VISTA CHEMICAL COMPANY

LAKE CHARLES VCM PLANT

AIR TOXICS MODELING

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Project 8835

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1.0 INTRODUCTION

This report summarizes the results of the dispersion modeling analysis performed for selected non-criteria air pollutants emitted at the Vista Chemical VCM Plant located in Westlake, Louisiana. The VCM Plant is part of the Vista Chemical complex. Figure 1 shows the plant location.

Maximum 1-hour ground-level concentrations are calculated for benzene, chlorine, 1,2-dichloroethane, hydrochloric acid, sulfuric acid and vinyl chloride sources located at the VCM Plant. In addition, maximum annual concentrations are calculated for vinyl chloride. The current procedure of the Louisiana Department of Environmental Quality (DEQ) is to compare the maximum 1-hour fenceline concentrations to 1/42 of the Threshold Limit Value - Time Weighted Average (TLV-TWA).[1]

The maximum 1-hour fenceline concentrations for all of the air pollutants, with the exception of chlorine, are less than 1/42 of the TLV-TWA (TLV/42). The chlorine guideline value is exceeded only on the west side of the plant. Concentrations fall below the guideline value within 100 meters of the west plant boundary. Also, the maximum annual vinyl chloride concentration falls within acceptable limits established by the Louisiana DEQ and the U.S. EPA.

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[1] American Conference of Governmental Industrial Hygienists, *TLV's, Threshold Limit Values and Biological Indices for 1988-1989*. (Cincinnati, OH: ISBN: 0-936712-72-4, 1988).

2.0 MODELING METHODOLOGY

The techniques used in the dispersion modeling study for non-criteria pollutants are consistent with current Environmental Protection Agency (EPA)[2] and Louisiana DEQ procedures.

2.1 Dispersion Models

Two dispersion models are employed in this analysis. Short term concentrations are calculated using the Industrial Source Complex Short-Term (ISCST) model. The long term modeling employs the Industrial Source Complex Long-Term (ISCLT) model.

2.1.1 ISCST

The ISCST model is employed to determine 1-hour concentrations. The ISCST modeling is performed using the following model options: urban mode 3, no terrain elevations, stack-tip downwash, buoyancy induced dispersion and gradual plume rise. The regulatory default values for wind profile exponents and vertical potential temperature gradients are used in accordance with the EPA guidelines.

2.1.2 ISCLT

The latest version (88167) of the ISCLT model is used to determine annual vinyl chloride concentrations. The ISCLT modeling is performed using the following model options: urban mode 3, no terrain elevations, stack heights adjusted for stack-tip downwash, buoyancy induced dispersion, and final plume rise. Default values for wind profile exponents and vertical potential temperature gradients are used.

2.2 Meteorological Data

The ISCST modeling is performed using preprocessed meteorological data supplied by the Lake Charles Technical Air Committee (TAC). The preprocessed meteorological data are based on the surface meteorological observations recorded during 1982 at a monitoring site established by the TAC in the Lake Charles vicinity. The surface observations from the TAC site have been processed with upper air data collected by the National Weather Service in Lake Charles during the same time period. Use of these data was approved by the Louisiana DEQ.

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[2] U.S. EPA, Office of Air Quality Planning and Standards. *Guideline on Air Quality Models (Revised)*. Research Triangle Park, NC. EPA 450/-78-027R. July, 1986.

The ISCLT modeling uses a STability ARray (STAR) meteorological summary based on surface observations recorded at the National Weather Service (NWS) surface observing station located in Lake Charles, Louisiana. The STAR data are a frequency distribution of six wind speed categories, six Pasquill-Gifford stability categories and sixteen 22.5 degree wind direction sectors.

The use of the NWS data is specified in a document excerpt supplied by the Louisiana DEQ.[3] One five-year average STAR deck, based on surface observations taken during the period 1983 through 1987, is used.

2.3 Source Parameters

The modeling analysis considers both point and area (fugitive) sources. Source parameters and emission rates for both the point and area sources were provided by Vista. The emission data are summarized in Tables 1 and 2.

The fugitive sources include evaporation from treatment basins, and releases from valve packings, flange gaskets, pump seals, and compressor seals. For modeling purposes, a UTM coordinate grid is drawn on the Vista plot plan. The grid consists of sequentially numbered 100 meter by 100 meter squares. Vista estimated the fugitive emissions occurring in each of the squares.

Due to the small emission rates from the fugitive sources, all emission rates (both point sources and fugitives) are multiplied by 1000 prior to input into the models.

2.4 Building Downwash

All of the point sources are evaluated in terms of their proximity to nearby structures. The purpose of this evaluation is to determine if the stack discharge might become caught in the turbulent wake of structures, leading to downwash of the plume.

The EPA provides guidance for determining whether building downwash occurs in, *Guideline for Determination of Good Engineering Practice Stack Height.*[4]

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[3] Louisiana DEQ (supplied) document excerpt, origination possibly U.S. EPA. *Modeling Guidelines for Carcinogens*.

[4] U.S. EPA, Office of Air Quality Planning and Standards. *Guideline for Determination of Good Engineering Practice Stack Height (Technical Support Document for the Stack Height Regulations) (Revised)*. Research Triangle Park, North Carolina. EPA 450/4-80 -023R. June, 1985.

The minimum stack height not subject to the effects of building downwash, called the Good Engineering Practice (GEP) stack height, is defined by the formula:

$$GEP = H + 1.5L$$

Where: GEP = Minimum GEP Stack Height
H = Height of the Structure
L = Lesser Dimension of the Structure (Height or Projected Width)

Downwash effects are limited to stacks located within 5L of a structure.

The downwash structures associated with each of the point sources are as follows:

Downwash Structure	Height (m)	Projected Width (m)	Stacks Affected
Cooling Tower	17.07	39.32	VP-VB, VP-IVD
T-962 A,B Tanks	7.62	14.85	VP-IVE

Sources VP-IVA and VP-VA are found not to be subject to the effects of building downwash.

2.5 Receptor Locations

Three receptor grids are employed in the modeling analysis. First, a "fine" grid, with 100-meter (m) receptor spacing is centered on the Vista facility. Receptors on this grid extend at least 500 meters beyond each of the plant boundaries. Next, a "coarse", 10-kilometer (km) by 10-km grid with 1-km receptor spacing, is centered near the facility. The locations of the fine and coarse receptor grids are shown in Figures 2 and 3, respectively.

A third grid, the "fenceline" grid, consists of a line of receptors, with 20-meter receptor spacing, placed along the west plant boundary.

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3.0 MODELING RESULTS

Maximum 1-hour fenceline concentrations are calculated for benzene, chlorine, 1,2-dichloroethane, hydrochloric acid, sulfuric acid and vinyl chloride using the ISCST model. Maximum annual vinyl chloride concentrations are calculated using the ISCLT model. Since the emission inputs into both models are multiplied by 1000, the concentrations in the model output are divided by 1000 to obtain actual concentrations. OK

As approved by the Louisiana DEQ[5], modeled concentrations which occur under a mixing height of 250 meters or less are ignored. Trinity Consultants reviewed the 1982 preprocessed meteorological data for all hours having modeled concentrations over the TLV/42 guideline value. Concentrations occurring on an hour having a mixing height of less than 250 meters were replaced by the next highest concentration occurring under a mixing height greater than 250 meters.

Model output for each of the non-criteria pollutants is in Appendix A.

The modeling results are summarized in the following sections. Table 3 summarizes the maximum concentrations for each of the pollutants/receptor combinations.

3.1 Benzene

The maximum 1-hour concentration for benzene is 2.1 micrograms per cubic meter. This value is much less than the TLV/42 guideline value of 76.0 micrograms per cubic meter. The maximum 1-hour fine grid benzene concentrations are shown in Figure 4.

3.2 Chlorine

The maximum 1-hour ground-level chlorine concentration, 83 micrograms per cubic meter, occurs along the west fenceline. This value is greater than the TLV/42 guideline value of 69.1 micrograms per cubic meter. Concentrations along the north, south, and east fencelines are well below the guideline value.

Due to the conservative method in which off-property receptors are identified for the fine grid, some of the receptors considered to be "off-property" fall slightly within the plant boundaries (Figure 2). For some of the receptors just inside the west plant boundary, modeled chlorine concentrations are greater than the guideline value. In order to determine concentrations at the fenceline, an additional fenceline grid is analyzed.

Chlorine concentrations at the following receptors on the fine and fenceline grids were replaced due to mixing heights less than 250 meters:

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[5] Personal Communication. Telephone conversation with Mr. Doug Walters, Louisiana DEQ. April 14, 1989.

UTM Location		Calculated	Replacement
East (km)	North (km)	Concentration ($\mu g/m^3$)	Concentration ($\mu g/m^3$)
473.2	3345.7	74.5	32.6
473.2	3345.8	82.2	36.3
473.1	3345.8	75.1	40.5
473.1	3345.9	99.1	47.1
472.4	3346.2	80.1	73.7
472.36	3346.36	81.9	80.4
472.36	3346.34	88.5	79.3
472.36	3346.32	87.3	77.9
472.367	3346.24	82.1	72.5

The maximum 1-hour fine grid and fenceline concentrations are shown in Figures 5 and 6. These figures include the updated receptors.

After the concentrations are replaced, only 3 receptors beyond the fenceline have concentrations above the guideline value. These three receptors are located within 70 meters of the fenceline.

3.3 1,2-Dichloroethane

The maximum 1-hour 1,2-dichloroethane concentration is 236.6 micrograms per cubic meter. This concentration is much less than the guideline value of 964.0 micrograms per cubic meter. The modeled fine grid concentrations are shown in Figure 7.

3.4 Hydrochloric Acid

The maximum 1-hour hydrochloric acid concentration is 94.9 micrograms per cubic meter. This concentration is much less than the TLV/42 guideline value of 180.1 micrograms per cubic meter. The maximum 1-hour hydrochloric acid concentrations occurring on the fine grid are shown in Figure 8.

3.5 Sulfuric Acid

The maximum 1-hour sulfuric acid concentration is 23.5 micrograms per cubic meter. This concentration is less than the TLV/42 guideline value of 23.8 micrograms per cubic meter. The maximum 1-hour sulfuric acid concentrations on the fine grid are shown in Figure 9.

3.6 Vinyl Chloride

Maximum concentrations are calculated for vinyl chloride for both the 1-hour and annual averaging periods.

The maximum 1-hour concentration, 49.2 micrograms per cubic meter, is less than 20 percent of the TLV/42 guideline value of 304.3 micrograms per cubic meter. The maximum 1-hour vinyl chloride concentrations on the fine grid are shown in Figure 10.

The maximum annual vinyl chloride concentration, 0.76 microgram per cubic meter, occurs along the west fenceline. Due to the conservative method used in determining off-property receptors on the fine grid, some of the receptors considered to be "off-property" are slightly within the plant boundaries (Figure 2). In order to determine concentrations at the fenceline, an additional fenceline grid is analyzed. The maximum concentration of 0.76 microgram per cubic meter is identified using the fenceline grid.

The Louisiana DEQ compares maximum annual vinyl chloride concentrations to several guideline values. One guideline value is based on a document excerpt supplied to Vista by the DEQ.[6] The excerpt, titled *Modeling Guidelines for Carcinogens*, contains an equation that is used in calculating an acceptable long-term carcinogenic concentration. The equation consists of a human intake factor, a human cancer potency factor and an incidental cancer risk estimate. The excerpt states that incidental cancer risk estimates ranging from 10^{-4} to 10^{-6} are considered acceptable. Based on the equation, the acceptable concentrations corresponding to the 10^{-4} and 10^{-6} factors are 13.8 and 0.138 micrograms per cubic meter, respectively. The maximum modeled concentration of 0.76 microgram per cubic meter falls well within this range.

Two other guideline values used by the Louisiana DEQ are based on unit risk factors supplied by the U.S. EPA. The two unit risk factors are 4.1×10^{-6} and 4.2×10^{-5} (microgram per cubic meter)$^{-1}$. Acceptable concentrations are obtained by dividing the incidental cancer risk estimate (10^{-4} through 10^{-6}) by the unit risk factors. The range of acceptable concentrations for the 4.1×10^{-6} (microgram per cubic meter)$^{-1}$ risk factor is from 0.24 (10^{-6} risk) to 24.4 (10^{-4} risk) micrograms per cubic meter. For the 4.2×10^{-5} (microgram per cubic meter)$^{-1}$ factor, concentrations in the range of .024 (10^{-6} risk) to 2.4 (10^{-4} risk) micrograms per cubic meter are considered acceptable. The maximum modeled concentration of 0.76 microgram per cubic meter falls well within these ranges.

The maximum annual concentrations on the fine grid are shown in Figure 11. The maximum annual concentrations along the west fenceline are shown in Figure 12.

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[6] Louisiana DEQ (supplied) document excerpt, origination possibly U.S. EPA. *Modeling Guidelines for Carcinogens*.

4.0 SUMMARY

The Louisiana DEQ has requested modeling for six non-criteria air pollutants released at the Vista VCM Plant. Maximum 1-hour concentrations are calculated for benzene, chlorine, 1,2-dichloroethane, hydrochloric acid, sulfuric acid and vinyl chloride. In addition, maximum annual concentrations are calculated for vinyl chloride. The results of the 1-hour modeling are compared to 1/42 of the TLV-TWA's for these compounds. The maximum annual vinyl chloride concentration is compared to guidelines established by the Louisiana DEQ based on U.S. EPA supplied information.

The results of the modeling analysis indicate that only chlorine has concentrations above the 1-hour guideline value. However, modeled concentrations greater than the guideline value for chlorine occur at only 3 receptors outside the plant boundary. These three receptors are within 70 meters of the west plant boundary. The maximum 1-hour concentrations for all other compounds are less than the TLV/42 guideline values. Also, the maximum annual vinyl chloride concentration falls within acceptable limits established by the Louisiana DEQ and the U.S. EPA.

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