NO REFRIG. SCRUBBER USED

(3.08 LB MOLES VAP/HR)(0.355)(133.4) = 145.8 LB/HR MC

(4.5 HRS)(145.8) = 656 LB/DAY

RE:

FORM CS-4 REV. 10/1/54

PPG INDUSTRIES

EDL 5/3/74 1:

ENGINEERING DEPARTMENT

* NITROMETHANE (NRE) 50 GPM FILL FOR 1.33 HRS ONCE PER D

50-50 WT MIXTURE OF MC & NRE

68°F 0.54 PSIA V.P } PLOT ON FOUST, P. 550
214.2°F 14.7 } & DRAW LINE

V.P MIX

MW MC = 133.4 AT 90°F VP = 1 PSIA – NRE × .787 = 0.79

3.48 PSIA MC × .313 = 1.09

1.88

MW NRE = 61 LIQ COMPOSITION IN TANK

$$\text{MOL FR MC} = \left[\frac{\frac{0.5}{133.4}}{\frac{0.5}{133.4} + \frac{0.5}{61}}\right] = 0.313 \text{ MOL FR MC} \times 3.48$$

0.787 MOL FR NRE

VAPOR COMPOSITION IN TANK AT 90°F

$$\frac{(0.313)(3.48)}{15} + \frac{(0.787)(1)}{15}$$

AT 85°F VP = 0.85 NRE × .787 = .67
MC = 3.00 × .313 = .94
1.6

7.26 MOL % MC
5.24 MOL % NRE
87.50 MOL % N_2

1 LB MOL/HR EFFLUENT DURING FILLING (SEE PRIOR CALC

(1)(0.875) 0.875 LB MOLES N_2 TO VENT SCRUBB.

AT 20°F VP MC IN SCRUBBER = 0.585 PSIA

MOL % N_2 = 96% (SEE PRIOR CALC)

$$\text{LB/HR MC} = (0.875)\left(\frac{4}{96}\right)(133.4) =$$ 4.86 LB/HR MC FOR 1.33 HRS ONCE PER DAY

× 1.33 = 6.5

* NOT VENTED AT ALL — EQUALIZE BACK TO TRUCK – KEEP TANK AT 15 PSIG PRESSURE

RE:

SL 049424

FORM CS-4 REV. 10/1/54

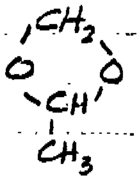
EBL 5/3/74

ENGINEERING DEPARTMENT

DIOXOLANE-ISOBUTANOL MIXTURE (DOL-IBL)

DOL 57.5 : 42.5 WT RATIO - SINCE MW'S ARE =

MW = 74.1 THIS IS ALSO MOLAR RATIO



68°F VP = 79 mm = 1.53 PSIA
168°F VP = 14.7 PSIA } DRAW LINE ON FOUST, P. 550

AT 90°F, V.P. = 2.6 PSIA

IBL, MW = 74.1

$C_4H_{10}O$ 15.8°F VP. = 0.02 PSIA

90.3°F VP = 0.39 PSIA

VAPOR COMPOSITION IN TANK AT 90°F

$\frac{(0.575)(2.6)}{15} = 10\%$ DOL

$\frac{(0.425)(0.39)}{15} = 1.1\%$ IBL

$100 - 10 - 1.1 = 88.9\%\ N_2$

AT 85°F DOL VP = 2.3 (0.57) = 1.3 PSI PART P.

AT 85° IBL VP = (0.38)(0.42) = 0.1 PSI PART P.

TOT = 1.4 PSI

1 LB MOL/HR EFFLUENT DURING FILLING (SEE PRIOR CALC'S) AT 20°C FROM VENT SCRUBBER

$(0.889 \text{ LB MOLES } N_2/\text{HR})\left(\frac{4 \text{ MOLES MC}}{96 \text{ MOLES } N_2}\right)(133.4) = 4.94 \text{ LB}/$

$(1.33)(4.94) = \boxed{6.57 \text{ LB MC EVERY TWO DAYS}}$

$(.575)(2.6) + (.425)(.39) = .09$

1.49
.16

RE:

FORM. CS-4 REV. 10/1/54

PPG INDUSTRIES

EGL 5/3/74

ENGINEERING DEPARTMENT

<u>BUTYLENE OXIDE (BLM)</u> 50 GPM UNLOADING FOR 1.33 HRS EVERY 8 DAYS

25°C (77°F) 4 PSIA V.P
60°C (140°F) 10 PSIA V.P. } PLOT ON P. 550 FOUST

5 PSIA V.P @ 90°F

VAPOR COMPOSITION TO SCRUBBER

$= \left(\frac{5}{15}\right) =$ 0.333 MOL FR BLM
0.667 MOL FR N_2

$CH_3\,CH_2-\overset{O}{CH}-CH_2$ (O bridging CH and CH_2)
MW = 72.1

1 LB MOL/HR TO SCRUBBER (SEE CALCS PRIOR)

$(1)(0.667 \text{ MOL FR } N_2) = 0.667 \text{ MOLES/HR } N_2$

AT 20°F EXITING SCRUBBER

$MC = (0.667 \text{ MOLES/HR } N_2)\left(\frac{4 \text{ MOLES MC}}{96 \text{ MOLES } N_2}\right)(133.4) = 3.71 \text{ LB/}$

$(1.33 \text{ HRS})(3.71) = \boxed{4.9 \text{ LB}^{MC} \text{ EVERY 8 DAYS}}$

RE:

SL 049426

Job No.

FORM CS-4 REV. 10-1/54

IPC INDUSTRIES

ENGINEERING DEPARTMENT

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

TOLUENE STORAGE TANK (TTG) 1 - EVERY 5 DAYS

50 GPM UNLOADING PUMP. - SO 4000 GAL IS OVER A 1.33 HR PERIOD

MW = 92.1

AT 90°F, V.P. = 0.8 PSIA (FOUST, P. 550)
THIS IS LESS THAN 1.5 PSIA & ∴ DOES NOT QUALIFY AS A VOLATILE ORGANIC COMPOUND -
~~#~~ NO VENT RECOVERY REQUIRED!

$\left(\frac{0.8}{15}\right)\left(\frac{50\,GPM}{7.48}\right)\left(\frac{92.1\,LB}{401\,FT^3}\right) 60 = (4.9\,LB/HR)\,1.33 = 6.53\,LB/FILL$

BTE (METHYL ETHYL KETONE) - FILL AT 50 GPM FOR 1.33 HRS ONC EVERY 4 DAYS

VP 68°F = 70.6 mm (1.36 PSIA)
175°F = 760 mm (14.7 PSIA)
PLOT ON FOUST P. 550 & DRAW STRAIGHT LINE

2 PSIA = 90°F

MUST HAVE TANK VENT RECOVERY

$ACT\ FT^3 @ 90°F = (359)\left(\frac{550}{492}\right) = 401\ FT^3\ ACT/MOL$

$\frac{2}{15} =$ 13.3 VOL% BTE IN TANK VENT

$CH_3-\overset{\overset{O}{\|}}{C}-CH_2-CH_3$

72.1

$(50\,GPM\ FILL\ RATE)\left(60\,\frac{MIN}{HR}\right)\left(\frac{FT^3}{7.48\,GAL}\right)\left(\frac{LB\ MOL}{401\,FT^3}\right) =$

1 LB MOL / HR LEAVING TANK

100 - 13.3 = 86.7% VOL N_2 IN TANK VOID SPACE
∴ 0.867 $\frac{LB\ MOLES}{HR}$ N_2 OUT TO VENT SCRUBBER

SINCE MC IS MAJOR COMPONENT IN SCRUBBER
AT 20°F, V.P MC = 0.583 PSIA
$MOL\ \%\ N_2 = \frac{15 - 0.583}{15} = 96\%$

$LB/HR\ MC = (0.867)\left(\frac{4}{96}\right)(133.4\ MW) = 4.8\ LB/HR$

$(4.8)(1.33\,HR) =$ 6.4 LB EVERY 4 DAYS

RE:

Job No. SL 049427

ENGINEERING DEPARTMENT

Job No. SL 049428

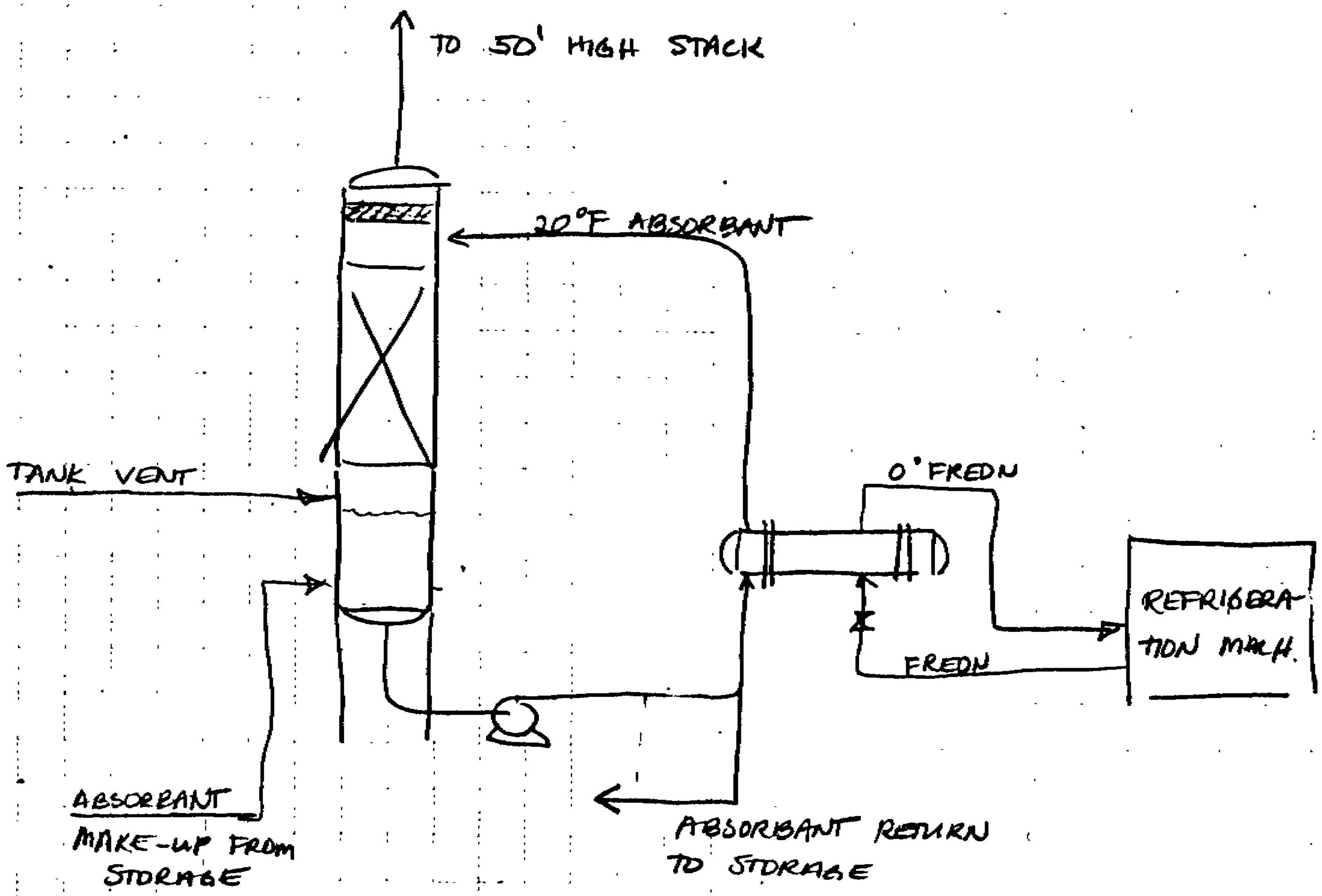


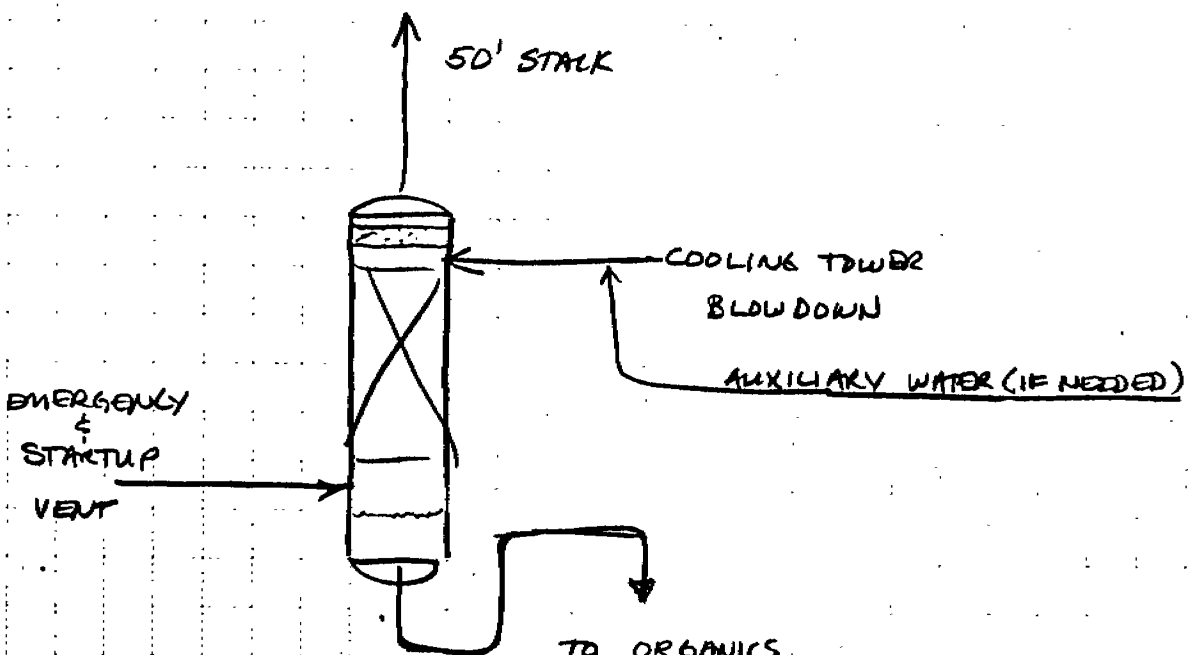
EXHIBIT IV
TYPICAL REFRIGERATED ABSORBER FOR SCRUBBING STORAGE TANK VENTS (APPLIES TO STACKS 2-74, 3-74, AND 5-74)

RE:

FORM CS-4 REV. 10/1/54

ENGINEERING DEPARTMENT

Job No. SL 049429



TO ORGANICS TREATMENT PLANT (TO BE IN OPERATION 1/1/77) AND NEUTRALIZATION

PRIOR TO 1/1/77 IT WILL GO TO NEUTRALIZATION ONLY

EXHIBIT V - 450 TPD TRI-ETHANE PLANT
WATER SCRUBBER FOR HCL RECOVERY
(EMERGENCY AND STARTUP USE ONLY)

RE:

FORM CS-4 REV. 10/1/54

RE:

FORM CS-4 REV. 10/1/54

PPG INDUSTRIES
ENGINEERING DEPARTMENT

TRI-ETHANE II – DATA FOR STACK CALCULATIONS – W/ T.E. VENT RECOVERY

	2-74 DCE SCRUBBER STACK	3-74 B/L MC & STAB SCRUBBER STACK	5-74 DOCK STB SCRUBBER STACK	4-74 STARTUP & EMERG. SCRUBBER STACK
STACK HEIGHT	25' 50	25' 50	25' 50	50'
DIST FROM PROP LINE	143' (N)	193' (N)	540' (NE)	272' (NORTH)
STACK DIA.	2" A = .0233 ft²	2"	2"	6" A = 0.2006 ft²
DCE (LB/HR)	4.2	–	–	7.2 } 5-10 TIMES/YR FOR 4-6 HRS
MC OR TRI-ETH. (")	–	9.7	10	3.5
TCE	–	–	–	22.7
SCFH (70°F)	246.1	572	802	2245
STACK VELOC. (FPS)	165/60 = 2.75 FPS	400/60 = 6.7	560/60 = 9.3	3.1
GAS TEMP	20°F	20°F	120°F	120°F
AMB. TEMP	77°F			
ATM PRESS	29.92 "Hg			
VC	62.501			
DCE MW	99.96			
MC OR TRI-ETH MW	133			
TCE	133			
Process Conditions: CFM (120°)				41.0
CFH (120°F)				2457
VEL (120°F) (FPS)				3.40
CFH (20°F)	[illegible]	518	726	
VEL (20°F) (FPS)	[illegible].66	6.18	8.66	
CFM (20°F)	3.72	8.63	12.1	

Job No. SL 049430

ENGINEERING DEPARTMENT

2-74 STACK DIA SIZING (DCE SCRUBBER STACK) - CRANE p. 3-17

$246.1\ SCFH_{70°F}$ /

< 0.05 PSI/100'

AVG MW = (.93)(28) + (0.07)(98) = 33.

$\left(242.1\ SCFH_{70°F}\right)\left(\frac{480°R}{492°R}\right) = 240\ ACFH$

$\left(\frac{246.1\ SCFH_{70}}{387\ FT^3/MOL}\right) 33\ AVG\ MW = 21\ \underline{LB}/HR = W$

$\bar{V} = \frac{240\ ACFH}{.21\ LB} = 11\ CF/LB$ —

$V = \frac{3.06\ W\bar{V}}{d^2}$ $\mu = .02$

d 2"

d^2 4.27

d^5 37.22

V = 165

$R_e = 6.31\ W/d\mu = 3312,\ f = .018$

$\Delta P_{100} = \frac{0.000336\ f\ W^2 \bar{V}}{d^5} = 0.00017\ PSI$ — OK —

RE:

SL 049431

Job No.

ENGINEERING DEPARTMENT

3-74 BATTERY LIMITS MC & STABILIZER SCRUBBER STACK*

572 $SCFH_{70°F}$

$$\text{AVG MW} = (28)(.96) + (133)(0.04) = 32$$

$$\text{ACFH} = (572)\left(\frac{480}{492}\right) = 558 \text{ ACFH}$$

$$\frac{(572\ SCFH_{70°F})(32\ MW)}{(387\ FT^3/MOL)} = 47\ LB/HR = W$$

$$\bar{V} = \frac{558\ ACFH}{47\ LB/HR} = 11.9\ FT^3/LB \qquad \mu = 0.02\ cp$$

$d = 2''$

$d^2 = 4.27$

$d^5 = 37.72$

$$V = \frac{3.06\, W\bar{V}}{d^2} = 400$$

$$R_e = \frac{6.31\, W}{d\mu} = 7414, \quad f = 0.019$$

$$\Delta P_{100} = 0.000336\,\frac{f\, W^2 \bar{V}}{d^5} = 0.004\ PSI - OK$$

*ASSUMES T.E. VENT RECOVERY AT 20°F

RE:

SL 049432

FORM CS-4 REV. 10/1/54

PPG INDUSTRIES

ENGINEERING DEPARTMENT

4-74 EMERGENCY & STARTUP SCRUBBER

SIZE FOR CAPACITY OPERATION
USUALLY 1/10 OF THIS RATE 2
23,220 SCFH$_{70}$ TO SCRUBBER MAX IF NO HCl
SAY 100% N_2 AT 200°F MAX

TRY 8" STACK
$d = 8.125$
$d^2 = 66.02$
$d^5 = 35,409$

$$W_{MAX} = \left(\frac{23,220\ SCFH_{70}}{387\ FT^3/MOL}\right)(28) = 1680\ LB/HR$$

$$\bar{V} = \frac{(23,220\ SCFH_{70})}{(1680\ LB/HR)}\left(\frac{660}{530}\right) = 17.2 \qquad \mu = 0.02$$

$$V = \frac{3.06 W \bar{V}}{d^2} = \frac{(3.06)(1680)(17.2)}{(66.02)} = 1340\ FT/MIN$$

$$R_e = \frac{6.31 W}{d \mu} = \frac{(6.31)(1680)}{(8.125)(0.02)} = 65,235$$

$f \approx 0.014$

$$\Delta P_{100} = 0.000336 \frac{f W^2 \bar{V}}{d^5} = \underline{0.006} \quad OK$$

RE: ____________________

Job No. SL 049433

EGL 5/6/74

5-74 MC DOCK STORAGE VENT (IF NO VENT RECOVERY)

3.08 LB MOLES VAP/HR 35% MC

$SCFH_{70°F} = (3.08)(387 FT^3/MOL) = 1192 SCFH$

AVG MW = $(0.35)(133) + (0.65)(28) = 64.7$

$W = (3.08 \text{ LB MOLS/HR})(64.7) = 199.4$ LB/HR

STACK TEMP = 110°F MAX

$$\bar{V} = \frac{(3.08 \text{ LB MOLS/HR})(359 FT^3/MOL_{32°F})}{(199.4 \text{ LB/HR})}\left(\frac{560°R}{492°R}\right) = 6.31 FT^3/LB$$

$\mu = 0.02$?

$d = 3.06$

$d^2 = 9.41$

$d^5 = 271.8$

$$V = \frac{3.06 W\bar{V}}{d^2} = \frac{(3.06)(199.4)(6.31)}{(9.41)} = 409/60 = 6.8 FT$$

$$Re = \frac{(6.31)(199.4)}{(3.06)(0.02)} = 20,560$$

$f = 0.018$

$$\Delta P_{100} = \frac{0.000336 f W^2 \bar{V}}{d^5} = \frac{(0.000336)(0.018)(199.4)^2(6.31)}{(271.8)} = 0.005$$

OK

RE:

SL 049434

Job No.

FORM CS-4 REV. 10/1/54

ENGINEERING DEPARTMENT

RE:

TRI-ETHANE II - DATA FOR STACK CALCULATIONS W/O TE T.E. VENT RECOVERY

	2-74 DCE SCRUBBER STACK	3-74 B/L MC & STAB SCRUBBER STACK	5-74 DOCK STG SCRUBBER STACK	4-74 STARTUPS & EMERG SCRUBBER STACK
STACK HT. FT	25	25'	25'	50'
DIST. FR PROP.	143	193	540	272
STACK D/A	2"	2"	3"	8"
VC	SAME AS W/ T.E. VENT REC.	-		SAME AS W/ T.E. VENT. REC.
DCE		-		
MC OR T.E.		53.8 LB/HR	145.8 LB/HR	
TCE		-		
SCFH (70°F)		717	1192	
STACK VELOCITY (FPS)		8.6	6.8	
GAS TEMP		74°F	110°F	

AMB TEMP = 77°F

AMB PRESS = 29.92" Hg

MOL. WT

VC	62.5
DCE	98.97
MC	133.4
TCE	133.4

Job No. SL 049435

PPG INDUSTRIES

ENGINEERING DEPARTMENT

EBL 5/6/74

3-74 BATTERY LIMITS MC & STABILIZER STACK *

$SCFH_{70}$ = 448 FROM MC TKS 35% VOL MC = 145

= 269 FROM STAB. STR. 4% VOL MC 10

OVERALL = 155 SCFH MC / $\underbrace{448 + 269}_{717}$ = 21.9%

$$AVG\ MW = (0.781)(28) + (0.219)(133.4) = 51$$

$$W = \left(\frac{717\ SCFH_{70°}}{387\ FT^3/MOL}\right)(51) = 94.6\ LB/HR$$

$$AVG\ STACK\ TEMP \cong \frac{(448)(110°F) + (269)(20°F)}{717} = 76°F$$

$$\bar{V} = \left(\frac{717\ SCFH_{70°F}}{94.6\ LB/HR}\right)\left(\frac{536°R}{530°R}\right) = 7.66\ FT^3/LB$$

$\mu \cong 0.02$

$d = 2''$

$d^2 = 4.27$

$d^5 = 37.72$

$$V = \frac{3.06\ W\bar{V}}{d^2} = \frac{(3.06)(94.6)(7.66)}{(4.27)} = 519\ FPM = \underline{\underline{8.65\ F}}$$

$$R_e = \frac{6.31\ W}{d\mu} = \frac{(6.31)(94.6)}{(2)(0.02)} = 14923$$

$f = 0.019$

$$\Delta P_{100} = \frac{0.000336\ f\ W^2\bar{V}}{d^5} = \frac{(0.000336)(0.019)(94.6)^2(7.66)}{(37.72)} = \underline{0.011}$$

OK

* ASSUMES 110°F STORAGE ON MC - NO VENT RECOVERY

RE:

Job No. SL 049436

FORM CS-4 REV. 10/1/54

PPG INDUSTRIES

ENGINEERING DEPARTMENT

5-74 DOCK STORAGE TANK VENT SCRUBBER STACK*

$802\ SCFH_{70°}$

AVG MW = SAME AS 2-74 = 32

$$ACFH = (802)\left(\frac{480}{492}\right) = 782$$

$$W = \left(\frac{802\ SCFH_{70°F}}{387\ FT^3/MOL}\right)(32) = 66.3\ LB/HR$$

$$\bar{V} = \frac{782\ ACFH}{66.3\ LB/HR} = 11.8 \qquad \mu = 0.02$$

$d = 2''$

$d^2 = 4.27$

$d^5 = 37.72$

$$V = \frac{3.06\ W\bar{V}}{d^2} = 560\ FT/SEC$$

$$R_e = \frac{6.31\ W}{d\mu} = 10,458$$

$f = 0.019$

$$\Delta P_{101} = 0.000336\ \frac{f\ W^2 \bar{V}}{d^5} = 0.008\ \underline{\underline{OK}}$$

*ASSUMES T.E. VENT RECOVERY AT +20°F

RE: ____________________

SL 049437

Job No. __

FORM GS-4 REV-10/1/54

ENGINEERING DEPARTMENT

CALCULATIONS FOR CONCENTRATION OF POLLUTANT GASES IN DISCHARGE GAS

DCE STG TANKS – 6.7 VOL% DCE = 6.7×10^4 PPM

$$\frac{(6.7\times10^4)(98966\ mg\ MW)}{22.4} = 2.96\times10^8\ mg/m^3$$

MC STABILIZING TANKS & STABILIZER TANKS

3.9 VOL% = 3.9×10^4 PPM

$$\frac{(3.9\times10^4)(133400)}{22.4} = 2.3\times10^8$$

DOCK STG TANK VENT

VOL = 3.9% = 3.9×10^4 PPM

[illegible] Miller]
[illegible]

STARTUP SCRUBBER (TAKE OUT DCE SECT VENT)

6.5 MOLES/HR N_2 = 5.5 MOLES/HR

~~2.9/62.5 VC = 0.038 MOLES/HR~~

7.4 ~~8.4~~/98.97	DCE	~~0.085~~	0.075
3.7 ~~4.9~~/133	MC	~~0.036~~	0.028
23.3 ~~23.2~~/133	TCE	~~0.174~~	0.175
		~~5.83~~	5.78

~~VC VOL % = 0.038/5.9 = 0.66 % vol = 6.6x10^3 ppm vol = 1.5x10^7~~

DCE " = $\frac{.075\ \cancel{.085}}{5.8}$ = 1.3 ~~1.5~~ = 1.3 ~~1.5~~ $\times10^4$ ppm vol = 5.7 ~~[illegible]~~ $\times10^7$

MC " = $\frac{.028\ \cancel{0.036}}{5.8}$ = 0.48 ~~0.62~~ = 4.8 ~~[illegible]~~ $\times10^3$ ppm vol = 2.9 ~~[illegible]~~ $\times10^7$

TCE = $\frac{0.175\ \cancel{0.174}}{5.8}$ = 3.0 = 3.0×10^4 ppm vol = 1.8×10^8

[$mg/m^3 = mg\ MW/22.4 \times ppm\ vol$]

RE:

SL 049438

Job No.