APPENDIX A

Offsite Consequence Analysis Calculations

WORST-CASE SCENARIO FOR FLAMMABLE LIQUIDS
Polychemie Inc. - Los Angeles, CA
GESI Project No. 02512.01

Flammable Liquid	Maximum Quantity of Flammable Liquid Stored[1]	Maximum Quantity of Flammable Released[2] QS	Heat of Combustion DMA (kJ/kg)[3]	Heat of Combustion Water (kJ/kg)	Heat of Combustion Mixture[4] (kJ/kg)	Distance to Endpoint[5]
Dimethylamine, 60% density, lb/gal 6.50 Stored in pressure vessel	80,000 gallons 520,000 lbs, 60% 312,000 lbs, 100%	20,000 gallons 130,000 pounds 78,000 lbs, 100%	35,813	0	21,488	0.32 miles 1,671 feet

NOTES: - Calculations are based on U.S. EPA RMP Guidance for Offsite Consequence Analysis provided by the EPA dated April 15, 1999.

1 - Maximum Quantity Stored is based on two full storage tanks and two full railcars, each at 20,000 gallon capacity.

2 - Maximum quantity released is equal to the volume of the largest vessel.

3 - Heat of combustion of DMA from EPA RMP Guidance for OCA, Exhibit C-1.

4 - From equation C-3, estimate the heat of combustion (HC) of the mixture by adding the heats of combustions of the components:
= wt percent of DMA (60%) x DMA heat of combustion (35,813) + 0 (for water)

5 - From equation C-2, the distance to overpressure of 1 psi (assuming 10% participates in explosion, per guidance):

$$D_{mi} = 0.0081 \times [0.1 \times \text{wt of flammable sustance (lbs)} \times \text{heat of combustion of mixture (kg/kJ)} / 4680 \text{ kJ/kg}]^{1/3}$$

By: NSB 05/27/2004
Checked By: KSD 05/27/2004

GESI

CALCULATION SHEET

Calc. No. FS-1

Prepared By: Natasha Brash Date: 5/27/2004 Reviewed By: Karen Dorman Date: 5/27/2004

Section I. General Information

Project: Polychemie, Inc. - Los Angeles, CA
2004 RMP Update

Project No.: 02512.01

Subject: RMP Alternate Case, Flammable Substance Release - Dimethylamine

Section II. Scenario

A. 60% dimethylamine is released from ruptured unloading hose on a pressurized railcar during delivery. Release occurs outside of a containment area. Break occurs before pump (Option 1) or after pump (Option 2). Compare quantity released from both options and use larger amount in subsequent analysis. Response time is 5 minutes to stop flow.

Section III. Calculations

A. The OCA document (Ref. A) does not directly address releases for flammable liquids from a pressurized storage vessel. Therefore, the equation used for the alternate analysis for liquids in Appendix D of the OCA document will be used.

Option 1: Per OCA document, Equation D-13:

Discharge rate, m (kgs/sec) = $A_h C_d (\rho_l [2g\rho_l (H_L - H_h) + 2(P_c - P_a)])^{0.5}$

A_h = opening area (m^2) = assume hose = 3 in = 0.0762 m = 0.005 m^2

C_d = discharge coefficient (unitless) = 0.62 From ARCHIE memo (Ref. B)

g = gravitational constant = 9.8 m/s^2

ρ_l = liquid density (kg/m^3) = 1000 kg/m^3 x 0.7789 = 778.9 kg/m^3

P_c = storage pressure = 25 psig = 39.7 psia = 273,693 Pa (from the facility)

P_a = ambient pressure = 14.7 psia = 101,325 Pa

H_L = liquid height above bottom of container = assume top of railcar = 10 ft = 3.048 m

H_h = height of opening = 0 m (bottom loading)

m = 49.36 kg/sec = 2962 kg/min = 6,529 lbs/min (As a conservative estimate, this will be used as the evaporation rate)

Assume response time, t = 5 minutes

Quantity release, QS = QR_L (or m) x t = 32,645 pounds Eq 3-5 of OCA Guidance

B. Option 2: Approximate quantity released as amount being pumped.

Liquid being pumped at 75 gpm.
Use 75 gpm and increase by 1.25 to account for increase in inflow due to loss of head.

Flow = 75 gpm x 1.25 = 93.75 gpm

QR = 93.75 gpm x 5 min = 469 gals x 6.50 lb/gal = 3047 lbs

Section IV. Results

A. Evaluate Option 1 since quantity released before pump is greater.

Section V. References

A. Risk Management Program Guidance for Offsite Consequence Analysis. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, (EPA 550-B-99-009), 04/15/1999.

B. "Correction of Program Error - - New Version of MODCON.EXE" memo. Memo issued as an update to the ARCHIE model referenced in The Handbook of Chemical Hazard Analysis Procedures, Department of Transportation, the Federal Emergency Management Agency, and the Environmental Protection Agency, (http://hazmat.dot.gov/risk_tools.htm), 1989.

ALTERNATE CASE SCENARIO FOR FLAMMABLE LIQUIDS
Polychemie Inc. - Los Angeles, CA
GESI Project No. 02512.01

Flammable Liquid	Alternate Scenario[1]	Quantity Released[1] QS	LFL[2] (mg/L)	Release Rate (lb/min)	Reference Table To Use[3]	Reference Table	Distance to Endpoint[4]
Dimethylamine, 60% density, lb/gal 6.50 Stored in pressure vessel	Vapor Cloud Fire	32,645 lbs, 60%	52	6,529	- Dense - Urban	29	<0.1 miles Report 0.1

NOTES:
- Calculations are based on U.S. EPA RMP Guidance for Offsite Consequence Analysis provided by the EPA dated April 15, 1999.
1 - Alternate case scenario based on Section 10.1 of EPA RMP Guidance for OCA.
2 - LFL from EPA RMP Guidance for OCA, Exhibit C-2.
3 - Reference Table number from EPA RMP Guidance for OCA, Exhibit 6.
4 - Distance to endpoint is calculated using Reference Table.

Flammable Liquid	Alternate Scenario	Quantity Released[1] QS	Density Factor[2] DF	Area of Pool[3] A (ft^2)	Pool Fire Factor[4] PFF	Distance to Endpoint[5] (feet)	Distance to Endpoint[5] (miles)
Dimethylamine, 60% density, lb/gal 6.50 Stored in pressure vessel	Pool Fire	32,645 lbs, 60%	0.62	20,345	0.4607	66	0.012 <0.1 Report 0.1

NOTES:
- Calculations are based on U.S. EPA RMP Guidance for Offsite Consequence Analysis provided by the EPA dated April 15, 1999.
1 - Quantity Released is assumed to equal spill release amt. - see Calculation No. FS-1
2 - Density Factor of Liquid, DF = 1/ 0.033 * density of substance (lb/ft^3) = 1/ 0.033 * (6.50 lb/gal * 7.4805 gal/ft^3) [Eq. D-4]
3 - Area of Pool, A (ft2) = Quantity released, QS (lbs) * DF [Eq. 3-6]
4 - PFF values listed in Exhibit C-2 is for pure DMA. See attached calculations for PFF determination for 60% dimethylamine.
5 - Distance to endpoint, d (ft) = PFF * $A^{1/2}$ (ft2) [Eq. 10-1]

By: NSB 05/27/2004
Checked By: KSD 05/27/2004

WORST-CASE SCENARIO FOR TOXIC LIQUIDS
Polychemie Inc. - Los Angeles, CA
GESI Project No. 02512.01

Toxic Liquid	Maximum Quantity Released[1] QS	Area of Dike[4] A (ft^2)	Density Factor[2] of Liquid Df	Maximum Area of Pool[3] (ft^2)	Liquid Factor Ambient[2] LFA	Release Rate[5] QR (lb/min)	Duration of Release[6] t (min)	Maximum Duration of Release[7] (min)	Toxic Endpoint[2] (mg/l)	Release Rate/ Toxic Endpoint	Reference Table	Reference Table to Use	Distance to Endpoint[8] (miles)
Formaldehyde, 37% density, lb/gal: 9.18	17,100 gals 156,978 lbs, 37% 58,082 lbs, 100%	2819 (assumed similar to existing dike area)	0.44	69,070	0.0002	0.79	198,878	10	0.012	66	3	- Buoyant - Urban - 10 minute release	0.2
Maximum On-site[9]	*TANK (proposed)*												
223,992 lbs, 37%	***RELEASE***												
82,877 lbs, 100%													

NOTES:
1 - Calculations are based on U.S. EPA RMP Guidance for Offsite Consequence Analysis provided by the EPA dated April 15, 1999.
2 - Maximum quantity released is equal to the capacity of the largest vessel handling the liquid.
3 - Density Factor of Liquid, Liquid Factor Ambient, Toxic Endpoint are found in Exhibit B-3 of the EPA RMP Guidance for OCA.
4 - Maximum area of the liquid pool, A (ft^2) = Quantity Released,QS(lb) * Density Factor of the Liquid (Df) [Eq. 3-6]
5 - For area of pool, use the minimum of the dike area (less tank area) or the area calculated using the density factor (see Note 3).
6 - Mitigated Release Rate, QR = 1.4 * LFA * Area of the Pool or Dike (whichever is less). [Eq. 3-7]
7 - Duration of Release,t= Quantity Released,QS (lb) / Release Rate, QR (lb/min) [Eq. 3 5]
8 - Maximum Duration of the release is from the EPA RMP Guidance for OCA. The maximum duration for water solutions of toxic substances is 10 minutes. [Sect. 3.3]
9 - Distance to endpoint is calculated using Reference Table .
Maximum on-site based on 2 storage tanks.

By: NSB 05/27/2004
Checked: KSD 05/27/2004

GESI
2121 newmarket pkwy
suite 140
marietta, ga 30067
tel 770 690 9552
fax 770 690 9529

Project Name: Polychemie - LA, CA
Project Number: 0512
Subject: Formaldehyde Release Scenarios
Page: 1 By: NSB Checked: JESM
Of: 2 Date: 5/26/04 Date: 5.26.04
Revised NSB 6/3/04

(For)

Formaldehyde Worst-Case Scenario Analysis

→ Release from largest storage tank (predictive) analyzed using OCA Guidance. Containment area assumed similar to existing tank (2279 sq ft). See excel calcs.

→ Analyze other portions of process to determine if a greater release distance possible. Formaldehyde use in 1 process, FOR-DMA mixture. Since the reaction is at an elevated temperature, the ARCHIE model will be used for analysis.

- T = 110°F — 750 gal mix tank
- P = ambient — 920 sq ft containment area
- Record high temp for LA is 112°F. To be used for ambient temp and vessel in temp as per OCA guidance.
- Pure FOR is 19.2% of total mixture. See attached vapor pressure calcs for pressure @ 112°F for 19.2% FOR.

VP = 3.58721 mm Hg

- From OCA Guidance (April 1991)

Wind velocity = 3.4 mph, Stability = F
Toxic vapor limit = 0.012 mg/L = 12 mg/m³

→ Pool Area @ 1 cm depth

ft³ = 750 gal tank x 75% = 562.5 gal x 1 ft³ / 7.4805 gal = 75 ft³

ft² = 75 ft³ / 0.033 ft (1 cm)

ft² = 2279 sq ft

Since the area of the containment area (920 sq ft) is less than that of the pool released (2279 sq ft), the containment area will be used, per OCA Guidance.

GESI
2121 newmarket pkwy
suite 140
marietta, ga 30067
tel 770 690 9552
fax 770 690 9529

Project Name: Polychemie - LA, CA
Project Number: 02512
Subject: Formaldehyde Release Scenarios
Page: 2 By: DSR Checked: JSM
Of: 2 Date: 5/20/04 Date: 5.26.04
Revised DSR 6/3/04

- FOR MW = 30.01
- Normal Boiling pt = 210°F
- Specific gravity = 1.09
- → Duration of emission limited to 10 min per OCA Guidance.

Determine Quantity Released

→ Density of FOR - DMA mixture in tank =

37% FOR = 9.18 lb/gal 60% DMA = 6.50 lb/gal

$1/\rho_{soln} = \frac{48.1\%}{\rho DMA} + \frac{51.9\%}{\rho FOR} = \frac{0.481}{6.50} + \frac{0.519}{9.18}$

$1/\rho_{soln} = 0.1305$

$\rho_{soln} = 7.66$ lb/gal ✓

→ Quantity Released (lbs)

750 gal tank

$\frac{lb}{batch} = 750\ gal \times 75\% \times 7.66\ \frac{lb}{gal}$

$= 4,309$ lb → ~ 4800 lbs ✓

Qty of pure FOR = 19.2% x 4800 lbs = 825.6 lbs → 830 lbs

From ARCHIE model, distance to endpoint from pre-mix tank is 0.12 miles.

Since distance is greater for a tank release, tank scenario based on worst-case (see excel calcs).

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Project Name: SNF RMP Page: 2 of: 2
Project Number: By: KSD Date: 2.3.99
Subject: Alt Case DMA w/ RMP Guidance Checked: CSS Date: 2.4.99

Pool Fire

From Sect. 10.2 (eqn 10-1)

$q_{fst} = PFF \times \sqrt{A}$ ✓ where A = sq ft of pool

PFF → eqn D-28

H_c = 21,488 KJ/kg for 60% DMA (see worst case calc.) ✓
= 21,488,000 J/kg

H_v ⇒ $H_{v_{DMA}}$ = 6660.0 gcal/gmol × 4.184 J/gcal / 45.1 g/gmol
= 617.9 J/g ✓
= 617,900 J/kg ✓

$H_{v_{H_2O}}$ = 40.656 KJ/gmol / 18 g/gmol
= 2.26 KJ/g × 1000 J/KJ × 1000 g/kg ✓
= 2,258,667 J/kg ✓

$H_{v_{mix}}$ = 0.6 g/g$_{total}$ (617,900) + 0.4 (2,258,667)
= 1,274,207 J/kg ✓

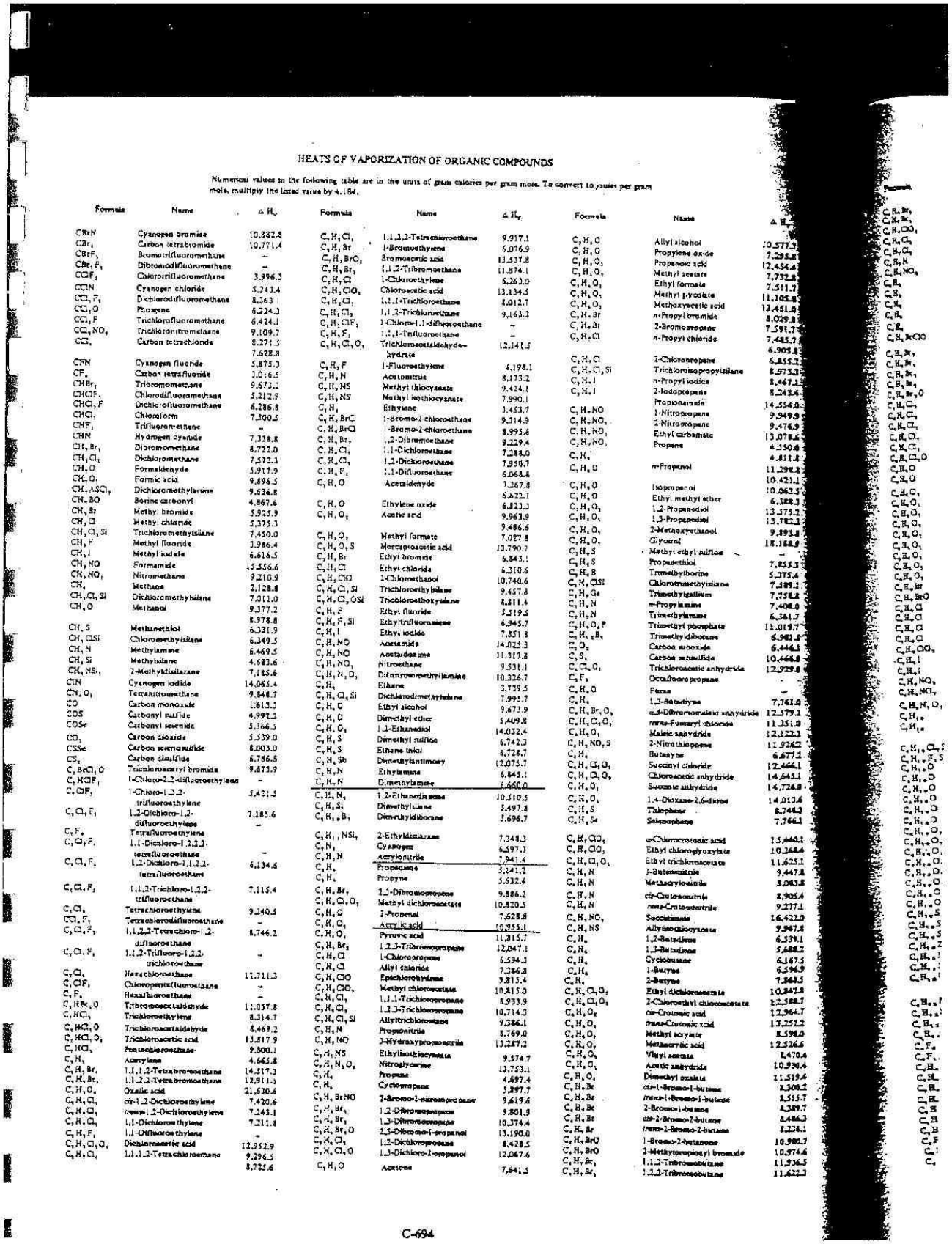
Cp_L = 0.87 cal/g °C for 60% mix (see attached calc.)
= 0.87 cal/g·°C × 4.1868 × 10^3 J/kg·K
= 3643 J/kg·°K ✓

T_o = 28.39°C From MSDS
= 301.4 K

$PFF = H_c \sqrt{\frac{0.0001}{5000\pi(H_v + Cp(T_o - 298))}} = \sqrt{0.0929}$

$= 21,488,000 \sqrt{\frac{0.0001}{5000\pi(1,274,207 + 3643(301.4-298))}} = \sqrt{0.0929}$

= 0.4607



HEATS OF VAPORIZATION OF ORGANIC COMPOUNDS

Numerical values in the following table are in the units of gram calories per gram mole. To convert to joules per gram mole, multiply the listed value by 4.184.

Formula	Name	ΔH_v
$CBrN$	Cyanogen bromide	10,882.8
CBr_4	Carbon tetrabromide	10,771.4
$CBrF_3$	Bromotrifluoromethane	–
CBr_2F_2	Dibromodifluoromethane	–
$CClF_3$	Chlorotrifluoromethane	3,996.3
$CClN$	Cyanogen chloride	5,243.4
CCl_2F_2	Dichlorodifluoromethane	5,363.1
CCl_2O	Phosgene	6,224.3
CCl_3F	Trichlorofluoromethane	6,424.1
CCl_3NO_2	Trichloronitromethane	9,109.7
CCl_4	Carbon tetrachloride	8,271.5 7,628.8
CFN	Cyanogen fluoride	5,875.3
CF_4	Carbon tetrafluoride	3,016.5
$CHBr_3$	Tribromomethane	9,673.2
$CHClF_2$	Chlorodifluoromethane	5,212.9
$CHCl_2F$	Dichlorofluoromethane	6,286.8
$CHCl_3$	Chloroform	7,500.5
CHF_3	Trifluoromethane	–
CHN	Hydrogen cyanide	7,338.8
CH_2Br_2	Dibromomethane	8,722.0
CH_2Cl_2	Dichloromethane	7,572.1
CH_2O	Formaldehyde	5,917.9
CH_2O_2	Formic acid	9,896.5
CH_3ASCl_2	Dichloromethylarsine	9,636.8
CH_3BO	Borine carbonyl	4,867.6
CH_3Br	Methyl bromide	5,925.9
CH_3Cl	Methyl chloride	5,375.3
CH_3Cl_3Si	Trichloromethylsilane	7,450.0
CH_3F	Methyl fluoride	3,986.4
CH_3I	Methyl iodide	6,616.5
CH_3NO	Formamide	15,556.6
CH_3NO_2	Nitromethane	9,210.9
CH_4	Methane	2,128.8
CH_4Cl_2Si	Dichloromethylsilane	7,011.0
CH_4O	Methanol	9,377.2 8,978.8
CH_4S	Methanethiol	6,331.9
CH_5ClSi	Chloromethylsilane	6,349.5
CH_5N	Methylamine	6,469.5
CH_5Si	Methylsilane	4,683.6
CH_5NSi_2	2-Methyldisilazane	7,185.6
CIN	Cyanogen iodide	14,065.4
CN_2O_4	Tetranitromethane	9,848.7
CO	Carbon monoxide	[813.3]
COS	Carbonyl sulfide	4,992.2
$COSe$	Carbonyl selenide	5,366.5
CO_2	Carbon dioxide	5,539.0
$CSSe$	Carbon selenosulfide	8,003.0
CS_2	Carbon disulfide	6,786.8
C_2BrCl_3O	Trichloroacetyl bromide	9,673.9
C_2HClF_4	1-Chloro-2,2-difluoroethylene	–
C_2ClF_3	1-Chloro-1,2,2-trifluoroethylene	5,421.5
$C_2Cl_2F_2$	1,2-Dichloro-1,2-difluoroethylene	7,185.6
C_2F_4	Tetrafluoroethylene	–
$C_2Cl_2F_4$	1,1-Dichloro-1,2,2,2-tetrafluoroethane	–
$C_2Cl_2F_4$	1,2-Dichloro-1,1,2,2-tetrafluoroethane	6,134.6
$C_2Cl_3F_3$	1,1,2-Trichloro-1,2,2-trifluoroethane	7,115.4
C_2Cl_4	Tetrachloroethylene	9,240.5
CCl_2F_2	Tetrachlorodifluoroethane	–
$C_2Cl_4F_2$	1,1,2,2-Tetrachloro-1,2-difluoroethane	8,746.2
$C_2Cl_3F_3$	1,1,2-Trifluoro-1,2,2-trichloroethane	–
C_2Cl_6	Hexachloroethane	11,711.3
C_2ClF_5	Chloropentafluoroethane	–
C_2F_6	Hexafluoroethane	–
C_2HBr_3O	Tribromoacetaldehyde	11,057.8
C_2HCl_3	Trichloroethylene	8,314.7
C_2HCl_3O	Trichloroacetaldehyde	8,469.2
$C_2HCl_3O_2$	Trichloroacetic acid	13,817.9
C_2HCl_5	Pentachloroethane	9,800.1
C_3H_3N	Acrylonitrile	6,665.8
$C_2H_2Br_4$	1,1,2,2-Tetrabromoethane	14,517.3
$C_2H_2Br_4$	1,1,2,2-Tetrabromoethane	12,911.5
$C_2H_2O_4$	Oxalic acid	21,630.4
$C_2H_2Cl_2$	*cis*-1,2-Dichloroethylene	7,420.6
$C_2H_2Cl_2$	*trans*-1,2-Dichloroethylene	7,243.1
$C_2H_2Cl_2$	1,1-Dichloroethylene	7,211.8
$C_2H_2F_2$	1,1-Difluoroethylene	–
$C_2H_3Cl_3O_2$	Dichloroacetic acid	12,952.9
$C_2H_3Cl_3$	1,1,1,2-Tetrachloroethane	9,296.5 8,725.6
$C_2H_3Cl_3$	1,1,2,2-Tetrachloroethane	9,577.1
C_2H_3Br	1-Bromoethylene	6,076.9
$C_2H_3BrO_2$	Bromoacetic acid	13,537.8
$C_2H_3Br_3$	1,1,2-Tribromoethane	11,874.1
C_2H_3Cl	1-Chloroethylene	6,263.0
$C_2H_3ClO_2$	Chloroacetic acid	13,134.5
$C_2H_3Cl_3$	1,1,1-Trichloroethane	8,012.7
$C_2H_3Cl_3$	1,1,2-Trichloroethane	9,163.2
$C_2H_3ClF_2$	1-Chloro-1,1-difluoroethane	–
$C_2H_3F_3$	1,1,1-Trifluoroethane	–
$C_2H_3Cl_3O_2$	Trichloroacetaldehyde-hydrate	12,141.5
C_2H_3F	1-Fluoroethylene	4,198.1
C_2H_3N	Acetonitrile	8,173.2
C_2H_3NS	Methyl thiocyanate	9,424.1
C_2H_3NS	Methyl isothiocyanate	7,990.1
C_2N_2	Ethylene	3,453.7
C_2H_4BrCl	1-Bromo-2-chloroethane	9,314.9
C_2H_4BrCl	1-Bromo-2-chloroethane	8,995.6
$C_2H_4Br_2$	1,2-Dibromoethane	9,229.4
$C_2H_4Cl_2$	1,1-Dichloroethane	7,288.0
$C_2H_4Cl_2$	1,2-Dichloroethane	7,950.7
$C_2H_4F_2$	1,1-Difluoroethane	6,068.6
C_2H_4O	Acetaldehyde	7,267.8 6,622.1
C_2H_4O	Ethylene oxide	6,823.3
$C_2H_4O_2$	Acetic acid	9,963.9 9,486.6
$C_2H_4O_2$	Methyl formate	7,027.8
$C_2H_4O_2S$	Mercaptoacetic acid	13,790.7
C_2H_5Br	Ethyl bromide	6,843.1
C_2H_5Cl	Ethyl chloride	6,310.6
C_2H_5ClO	2-Chloroethanol	10,740.6
$C_2H_5Cl_3Si$	Trichloroethylsilane	9,457.8
$C_2H_5Cl_3OSi$	Trichloroethoxysilane	8,811.4
C_2H_5F	Ethyl fluoride	5,519.5
$C_2H_5F_3Si$	Ethyltrifluorosilane	6,945.7
C_2H_5I	Ethyl iodide	7,851.8
C_2H_5NO	Acetamide	14,025.3
C_2H_5NO	Acetaldoxime	11,317.8
$C_2H_5NO_2$	Nitroethane	9,531.1
$C_2H_5N_3O_9$	Ditetranitromethylamine	10,226.7
C_2H_6	Ethane	3,729.5
$C_2H_6Cl_2Si$	Dichlorodimethylsilane	7,995.7
C_2H_6O	Ethyl alcohol	9,673.9
C_2H_6O	Dimethyl ether	5,409.8
$C_2H_6O_2$	1,1-Ethanediol	14,032.4
C_2H_6S	Dimethyl sulfide	6,742.3
C_2H_6S	Ethane thiol	6,728.7
C_2H_9Sb	Dimethylantimony	12,075.7
C_2H_7N	Ethylamine	6,845.1
C_2H_7N	Dimethylamine	6,660.0
$C_2H_8N_2$	1,2-Ethanediamine	10,510.5
C_2H_8Si	Dimethylsilane	5,497.8
$C_2H_{12}B_2$	Dimethyldiborane	5,696.7
$C_2H_{11}NSi_2$	2-Ethyldisilazane	7,348.3
C_2N_2	Cyanogen	6,597.3
C_3H_3N	Acrylonitrile	7,941.4
C_3H_4	Propadiene	5,141.2
C_3H_4	Propyne	5,632.4
$C_3H_4Br_2$	2,3-Dibromopropene	9,886.2
$C_3H_4Cl_2O_2$	Methyl dichloroacetate	10,820.5
C_3H_4O	2-Propenal	7,628.8
$C_3H_4O_2$	Acrylic acid	10,955.1
$C_3H_4O_3$	Pyruvic acid	11,815.7
$C_3H_5Br_3$	1,2,3-Tribromopropane	12,047.1
C_3H_5Cl	1-Chloropropene	6,594.2
C_3H_5Cl	Allyl chloride	7,386.8
C_3H_5ClO	Epichlorohydrine	9,815.4
$C_3H_5ClO_2$	Methyl chloroacetate	10,815.0
$C_3H_6Cl_2$	1,1,1-Trichloropropane	8,933.9
$C_3H_6Cl_2$	1,2,3-Trichloropropane	10,714.3
$C_3H_5Cl_3Si$	Allyltrichlorosilane	9,586.1
C_3H_5N	Propionitrile	8,769.0
C_3H_5NO	3-Hydroxypropionitrile	13,287.2
C_3H_5NS	Ethylisothiocyanate	9,574.7
$C_3H_5N_3O_9$	Nitroglycerine	12,753.1
C_3H_6	Propene	4,697.4
C_3H_6	Cyclopropane	5,297.7
C_3H_6BrNO	2-Bromo-2-nitropropane	9,619.6
$C_3H_6Br_2$	1,2-Dibromopropane	9,801.9
$C_3H_6Br_2$	1,3-Dibromopropane	10,374.4
$C_3H_6Br_2O$	2,3-Dibromo-1-propanol	13,190.0
$C_3H_6Cl_2$	1,2-Dichloropropane	8,428.5
$C_3H_6Cl_2O$	1,3-Dichloro-2-propanol	12,067.6
C_3H_6O	Acetone	7,641.5
C_3H_6O	Allyl alcohol	10,577.2
C_3H_6O	Propylene oxide	7,295.8
$C_3H_6O_2$	Propanoic acid	12,454.4
$C_3H_6O_2$	Methyl acetate	7,732.8
$C_3H_6O_2$	Ethyl formate	7,511.7
$C_3H_6O_3$	Methyl glycolate	11,105.8
$C_3H_6O_3$	Methoxyacetic acid	13,451.8
C_3H_7Br	*n*-Propyl bromide	8,029.8
C_3H_7Br	2-Bromopropane	7,591.7
C_3H_7Cl	*n*-Propyl chloride	7,485.7 6,905.1
C_3H_7Cl	2-Chloropropane	6,855.2
$C_3H_7Cl_3Si$	Trichloroisopropylsilane	8,573.3
C_3H_7I	*n*-Propyl iodide	8,467.1
C_3H_7I	2-Iodopropane	8,243.4
C_3H_7NO	Propionamide	14,554.0
$C_3H_7NO_2$	1-Nitropropane	9,949.9
$C_3H_7NO_2$	2-Nitropropane	9,476.9
$C_3H_7NO_2$	Ethyl carbamate	13,078.6
C_3H_8	Propane	4,150.8 4,811.8
C_3H_8O	*n*-Propanol	11,298.2 10,421.1
C_3H_8O	Isopropanol	10,063.5
$C_3H_8O_2$	Ethyl methyl ether	6,388.3
$C_3H_8O_2$	1,2-Propanediol	13,575.2
$C_3H_8O_2$	1,3-Propanediol	13,782.3
$C_3H_8O_2$	2-Methoxyethanol	9,893.8
$C_3H_8O_3$	Glycerol	18,168.9
C_3H_8S	Methyl ethyl sulfide	–
C_3H_8S	Propanethiol	7,853.3
C_3H_9B	Trimethylborine	5,375.4
C_3H_9ClSi	Chlorotrimethylsilane	7,589.1
C_3H_9Ga	Trimethylgallium	7,758.8
C_3H_9N	*n*-Propylamine	7,408.0
C_3H_9N	Trimethylamine	6,361.7
$C_3H_9O_3P$	Trimethyl phosphate	11,019.7
$C_3H_9B_3$	Trimethylboroxine	6,981.8
C_3O_2	Carbon suboxide	6,446.1
C_3S_2	Carbon subsulfide	10,466.8
$C_4Cl_2O_3$	Trichloroacetic anhydride	12,929.8
C_3F_8	Octafluoropropane	–
C_4H_4O	Furan	–
C_4H_6	1,3-Butadiyne	7,761.0
$C_4H_2Br_2O_3$	*a,b*-Dibromomaleic anhydride	12,579.3
$C_4H_2Cl_2O_2$	*trans*-Fumaryl chloride	11,251.0
$C_4H_2O_3$	Maleic anhydride	12,222.3
$C_4H_3NO_2S$	2-Nitrothiopheme	11,924.2
C_4H_6	Butenyne	6,677.1
$C_4H_4Cl_2O_2$	Succinyl chloride	12,466.1
$C_4H_4O_3$	Chloromaleic anhydride	14,645.1
$C_4H_4O_3$	Succinic anhydride	14,726.8
$C_4H_4O_3$	1,4-Dioxane-2,6-dione	14,013.6
C_4H_4S	Thiophene	8,744.3
C_4H_4Se	Selenophene	7,766.1
$C_4H_4Cl_2O_2$	*a*-Chlorocrotonic acid	15,440.1
$C_4H_4ClO_2$	Ethyl chloroglyoxylate	10,268.4
$C_4H_4Cl_2O_2$	Ethyl trichloroacetate	11,625.1
C_4H_5N	3-Butenenitrile	9,447.8
C_4H_5N	Methacrylonitrile	8,043.8
C_4H_5N	*cis*-Crotononitrile	8,905.4
C_4H_5N	*trans*-Crotononitrile	9,277.1
$C_4H_4NO_2$	Succinimide	16,422.0
C_4H_5NS	Allylisothiocyanate	9,967.8
C_4H_6	1,2-Butadiene	6,539.1
C_4H_6	1,3-Butadiene	5,688.2
C_4H_6	Cyclobutene	6,167.5
C_4H_6	1-Butyne	6,596.9
C_4H_6	2-Butyne	7,068.5
$C_4H_6Cl_2O_2$	Ethyl dichloroacetate	10,847.8
$C_4H_5ClO_2$	2-Chloroethyl chloroacetate	12,588.7
$C_4H_6O_2$	*cis*-Crotonic acid	12,964.7
$C_4H_6O_2$	*trans*-Crotonic acid	13,252.2
$C_4H_6O_2$	Methyl acrylate	8,598.0
$C_4H_6O_2$	Methacrylic acid	12,526.6
$C_4H_6O_3$	Acetic anhydride	10,930.4
$C_4H_6O_4$	Dimethyl oxalate	11,519.4
C_4H_7Br	*cis*-1-Bromo-1-butene	8,308.2
C_4H_7Br	*trans*-1-Bromo-1-butene	8,515.7
C_4H_7Br	2-Bromo-1-butene	8,389.7
C_4H_7Br	*cis*-2-Bromo-2-butene	8,486.3
C_4H_7Br	*trans*-2-Bromo-2-butene	8,238.1
C_4H_7BrO	1-Bromo-2-butanone	10,980.7
C_4H_7BrO	2-Methylpropionyl bromide	10,574.6
$C_4H_7Br_3$	1,1,2-Tribromobutane	11,536.5
$C_4H_7Br_3$	1,2,3-Tribromobutane	11,622.3

GESI
GLOBAL ENVIRONMENTAL SOLUTIONS, INC.

Project Name: KMP Page: 2 of: 3
Project Number: By: KSD Date: 12.9.98
Subject: DNA - Alt. Scenario Checked: CSS Date: 2.3.99

- Specific Heat of Liquid: Btu/lb°F
  - Specific heat of DNA

Estimate using Johnson & Huang method (see Handbook of Chemical Property Estimation methods, pg. 23-11c)

Group	Contribution cal/mol-°C		
CH_2	9.9	x 2 =	19.8 ✓
NH	15.2	x 1 =	15.2 ✓
			35.0 cal/mol °C

$C_p = \frac{35.0 \text{ cal/mol°C}}{45.09 \text{ g/mol}} = 0.78 \frac{\text{cal}}{\text{g°C}}$ ✓

- water → C_p = 1 Btu/lb°F = 1 $\frac{\text{cal}}{\text{g°C}}$

- $C_{p_{mix}} = \Sigma$ Xi/mass x C_p $\frac{\text{cal}}{\text{g°C}}$

$= 0.6\left(0.79 \frac{\text{cal}}{\text{g°C}}\right) + 0.4\left(1 \frac{\text{cal}}{\text{g°C}}\right)$

$= 0.87 \frac{\text{cal}}{\text{g°C}}$ ✓

Vapor pressure calculations for 19.2% formaldehyde

	degrees F	degrees C	degrees K		psia	mmHg	atm
Temperature	110	43.3	316.5	Pressure	14.696	760	1
	64.70	18.2	291.3				
	60.09	15.6	288.8				
	69.32	20.7	293.9				
	77	25.0	298.2				
	112	44.4	317.6				

Formaldehyde

Formula: $\log P^* = 9.942 - 0.953\,(0.488)^{W/10} - 2905/T$

where P* = partial pressure of formaldehyde in mmHg
W = formaldehyde concentration in per cent by weight
T = absolute temperature

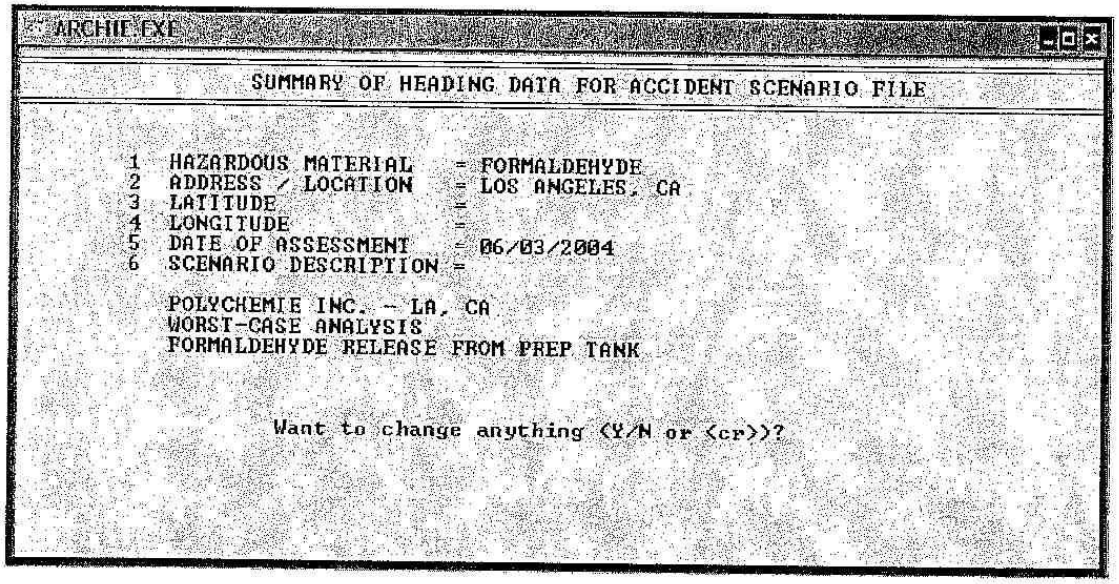
formula valid for 10 to 40 per cent formaldehyde solutions, below 60 degrees C
source: Formaldehyde, third edition, by J. Frederic Walker, page 115, Lacy equation

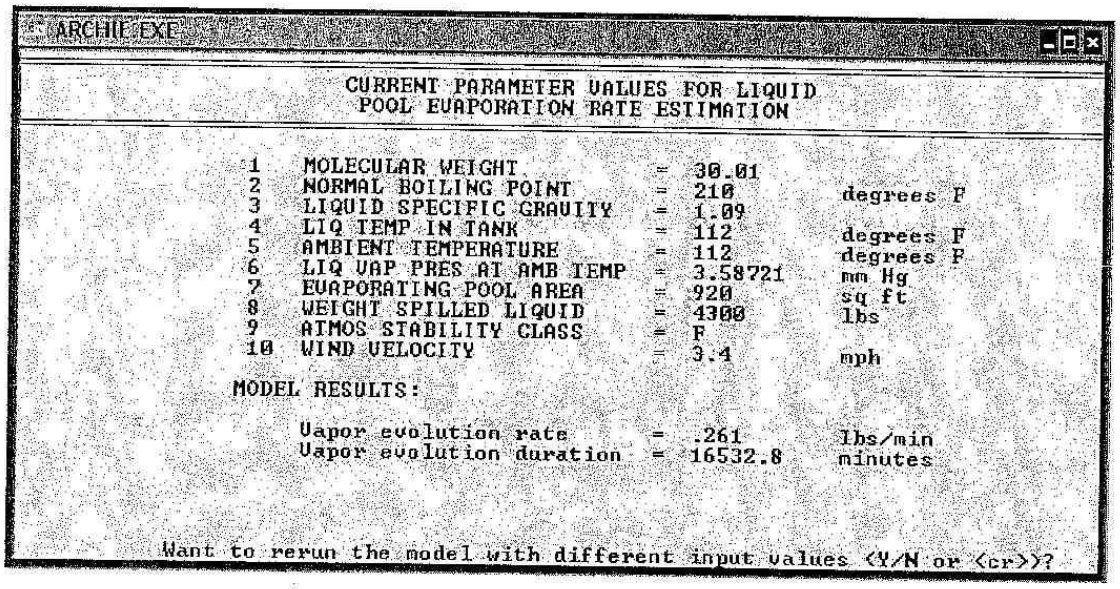
P* = 3.33 mmHg
W = 19.2 per cent by weight
T = 316.48 degrees K

For 19.2% wt. formaldehyde:

T, deg F =	64.70	P* =	0.53663	P* =	0.01038
	60.09	mmHg	0.43775	psia	0.00846
	69.32		0.65579		0.01268
	77		0.90829		0.01756
	112		3.58721		0.06937

By: CSS 03/12/2002
Additions: NSB 05/26/2004


ARCHIE.EXE
SUMMARY OF HEADING DATA FOR ACCIDENT SCENARIO FILE
1 HAZARDOUS MATERIAL = FORMALDEHYDE
2 ADDRESS / LOCATION = LOS ANGELES, CA
3 LATITUDE =
4 LONGITUDE =
5 DATE OF ASSESSMENT = 06/03/2004
6 SCENARIO DESCRIPTION =
POLYCHEMIE INC. - LA, CA
WORST-CASE ANALYSIS
FORMALDEHYDE RELEASE FROM PREP TANK
Want to change anything (Y/N or <cr>)?



ARCHIE.EXE

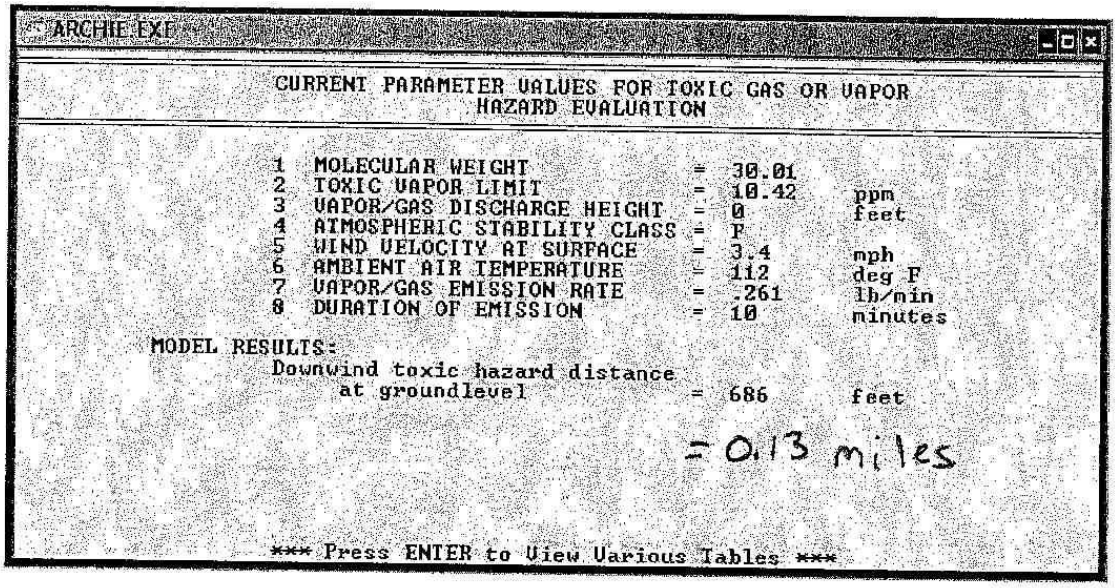
CURRENT PARAMETER VALUES FOR LIQUID
POOL EVAPORATION RATE ESTIMATION

1	MOLECULAR WEIGHT	=	30.01	
2	NORMAL BOILING POINT	=	210	degrees F
3	LIQUID SPECIFIC GRAVITY	=	1.09	
4	LIQ TEMP IN TANK	=	112	degrees F
5	AMBIENT TEMPERATURE	=	112	degrees F
6	LIQ VAP PRES AT AMB TEMP	=	3.58721	mm Hg
7	EVAPORATING POOL AREA	=	920	sq ft
8	WEIGHT SPILLED LIQUID	=	4300	lbs
9	ATMOS STABILITY CLASS	=	F	
10	WIND VELOCITY	=	3.4	mph

MODEL RESULTS:

Vapor evolution rate	=	.261	lbs/min
Vapor evolution duration	=	16532.8	minutes

Want to rerun the model with different input values <Y/N or <cr>>?



ARCHIE.EXE

CURRENT PARAMETER VALUES FOR TOXIC GAS OR VAPOR
HAZARD EVALUATION

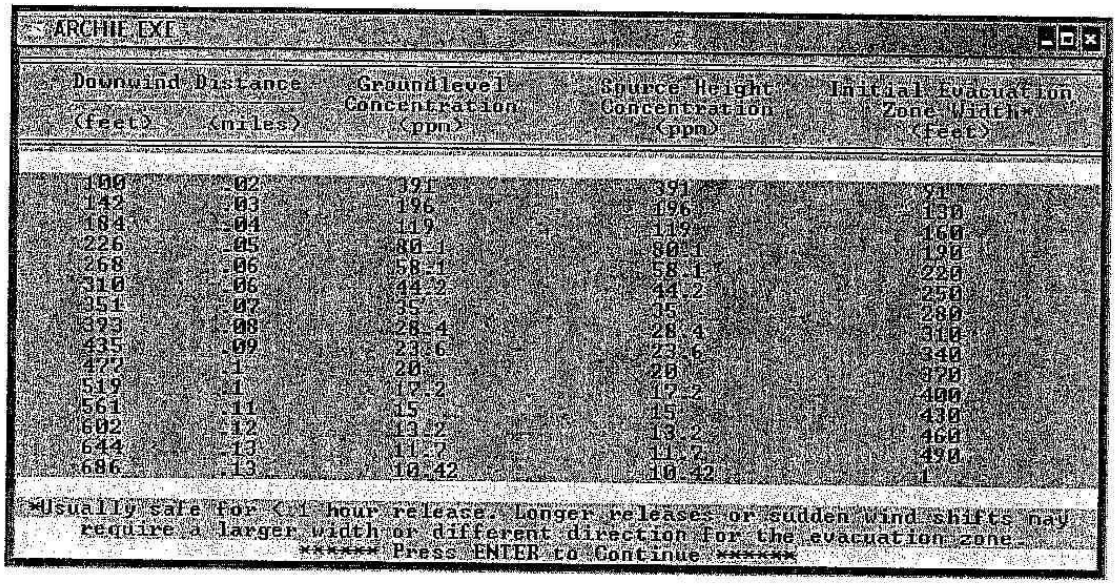
1	MOLECULAR WEIGHT	=	30.01	
2	TOXIC VAPOR LIMIT	=	10.42	ppm
3	VAPOR/GAS DISCHARGE HEIGHT	=	0	feet
4	ATMOSPHERIC STABILITY CLASS	=	F	
5	WIND VELOCITY AT SURFACE	=	3.4	mph
6	AMBIENT AIR TEMPERATURE	=	112	deg F
7	VAPOR/GAS EMISSION RATE	=	.261	lb/min
8	DURATION OF EMISSION	=	10	minutes

MODEL RESULTS:

Downwind toxic hazard distance at groundlevel	=	686	feet

= 0.13 miles

*** Press ENTER to View Various Tables ***

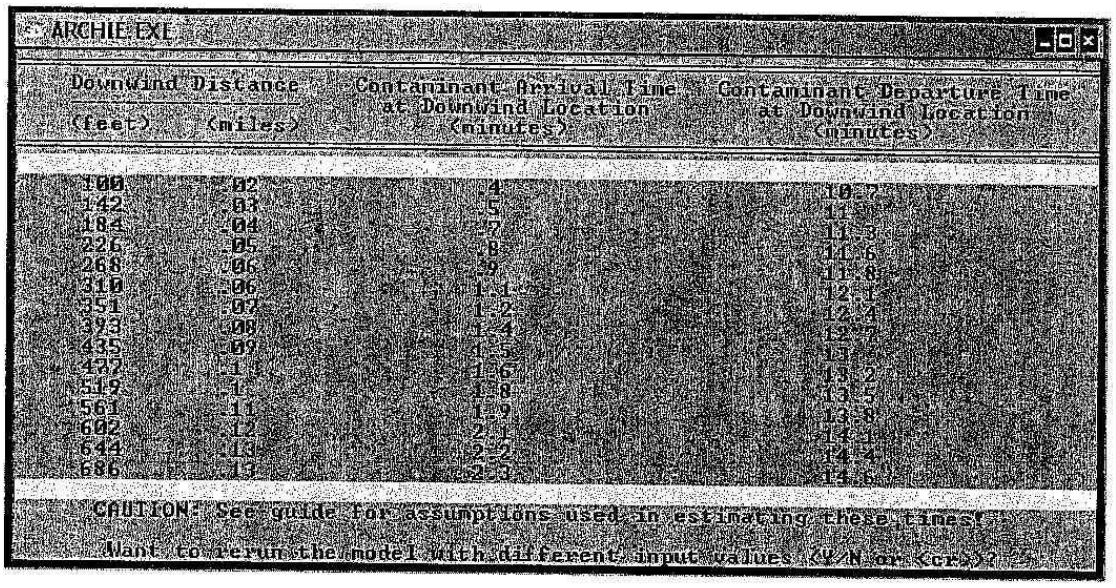


ARCHIE.EXE

Downwind Distance (feet)	(miles)	Groundlevel Concentration (ppm)	Source Height Concentration (ppm)	Initial Evacuation Zone Width* (feet)
100	.02	391	391	90
142	.03	196	196	130
184	.04	119	119	160
226	.05	80.1	80.1	190
268	.06	58.1	58.1	220
310	.06	44.2	44.2	250
351	.07	35	35	280
393	.08	28.4	28.4	310
435	.09	23.6	23.6	340
477	.1	20	20	370
519	.1	17.2	17.2	400
561	.11	15	15	430
602	.12	13.2	13.2	460
644	.13	11.7	11.7	490
686	.13	10.42	10.42	1

*Usually safe for < 1 hour release. Longer releases or sudden wind shifts may require a larger width or different direction for the evacuation zone.

****** Press ENTER to Continue ******



ARCHIE.EXE

Downwind Distance (feet)	(miles)	Contaminant Arrival Time at Downwind Location (minutes)	Contaminant Departure Time at Downwind Location (minutes)
100	.02	4	10.2
142	.03	5	11.3
184	.04	7	11.3
226	.05	8	11.6
268	.06	9	11.8
310	.06	1.1	12.1
351	.07	1.2	12.4
393	.08	1.4	12.7
435	.09	1.5	13
477	.1	1.6	13.2
519	.1	1.8	13.5
561	.11	1.9	13.8
602	.12	2.1	14.1
644	.13	2.2	14.4
686	.13	2.3	14.6

CAUTION: See guide for assumptions used in estimating these times!

Want to rerun the model with different input values (Y/N or <cr>)? _

GESI

CALCULATION SHEET

Calc. No.
TS-1

Prepared By: Natasha Brash Date: 5/27/2004 Reviewed By: Karen Dorman Date: 5/27/2004

Section I. General Information

Project: Polychemie, Inc. - Los Angeles, CA
2004 RMP Update
Project No.: 02512.01

Subject: RMP Alternate Case, Toxic Substance Release - Formaldehyde

Section II. Scenario

A. 37% formaldehyde is released from a ruptured unloading hose on a tanker truck (containment area of approximately 1500 sq. ft.) during delivery. Break occurs before pump (Option 1) or after pump (Option 2). Compare quantity released from both options and use larger amount in subsequent analysis. Response time is 3 minutes to shut off leak.

Section III. Calculations

A. Option 1: Per OCA (Ref. A), Equation 7-4:

Liquid Release rate, QR_L (lbs/min) = HA x (LH) $^{0.5}$ x LLF

HA = hole area (in^2) = assume 2 in hole = 3.142 in^2
LH = height of liquid above hole (in) = full tanker truck height = 10 ft = 120 in

LLF = 53 (from Exhibit B-3, OCA Guidance)

QR_L = 1824 lbs/min

Assume response time, t = 3 minutes.

Quantity release, QS = QR_L x t = 5,472 lbs Eq 3-5 of OCA Guidance

B. Option 2: Approximate quantity released as amount being pumped.

Liquid being pumped at 40-60 gpm.
Use 60 gpm and increase by 1.25 to account for increase in inflow due to loss of head.

Flow = 60 gpm x 1.25 = 75 gpm

QR = 75 gpm x 3 min = 225 gals x 9.18 lb/gal = 2066 lbs

Section IV. Results

A. Evaluate Option 1 since quantity released before pump is greater.

Section V. References

A. Risk Management Program Guidance for Offsite Consequence Analysis. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, (EPA 550-B-99-009), 04/15/1999.

ALTERNATE SCENARIO FOR TOXIC LIQUIDS
Polychemie Inc. - Los Angeles, CA
GESI Project No. 02512.01

Toxic Liquid	Quantity Released[1] QS	Length of Dike (ft)	Width of Dike (ft)	Area of Dike[4] A (ft^2)	Density Factor[2] of Liquid DF	Maximum Area of Pool[3] (ft^2)	Liquid Factor Ambient[2] LFA	Release Rate[5] QR (lb/min)	Duration of Release[6] (min)	Maximum Duration of Release[7] (min)	Toxic Endpoint[2] (mg/l)	Release Rate/ Toxic Endpoint	Reference Table to Use	Reference Table	Distance to Endpoint[8] (miles)
Formaldehyde 37 % density = 9.18 lb/gal	5,472 lbs, 37% 2,025 lbs, 100% ***TANKER TRUCK TRANSFER HOSE RUPTURE***	NA	NA	1500 Total containment area	0.44	2,408	0.0002	0.720	7,600	10	0.012	60	- Buoyant - Urban - 10 minute release	16	0.1 (Shortest reportable distance)

NOTES: - Calculations are based on U.S. EPA RMP Guidance for Offsite Consequence Analysis provided by the EPA dated April 15, 1999.
1 - Quantity Released is assumed to equal spill release amount. - see Calculation No. TS-1
2 - Density Factor of Liquid, Liquid Factor Ambient, Toxic Endpoint are found in Exhibit B-3 of the EPA RMP Guidance for OCA.
3 - Maximum area of the liquid pool, A (ft^2) = Quantity Released,QS(lb) * Density Factor of the Liquid (DF). [Eq. 3-6]
4 - Use the minimum of the dike area (less tank area) or the area calculated using the density factor (see Note 3).
5 - Mitigated Release Rate, QR = 2.4 * LFA * Area of the Pool or Dike area (whichever is less). [Eq. 7-10]
6 - Duration of Release, t = Quantity Released,QS (lb) / Release Rate, QR (lb/min) [Eq. 3-5]
7 - Maximum Duration of the release is from the EPA RMP Guidance for OCA. The maximum duration for water solutions of toxic substances 10 minutes. [Sect. 3.3]
8 - Distance to endpoint is calculated using Reference Table.

By: NSB 05/27/2004
Checked: KSD 05/27/2004

GEST

2121 newmarket pkwy
suite 140
marietta, ga 30067
tel 770 690 9552
fax 770 690 9529

Project Name: Polychemie – LA, CA
Project Number: 02512
Subject: Acrylamide Release Scenarios
Page: 1 By: DSB Checked: [illegible]
Of: 2 Date: 5/27/04 Date: 5/28/04

Acrylamide Worst-Case Scenario

→ Railcar (20,000 gal, no containment) and a tank (8,000 gal containment) onsite. Both at ambient temp and pressure. Small leak using OCA Guidance. See attached calcs.

→ Determine if other portions of process that may result in a greater release distance.

	T	P	Conc	Qty
PAM	95°F	ambient	~5%	14,360 gal
ADAM-Quat	131°F	ambient	15%	2,100 gal

Although PAM process is @ a lower temp (process) it has a greater batch quantity. Therefore, both scenarios on the railcar and tank release will be considered. R/C of the elevated process temperatures ARCHIE will be used to evaluate releases from the processes.

Temp
The recorded temp of 112°F for LA will be used for ambient temp. Since this is greater than the PAM process temp it will be used as the PAM process temp also.

VP
See attached sheet for VP estimates.

PAM Rxr = 0.00334 mm Hg
ADAM-Quat Rxr = 0.04266 mm Hg

Containment
PAM containment area = 2819 sq ft
ADAM " " = 2819 sq ft (assume square)
Wind Velocity = 3.4 mph } as per OCA Guidance
Stability Class = F }

GESI

2121 newmarket pkwy
suite 140
marietta, ga 30067
tel 770 690 9552
fax 770 690 9529

Project Name: Polychemie - LA, CA
Project Number: 02512
Subject: Acrylamide Release Scenarios
Page: 2 By: JSR Checked: [illegible]
Of: 2 Date: 5/27/04 Date: 5/27/04

Weight of Material Released

PAM 11,360 gal released (45% acrylamide, 55% H₂O)

Estimate pounds released using density of water.

11,360 gal × 8.345 lb/gal = 94,800 lbs ✓

ADAM-quat

2100 gal × 8.345 lb/gal = 17,525 lbs ✓

Toxic Vapor Limit

From Appendix B of CalARP Program's, AA Guidance, California OES (attached) —

Endpoint = 0.11 mg/L = 110 mg/m³ ✓

Duration of Release

Per OCA Guidance, release duration limited to 10 min for aqueous solutions.

Results (see attached model runs) → Release from ADAM Quat Distance to Endpoint <0.1 mi

PAM Rxtr <0.1 mi

⇒ Formaldehyde worst-case scenario results in a greater release distance than all acrylamide releases, therefore, formaldehyde to be applied as worst-case.