

Appendix 6

Area Sources - Improved Categories

Post 1990 Improvements to the Area Source Emissions Inventory

The following sections provide brief descriptions of projects developed by TCEQ staff and contractors which greatly improved the Area Source Emissions Inventory. These descriptions are actual introductory sections from the project documents. Complete documents can be obtained from Emissions Inventory staff at (512) 239-1478.

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ASPHALT PAVING

Asphalt Applications in Texas

Staff

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2.1 Overview of Asphalt Mixtures

Miles and miles of Texas is many miles of Texas roads. Texas has a diverse road way system that reflects many types of payments. Asphalt applications are typically used for building or maintaining many roads, streets, highways and parking lots. Approximately 70 % of the asphalt hot mix produced is utilized for paving projects.¹ Paving, sealing, preparing and maintaining pavement structures usually incorporates several asphalt products. Three major categories of asphalt products are utilized for pavement applications: hot mix asphalt, cutback asphalt and emulsified asphalt. Other asphalt applications include roofing, waterproofing and other coating material.

Asphalt products undergo an array of tests to determine mix density, void space, asphalt content, viscosity and many other characteristics. Asphalt, a complex hydrocarbon, is produced by high temperature distillation of crude oil. This process separates refined product into light and heavy fractions. The heavy fraction contains asphaltenes suspended in a lighter medium of malthenes, which composes the asphalt.¹ Asphalt mixtures are meticulously tested at laboratories to ensure quality and performance of the product. Specifications are detailed for each project application. The Texas Department of Transportation (TXDOT) is responsible for testing of asphalt products utilized by the State or it's contractors. Paving applications conducted by the State represents approximately 60% of asphalt paving activities in Texas. This activity represents approximately 14 million tons of hot mix applications. Production of hot mix for the entire state ranges at over 20 million tons and approximately 2 million tons of this is the asphalt binder. Asphalt production is seasonal, more asphalt is generated during the warmer months when most paving occurs. Production is effected by the economy, federal highway funding and the weather.⁴

Asphalt production occurs at an asphalt terminal or refinery, Texas host 40 % of the refineries in the US.*** Texas also receives asphalt from Oklahoma, Arkansas, Louisiana and Mexico. ***
MAP/REF. List Hot mix batch or drum plants mix asphalt (used as a binder) with aggregate to make the hot mix or asphalt concrete for paving applications. Asphalt emulsions are produced at an emulsion plant, while cutback asphalt is made at an asphalt refinery or terminal. Although emissions are inherent in the production of asphalt products, this study will focus on the use of the different types of asphalts and the emissions which occur during and after their application. The objective of this document is to inventory the Volatile Organic Compound (VOC) emissions occurring from asphalt applications in the nonattainment counties in Texas for calendar year 1998.

INDUSTRIAL SURFACE COATING

ESTIMATION OF VOC EMISSION FOR INDUSTRIAL SURFACE COATING IN TEXAS 1999

Staff

This report presents the reasons for selecting a methodology to calculate a new per capita emission factor to estimate the 1999 emissions for industrial surface coating based on a paper written by the Texas Natural Resource Conservation Commission (TNRCC) emission inventory (EI) staff. Alternative methods for calculating volatile organic compound (VOC) emissions are also described and future recommendations to update the new emission factors are provided.

Emission Inventory Source Category
Industrial Surface Coating

Industrial Surface Coating Category Descriptions, Code (AMS Codes)

- (1) factory finished wood 2401015000
- (2) wood furniture 2401020000
- (3) metal furniture 2401025000
- (4) paper 2401030000
- (5) sheet, strip and coil 2401045000
- (6) metal cans 2401040000
- (7) machinery and equipment 2401055000
- (8) large appliances 2401060000
- (9) electronic and other electrical 2401065000
- (10) motor vehicles 2401070000
- (11) aircraft 2401075000
- (12) marine 2401080000
- (13) railroad 2401085000
- (14) miscellaneous 2401090000

INTRODUCTION

Industrial surface coating is the application of a thin layer of coating to an object for decorative or protective purposes. Industrial surface coatings include coatings that are applied during the manufacturing of products by Original Equipment Manufacturers (OEMs), some marine coatings, and maintenance coatings not accounted for by point sources. The VOC Emissions are results of the evaporation of paint solvent during coating operation, any additional solvent used to thin the coating, the use of solvents in cleaning the surface prior to coating, and cleaning coating equipment after use. It is assumed that all coating solvent evaporates during application, even though some residual (VOC) solvents may remain in the coating after it has been dried. Unused coating sometimes may be disposed of along with wastewater or in a landfill.

The applicable TNRCC regulations require most industrial surface coating categories to comply with 30 TAC §115.421-115.427, 115.429. These regulations require coating operations in Beaumont/Port Arthur, Dallas/Fort Worth, El Paso, and Houston/Galveston to use low VOC coatings, employ vapor control systems, special types of spray guns to control overspray, and to maintain proper housekeeping guidelines.

METHODOLOGY

This paper suggests using a method using a paper written by EI staff, Quantifying Architectural Painting VOC Air Emissions: A Methodology with Estimates and forecasts (Anderson & Rubick 1996). This paper in detail discusses how to calculate a per capita emission factor based on a material balance summary. Based on this methodology the average VOC emissions is dependent on five factors: (1) Quantity of various types of paints used, (2) amount of VOCs in the paints used, (3) amount of additional solvents (thinners/reducers and cleanup) used, (4) amount of VOCs in the thinner/reducers added to the paints, and (5) the amount of VOCs in the cleanup solvents.

The National Paint and Coating Association (NPCA) published a summary of a material balance for all coating categories in 1992. The data was used to determine the amount of VOC in the paints used. It is assumed that the amount of VOC contained in the paints' used by the industrial surface coating category has not changed from 1991. This assumption was made based on the TNRCC 30 TAC §115.42 which exempts many industrial surface coating operations which would be considered area sources.

The National Paint and Coating Association (NPCA) data base states approximately 31% of the total solvent sold was used by the paint and coating industry. The NPCA reported in 1991 that out of the 2,559,000,000 gallons of total solvents sold, 125,000,000 gallons of solvents was sold to the paint and coating industry. These solvents include mineral spirits, VM&P naphthas, and lacquer diluents used for thinning, reducing, and cleanup. In 1999, the Department of Commerce, Industrial Reports shows an increase of thinner, reducer and cleanup up to 156,327,000 gallons. This increase from 1991 to 1999 of solvent sold is due to the increase of OEM production. From 1991 to 1995, the NPCA estimated an increase of 17% in the volume of coatings used by OEMs. The NPCA also predicts 2.9% average annual rate of growth until 2000.

The NPCA states that most OEMs purchase their paints ready-to-spray to avoid mixing on site. Most high solid coatings tend to violate TNRCC VOC regulation when thinned. Since OEMs coatings are premixed it is assumed that most solvents are used are for cleaning and maintenance. The NPCA states that there is no official statistics which give a breakdown of solvents by use. Therefore to allocate solvent to each category the assumption is made that one gallon of coating used by the industrial coating category requires the same amount of solvent for cleaning and maintenance. Therefore, the percentage of coatings used by each category will be assumed to be equal to the percentage solvents used for cleaning and maintenance.

Total VOC for 1999 was calculated using the (1) VOC per gallon of paint, (2) total amount of paint used by each category, (3) the amount of solvents used by each category, and (4) the VOC per gallon of solvent. The total VOC for 1999 was then divided by the population of the United States in 1999, to determine a per capita emission factor.

CONSUMER PRODUCTS

DERIVATION OF 1999 CONSUMER AND COMMERCIAL PRODUCT PER CAPITA EMISSION FACTORS FOR THE STATE OF TEXAS

Staff

This report presents the reasons for selecting the California Air Resources Board (CARB) 1997 Consumer and Commercial Product Survey results to calculate the Texas Natural Resources Conservation Commission (TNRCC) 1999 emissions inventory totals for all consumer and commercial product groups. The 1997 CARB survey results were selected in lieu of the dated U.S. Environmental Protection Agency (US EPA) 1990 Consumer and Commercial Products Survey results. Emissions estimation methods are included along with a short overview of the history of consumer and commercial products, a description of the 1990 US EPA survey, the 1997 CARB survey and applicable regulations. Information in the report was obtained from the Internet, the US EPA, the CARB, and representatives from industry and government.

EMISSION INVENTORY SOURCE CATEGORY

CONSUMER AND COMMERCIAL PRODUCTS 2465000000

CONSUMER AND COMMERCIAL PRODUCT CATEGORY DESCRIPTIONS, CODES (AMS CODES)

- (1) personal care products 2460100000
- (2) household products 2460200000
- (3) automotive aftermarket products 2460400000
- (4) coating and related products 2460500000
- (5) adhesives and sealants 2460600000
- (6) Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)-regulated products 2460800000
- (7) miscellaneous products 2460900000

Introduction

Consumer products are chemically formulated products used by individuals in a household setting (e.g., around the home, workshop, garden, garage) that may emit volatile organic compounds (VOCs) during use, consumption, storage, disposal, destruction or decomposition (Radian Corporation (Radian), 1995). Commercial products include products similar in nature to consumer products and may be used in various commercial, institutional, or industrial

applications (Radian, 1995). These solvent containing products are arranged into seven major consumer and commercial product categories in the 1996 Emission Inventory Improvement Program (EIIP) document, [Consumer and Commercial Solvent Use](#). The above list presents the seven product categories in the EIIP document and the corresponding AMS codes. The AMS codes for the categories were obtained from the [Factor Information Retrieval Data System \(FIRE 6.22 for Windows, 1999\)](#).

In 1996, the EIIP document "Consumer and Commercial Solvent Use" stated that 1990 US EPA nationally averaged per capita emission factors for the product groups of interest ([Table A](#)), adjusted for state and local emission limits, are preferred for estimating emissions for consumer and commercial solvent use. However, the 1990 US EPA nationally averaged per capita emission factors are no longer the latest factors available for consumer product emissions estimation and the factors do not reflect the current market formulations available to nationwide consumers. Dennis Fratz, a representative for the Chemical Specialties Manufacturers Association (CSMA), and David Julian of the CARB, both stated that at least two consumer and commercial products re-formulations throughout the consumer products industry have occurred since 1990. Both men, along with Bruce Moore of the EPA Office of Air Quality planning and Standards, informed TNRCC Technical Analysis Staff that emission factors developed from California's latest [1997 Consumer and Commercial Products Survey](#) (California Air Resources Board [CARB], 2000), adjusted to Texas County populations, are the most precise way to calculate the TNRCC 1999 Consumer and Commercial Products Inventory. (Dennis Fratz, Dave Julian and Bruce Moore, personal communication, April 25, 2000.)

GASOLINE STATION UNDERGROUND TANK LOADING

Staff

INTRODUCTION

This document consists of sample calculation estimates of Volatile Organic Compound (VOC) emissions from filling underground storage tanks (UST) in Harris and Travis Counties (FIPS County Codes 201 and 453). Data used in sample calculations were average values for temperature, pressure, saturation factor and molecular weight of gasoline in the USTs located in the two selected counties. The equation employed for the emission factor estimation is published in Chapter 5, Section 5.2 .2.1.1 , Compilation of Air Pollution Emission Factors-Volume 1: Stationary Point and Area sources, Fifth Edition, AP-42¹. The values of the variables used for the emission factor estimations are specific to each of the county/area of study. The Calendar year 1999 data was used for the estimation of VOC emissions using SAS software² . This document is intended for use as a quality assurance tool for validating the methodology and the equations used in developing the emission inventory for the category. The same methodology is used to estimate the Stage 1 total VOC emissions from each of the 254 counties in Texas. The AMS Code for the category is 2501060053 and satisfies AMS verification procedure.

EMISSION FACTORS

The US Environmental Protection Agency (EPA) has published general emission factors for filling of underground storage tanks and they are published in Table 11.3-1, Emission Inventory Improvement Program (EIIP) guidance, Gasoline Marketing (Stage I and Stage II)⁵ and also in Table 5.2-7 Chapter 5, Section 5.2 of Compilation of Air Pollution Emission Factors-Volume 1: Stationary Point and Area sources, AP-42, Fifth Edition. A general formula to estimate losses due to loading petroleum liquids is shown in Section 5.2.2.1.1 of AP-42¹. Selected variables, specific to the tank content in the area of study and seasonal weather data specific to the region, were used to produce unique emission factors. The emission factors generated were then used to calculate the VOC emissions during filling of underground tanks. Specific emission factors were developed for filling of USTs due to the product temperature variations experienced year round and varying Reid vapor pressures found in gasoline in the USTs in Texas counties. The total VOC emission from the UST during gasoline unloading activity was developed based on the assumption that emissions are generated when gasoline vapors in the USTs are displaced to the atmosphere by the gasoline being loaded into the UST³.

The following equation from section 5.2.2.1.1 of AP-42¹ is used to calculate the loading loss emission factors:

$$L_L = 12.46 \frac{SPM}{T} \quad (\text{Equation 1})$$

Where

- L_L = loading loss, pounds per 1000 gallons (lb/10³ gal) of liquid loaded
- S = a saturation factor (see AP-42, Table 5.2-1)(S is the amount or level of concentration of the gaseous vapor in equilibrium occupying the vapor space)
- P = true vapor pressure of liquid loaded, pounds per square inch absolute (psia)(see AP-42, Figures 7.1-5 and 7.1-6, and Table 7.1-2)
- M = molecular weight of vapors, pounds per pound-mole (lb/lb-mole) (see AP-42, Table 7.1-2)
- T = temperature of bulk liquid loaded, °R (°F + 460)

REGULATIONS AND EMISSION CONTROLS

Affected facilities (Stage 1) in nonattainment counties and covered attainment counties are required to comply with one of the Emission Specifications⁴ identified in Title 30 Texas Administrative Code (TAC) Chapter 115 §115.221. In general, affected facilities tend to comply with requirements as indicated in 30 TAC §115.221(2), relating to vapor balance control requirements. The rule⁴ requires that designated nonattainment and attainment counties to use a vapor balance system when filling underground storage tanks and to ensure that the displaced vapors are controlled. The vapor balance system controls include vapor-tight vessels, vapor-tight supply and return lines, and no avoidable leaks detected through audio, olfactory or visual inspection.

It is also assumed that, although all gasoline fuel dispensing facilities in Texas counties are not affected by the rule §115.221, all gasoline dispensing facilities employ vapor balance systems during gasoline unloading activities. This assumption will allow the use of general efficiency percentages in the estimation of controlled VOC emissions from Stage 1 activities in all Texas counties.

According to Section 5.2.2.1.1, page 5.2-14, of AP-42, Fifth Edition, a vapor balance system can operate with a control efficiency (CE) ranging from 93 to over 100 percent. The CE used for this study was 98 percent based on the information⁵ obtained from TNRCC. It is assumed that all gasoline unloading facilities in Texas operate with a CE of 98%. This assumption is applied to develop the methodology and profile the Stage 1 emission calculations in all Texas counties. The other associated control values, rule

penetration (RP) for this activity is 98%⁵, and the rule effectiveness (RE) is 90% are also based on the TNRCC information⁵.

Assuming that all Texas gasoline dispensing facilities (Stage 1) satisfy the TNRCC estimated control levels for CE, RP and RE, the overall VOC controlled emissions from Stage 1 facilities is defined by the following equation:

$$CAE = (EF) (Q) [1 - (CE)(RP)(RE)] \quad (\text{Equation 2})$$

where: CAE = controlled area source emissions
EF or L_L = emission factor for pollutant
Q = activity factor for category (in gallons)
CE = control efficiency/100
RP = rule penetration/100
RE = rule effectiveness/100

To reflect regional variables (temperature, Reid Vapor Pressure (RVP) and molecular weight) for the inventory, default values were changed to actual temperature and pressure values by using UST recorded temperatures and county specific RVP's which convert to true vapor pressures. The variables that differ from default values used in the Equation 1 are temperature and true vapor pressure of the gasoline in the tank. Temperatures utilized in the emission calculations were derived from actual measurements⁶ of gasoline temperatures from storage tanks in the study areas. Product temperatures were recorded throughout the year to establish the temperature range that actually occurs in these storage tanks in metroplex areas of the state. Average winter and summer ambient temperatures were used to represent the temperature variables in the equation (2). In areas where no actual data was obtained, monitored UST temperatures were correlated with ambient average temperatures recorded during fall and spring months because they were similar to the documented UST temperature averages for winter and summer. The average summer month temperatures were correlated with ambient fall temperature averages and ambient average spring temperatures were correlated to reflect the average winter temperatures. The ambient averages for fall and spring were utilized because they resembled the temperature profiles of the monitored temperatures for winter and summer. Ambient temperature contour lines from Texas weather maps⁷ were followed throughout the 254 counties to accommodate and reflect geographical, meteorological, and temperature fluctuations.

For the emission estimation the “summer season” is considered to be May through September. Ozone season calculations are addressed by using the regional temperature and pressure variables for the designated summer months. By utilizing regional data for the temperature , pressure and molecular weight variables, the emission factor is customized for each Texas county.

Federal RVP limits are defined in the Reformulated Gasoline rules in 40 CFR § 80.41 for metroplex areas including Houston, Dallas, Beaumont/Port Arthur. Additionally, RVP control requirements for the State are found in 30 TAC Chapter 115 rule §114.301 and affected counties in rule §114.309. The RVP values regulated by these rules can be used to determine equivalent true vapor pressures of VOC in the USTs and hence to estimate loading loss factors.

GRAPHIC ARTS

1999 Emissions Inventory for Texas Graphic Arts Area Sources

Final Report

Prepared by:

Eastern Research Group, Inc.
1600 Perimeter Park Drive
Suite 200
Morrisville, North Carolina 27560

October 4, 2001

ADMINISTRATIVE SUMMARY

The graphic arts industry is characterized by the use of several different printing technologies, printing substrates, and hundreds of different printing inks, washes, and process solutions. It contains predominantly small facilities operating without emission controls. Because of the large number of small sources that exist and the highly diverse operations and materials they use, it has historically been difficult to develop accurate emission inventories for the category. The objective of this project was to develop a 1999 base year emission inventory for volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from graphic arts area sources in Texas. Annual and ozone season daily emission estimates were to be calculated. The emissions were to be spatially allocated to at least the county level and to the specific individual facility level if possible. The primary source of data to conduct the inventory development effort was a survey of graphic arts area sources in Texas. Approximately 2,400 individual facilities were sent a survey in order to collect data on organic materials usage and emission controls. Industry trade associations participated in the project and provided significant assistance in conducting the facility survey. Of the 2,400 facilities surveyed, a 4.7% response rate was achieved. The data that were obtained were used to develop an emissions estimation methodology. The survey data received were used to develop average material consumption estimates for model facility within each major printing technology (e.g., lithography, flexography, etc.). The models were designed to mirror the area source facility configurations found in Texas.

VOC and HAP emission estimates were developed for each model based on specifications of the VOC and HAP content of the average materials consumed by each model facility. The model facility emissions were then assigned to their corresponding facility type according to the Texas graphic arts area source facility profile found in the U.S. Census Bureau's *County Business*

Patterns database. Emissions were determined on a county and statewide level. Statewide VOC emissions in 1999 were estimated to be 1,383.12 tons/year and 5.32 tons/ozone season day from graphic arts area sources.

BACKGROUND/PROJECT DESCRIPTION

This report documents the procedures and results of a project undertaken for the Texas Natural Resource Conservation Commission (TNRCC) under Contract No. 582-0-34730 to develop a 1999 base year statewide emissions inventory of volatile organic compound (VOC) and hazardous air pollutant (HAP) emissions from area source graphic arts facilities. VOC area sources (under ozone State Implementation Plan rules) are defined as being sources with emissions <10 tons/year, HAP area sources have emissions <10 tons/year of any one HAP or <25 tons/year of all HAPs in combination. For the purposes of this study, these definitions were applied to the extent possible with available data.

The graphic arts printing source category is a very large, diverse, and complex emissions category. It contains several different printing technologies or methodologies (e.g., rotogravure, offset lithography, flexography, letterpress, screen, etc.), several different printing substrates and substrate forms (paper, film, plastic, fabric and sheetfed versus web fed), and employs hundreds of different combinations of inks, washes, and process solutions to accomplish the desired printing application. Emissions can vary by the type of printing method used and the types of printing materials used. This large diversification has historically made it very difficult obtain facility characterization information and to estimate emissions from the graphic arts industry. Compounding this problem is the fact that in Texas and nationally, the bulk of facilities in this industry are small and do not get assessed and treated as point sources. For example, according to the *2000 Print Market Atlas*, in Texas in 1999, of the 3,104 graphic arts facilities identified in the state, approximately 97% had less than 100 employees, 93% had fewer than 50 employees, and 83% had fewer than 20 employees (Printing Industries of America, 2000). The breakout of facility sizes in Texas by number of employees is shown below.

No. of Employees	No. of Printing Facilities
1-4	1,242
5-9	842
10-19	483
20-49	316
50-99	119
100-249	79
250+	23

Efforts in the past to determine emissions from the smaller area source facilities in the graphic arts category have applied several different approaches with limited success. Emission factors have

been developed to estimate area source emissions on a per capita basis (e.g., emissions from all sources in a geographic area as a function of the population in the area) and on a per employee basis, and emissions have been estimated on the basis of a top-down allocation of national data on ink and printing solvent usage to the state/county level (e.g., using employment data in various printing Standard Industrial Classification [SIC] codes).

The goals of this project were twofold. First, there was a goal to survey all readily identifiable graphic arts area sources in the state. By conducting a survey of practically all area source graphic arts facilities in Texas, an inventory could be developed based on actual material consumption data and not outdated per capita emission factors. Also, it was hoped that this approach would provide more information to allow emissions to be spatially allocated to specific facility locations. Second, the survey could be used to gather current data on the actual materials being applied in the facilities to ensure that advances in lower-VOC inks and washes were being captured. Survey results on material usage and material composition could be extrapolated to the entire area source graphic arts source population. Based on the survey data, a statewide inventory of VOC and HAP emissions would be estimated on an annual and ozone season daily basis (for VOC emissions).

To help facilitate the survey and obtain higher response rates, the assistance of two graphic arts trade associations in Texas was solicited. These two groups together, the Printing Industries of Gulf Coast (PIGC) and the Printing and Imaging Association (PIA) - Texas/Oklahoma represent a majority of the graphic arts sources in Texas. Early on in the process, PIGC and PIA agreed to assist in crafting the survey form, mailing out the surveys to the area source population, and in providing clarifying information on printing processes and printing materials composition. Both groups were accessible throughout the project and provided key insights and information that served as the basis for several assumptions used in the overall emissions estimation process.

LANDFILLS

Staff

Landfill Emissions

Description

The landfill emission estimation was developed using applicable guidelines and methodologies described in Preferred Method of estimation for landfill emissions in the EIIP¹ document. The emissions estimated is limited to the landfills located in the 16 nonattainment counties. The landfill gas, mainly methane, and the VOC were estimated using the seven steps as described in the EIIP¹. The VOC content of the landfill gas was calculated using data from AP-42.

Emission Calculation Methodology

The first step was to estimate the total quantity of **waste in place**² at all landfill sites in Texas over the previous thirty years. An estimated 1999 Texas population of 20,489,442 and per capita waste per year of 902 pounds were used for the step one calculation. A default value of 24.8 was used for the 30-year multiplier. The Step two was to estimate the waste in place at large and small landfills in 1999. A default factor of 81% of the total waste in place was used for the estimation of the waste in place for large landfill sites. A large landfill site is where waste is over one million tons in place. The Step three was to use the fact that Texas is a nonarid state where the rainfall is more than 25 inches. The step four was to estimate the methane generation from small landfill sites by using the equation³ for nonarid as indicated. The Step five was to estimate the methane generation from large landfill site by using the equation⁴ for nonarid as stated. The Step six was to estimate the uncontrolled methane emission from the landfill sites using the information from the EPA publication⁵. The controlled amount of methane is considered to be burned in flares, collected and compressed for later use or burned to generate electricity. The difference between the total methane generation and the controlled amount of methane is determined to be the uncontrolled methane emissions.

The additional step seven is to convert the net methane emission nonmethane organic compounds or VOC emission using the data from AP-42⁶. An average NMOC value of 595 ppmv was used for the calculation of the net VOC emission from the state. The step eight was to calculate the VOC emissions for individual nonattainment counties using ratio method based on the step seven state VOC emission data and the 1999 population data. The 1999 population data was estimated using the TNRCC projected censuses population for 1999 and the 2000 US Censuses population data. The final Step nine was to determine the landfill emissions as an area source emission. This was done by subtracting the PSDB reported county landfill emissions for SIC 4953 from the step eight, so as to eliminate the double counting of emissions for the category.

Reference:

1. EIIP, Volume VIII, Chapter 5, pg 5.4-3, Preferred Method
2. EIIP, Volume VIII, Chapter 5, pg 5.4-5, Preferred Method
3. EIIP, Volume VIII, Chapter 5, pg 5.4-6, Preferred Method
4. EIIP, Volume VIII, Chapter 5, pg 5.4-7, Preferred Method
5. The EPA 430-K-99-029, Exhibit 1, pg TX-2
6. The EPA AP-42, Fifth Edition, pg 2.4-4

OIL AND GAS PRODUCTION: OFFSHORE

Staff

EMISSIONS FROM OFF-SHORE OIL & GAS PRODUCTION

Description

Emissions during the year 1999 from oil and gas production facilities which operated off-shores of Jefferson, Chambers, Galveston and Brazoria counties are addressed here. The area source emissions inventory includes those off-shore facilities which operated within the state boundary, where the boundary limits is 9 miles out to the waters from the coast line of each of the four counties. The facilities operated beyond the 9-mile state boundary are not included in the evaluation. The AP-42 emission factors¹ were used to estimate the emissions from equipment operating at the production platforms.

Assumptions

The type and the number of equipment on each of the gas/oil platform operation have been estimated based on the type and number of equipment in a permitted (PSDB) off-shore gas producing facility³ located within the state boundary.

An assumption was also made that each of the off-shore facilities consists of similar number of functional equipments and their capacities were also similar to those in the permitted facility.

It is assumed that a total production from six gas wells are processed by one off-shore platform facility.

Where as the total number of oil processing platforms were equal to the total number of oil wells operated in 1999. The Rail Road Commission of Texas (RRC) reports total barrels of oil measured at a platform not at a oil well as compared to gas well production report.

The type of equipment and the number of units common for all off-shore facilities is assumed to be the same and are given as follows: **Two large compressor engines, two power generating engines, two salt water disposal pumps, four tanks each 400 bbl capacity, two heater treaters, two glycol reboilers, two line heaters, a flare and piping components.**

Methods of Calculation

Estimation of the total number of off-shore facilities associated with each county:

1. The Off Shore Oil & Gas Well data for 1999 was obtained from RRC web sites³. The RRC identifies off-shore well locations on district basis. As such, the data from District 3, which is common for the four counties were extracted for the computation. The subdivision of the off-shore gas wells for each county was based on the ratios of the permitted total oil and gas

processing facilities operated in the four counties during 1999. The oil production platforms distribution on county basis were also computed using the same gas well ratios. The following oil and gas processing platform totals were estimated as indicated above:

County	Oil Processing Platforms	Gas Processing Platforms
Brazoria	4	4
Chambers	7	6
Galveston	3	3
Jefferson	3	3
TOTAL	17	16

As stated earlier it was assumed that each platform has two compressors, one generator, one waste water pump, two heater treaters, two on-line heaters, two glycol reboilers, one oil tank, one salt water tank, one gun barrel tank and one flare. All equipment emissions were computed using AP-42 emission factors considering that capacities and combustion ratings for each unit were similar to the referenced facility units with no controls. The tank emissions were also estimated based on the referenced facility tank emissions.

OIL AND GAS PRODUCTION: ONSHORE

Pollution Solutions

OIL AND GAS PRODUCTION

i. Introduction

Emissions considered in this category come from crude oil and natural gas production in each County in 1996. The production information was obtained from the Oil & Gas Division of the Railroad Commission of Texas. Minor sources were excluded to allow for uniform treatment of emissions based on total oil and gas production.

ii. Methodology

It was assumed, that the crude oil and natural gas condensate that was produced, was stored in a tank at the production site before it was transported off site to a processing plant. A survey was conducted and it was ascertained that the average size storage tank was approximately 8,820 gallons. The production in each county was divided by the **net throughput** of the average tank. This would provide the number of tanks in that county. The number of tanks was multiplied by the emissions per tank to obtain the tons of VOC emissions for crude oil and condensate. The emissions per tank was obtained by using the EPA Tanks 31 program. This is in lieu of surveying each tank at every production site.

For Natural gas production there are fugitive emissions from leaking components in gaseous and light liquid service, combustion emissions from heaters, combustion emissions from compressors used to transfer the natural gas into production lines, and the VOC emissions from the dehydration of Natural Gas. Surveys were done to estimate the average number of components in gas and liquid service, quantify the range and average horsepower of compressors, BTU rating of heaters, and use of heaters. Heater use includes gas dehydration and in line heating. Process emissions were then calculated using average values of gas produced per well site. Total emissions for a county was obtained by multiplying the emissions per typical well site times total county production divided by typical production per well site.

iii. Example Calculations crude/ condensate storage

A) Crude and Condensate Storage

The following were the input parameters for the crude oil Tanks 31 calculations: Vertical fixed roof, shell height 15 ft, diameter 10 ft, liquid height 15 ft, avg. liquid height 8 ft, volume 8,820 gallons, turnovers per year 12, shell color/shade gray/light, shell condition good, roof color/shade gray/light, roof condition good, roof height 1 ft, roof radius 11 ft, mixture/component crude oil (working loss was doubled to compensate for

truck filling emissions). The average gallons calculated per tank/year is 98712.

Example Calculation

Total VOC emissions from Tanks31 = 2.80376 tons/yr per tank for crude oil.

The example county Gregg produced 19,006,545 barrels of oil
Times 42 gallons/barrel divided by 98712 gal per tank/yr = 192.55 tanks
192.55 tanks/yr x 2.80376 tons/yr = 401.22 tons/yr of VOC emissions. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

B) Compressor Emissions

Compressor emissions were based on 11 gm/hp-hr for NOX, 1.5 gm/hp-hr for CO, and 0.43 gm/hp-hr for NMHC and 139.75 hp/mmscf/day production of gas. The total production for each county in million cubic feet per day was multiplied by 139.75 to ascertain the average operating horsepower. The operating horsepower was then multiplied by the emission factor for each emission component to calculate annual tons of NOX, NMHC, and CO.

Example Calculation

An example county (Gregg) had 61,988,980 mcf of production. $61,988,980 \text{ mcf} / (1000 \text{ mscf/mmscf}) / 365 \text{ days/yr} \times 139.75 \text{ daily hp/mmscf} \times 11 \text{ gm/hp-hr} \times (8760 \text{ hrs/yr}) / 454 \text{ gm/lb} / (2000 \text{ lbs/ton}) = 2518.75 \text{ ton/yr}$ NOX for the example county. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

C) Dehydrator Emissions

Dehydrator emissions were based on the emission program GLYCALC and the characteristics of natural gas produced in the Tyler-Longview-Marshall area. Different gas has different fractions other than methane. A study was conducted to determine the average amount of VOC lost per mmcf of gas produced. For the sample of gas wells studied, the VOC was determined to be 7.909 lbs VOC/mmscf. This was then applied to gas production for each county to determine VOC emissions. Combustion emissions are separately calculated and shown as part of the heater emissions.

Example Calculation

An example county (Gregg) had 61,988,980 mcf of production. $61,988,980 \text{ mcf} / 1000 \text{ mscf/mmscf} \times (7.90951 \text{ lbs/mmscf}) / (2000 \text{ lbs/ton}) = 245.15$

ton/yr VOC. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

D) Heater Emissions

Heater emissions were based on the emission factors in AP-42 and the number of combustion sources for the typical natural gas well site in the Tyler-Longview-Marshall area. In line heaters are used, heaters are a part of the dehydration process, and heaters are used in conjunction with amine treaters. Emissions were based on 100 lb/mmscf for NOX, 84 lb/mmscf for CO, and 5.5 lb/mmscf for VOC. Average production per well site was 977.33 mmscf/yr. The average heat consumption per 997.33 mmscf/yr was 4.443 mmBTU/hr. Each county's production was divided by the typical well site production and multiplied by 8760 hours per year and divided by 1000 scf/mmbtu.

Example Calculation

An example county (Gregg) had 61,988,980 mcf of production. $61,988,980 \text{ mcf} / (1000 \text{ mscf/mmscf}) / (977.33 \text{ mmscf/yr per typical well site}) \text{ times } (4.443 \text{ mmbtu/hr per typical well site}) \text{ times } (8760 \text{ hrs/yr}) / (1000 \text{ mcf/mmbtu}) \text{ times } (100 \text{ lbs NOX/mmscf}) / (2000 \text{ lbs/ton}) = 123.43 \text{ ton/yr NOX}$ for the example county. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

D) Fugitive Emissions

Fugitive emissions were based on the emission factors in AP-42 and the number of components in liquid and gas service for the typical natural gas well site in the Tyler-Longview-Marshall area.

VALVES	GAS	0.0045	PUMP	GAS	0.0024
	HV OIL	8.4E-06	SEALS	HV OIL	NA
	LT OIL	0.0025		LT OIL	0.013
	H2O/OIL	9.8E-05		H2O/OIL	2.4E-05
OTHERS	GAS	0.0088	CONNECTORS	GAS	0.0002
	HV OIL	3.2E-05		HV OIL	7.5E-06
	LT OIL	0.0075		LT OIL	0.00021
	H2O/OIL	0.014		H2O/OIL	0.00011
FLANGES	GAS	0.00039	OPEN LINES	GAS	0.002
	HV OIL	3.9E-07		HV OIL	0.00014
	LT OIL	0.00011		LT OIL	0.0014
	H2O/OIL	2.9E-06		H2O/OIL	0.00025

For the sample of wells studied, the number of components was as follows: 22 valves, 13 relief valves, 4 compressor seals, 40 flanges, 26 liquid valves, 2 open lines, and 2 pump seals. A spread sheet with the above emission factors times the number of components was developed. This resulted in a composite emission factor of 0.42 t/y per well site. This composite emission factor includes a reduction in total organics calculated to the percentage VOC (9.07%). This eliminated methane from emissions totals. The number of producing wells was multiplied by this factor for each county.

Example Calculation

An example county(Gregg) had 455 production wells. 455 wells times 0.42 t/y per typical well site) = 191.1 ton/yr VOC for the county. The seasonal factor is 1 and the activity days per week are 7 for the daily emissions.

iv. References

1. **Oil and Gas Well Production**, Texas Railroad Commission, Austin, TX.
2. **AP-42**, U. S. Environmental Protection Agency, 5th ed., January 1995,
3. **TANKS31 program**, U.S. Environmental

GASOLINE CONTAINERS

Emissions from Portable Gasoline Containers in Texas

ERG

Starcrest Consulting Group

August 30, 2002

Executive Summary

Hydrocarbon emissions from portable gasoline containers were estimated using a method developed by the California Air Resources Board (CARB). This methodology adds a new subcategory of emissions, transport spillage, which was previously not included in the air emissions inventory. In Texas, statewide emissions from portable gasoline containers were approximately 78 tons per day, and were comparable and slightly lower than those found in California. Table 1 shows the results in terms of tons per day of volatile organic compounds (VOC) by emission type.

Table 1: Portable Gasoline Container Emissions, Uncontrolled, 2007

Emission Type	Residential	Commercial	Total
Permeation	5.97	0.13	6.10
Diurnal	51.57	0.98	52.55
Transport-Spillage	2.86	2.89	5.75
Spillage	3.96	5.94	9.89
Vapor Displacement	1.20	2.19	3.40
<i>total</i>	65.56	12.13	77.69

A regulation that would reduce spillage and other emissions by approximately one-half through the adoption of a no-spill portable gasoline container requirement could achieve significant reductions of VOC in Texas, as is shown in Table 2.

Table 2: Potential Portable Gasoline Container Reductions, 2007

Emission Type	Residential	Commercial	Total
Permeation	3.02	0.07	3.08
Diurnal	24.47	0.47	24.94
Transport-Spillage*	0.00	0.00	0.00
Spillage	2.68	4.02	6.71
Vapor Displacement*	0.00	0.00	0.00
<i>total</i>	30.17	4.56	34.72

*These emissions are independent of container design.

The number of gas cans used in residential and commercial applications found through surveys is as follows:

Residential: 7,139,895

Commercial: 92,231

The sheer number of gas cans and amount of hydrocarbon emissions indicate that residential gas can emissions predominate, although commercial gas can use rates are much higher.

Introduction

Portable gasoline containers, usually called “gas cans,” can be a significant source of urban air emissions. The emissions arise from escaping gasoline vapor and spilled gasoline which then evaporates, and are measured as volatile organic compounds (VOC). While we have a fairly good grasp of emissions from refueling motor vehicles, gas can emissions are highly uncertain at this time. The California Air Resources Board (CARB) was instrumental in developing a methodology to quantify emissions from gas cans, and now several states including Texas are considering using the CARB method to help determine the need for a “no-spill” gas can regulation.

Historically, gas can emissions were part of the emissions inventory for non-road equipment such as lawn mowers, chainsaws, trimmers (“weed whackers”), and other portable power equipment. The 1992 Non-Road Equipment and Vehicle Emissions Study (NEVES) considered refueling emissions as a function of gasoline consumption, and included algorithms for spillage and vapor displacement. The draft NONROAD model has the same algorithms, which are used to estimate this part of the VOC emissions inventory. A major improvement in the NONROAD model over the NEVES was to separate commercial and residential equipment, as commercial equipment tend to be used during the week and residential equipment, which are more numerous in terms of numbers of engines, tend to be used fewer hours, mainly on the weekends. Therefore, we have adapted our surveys and methods to include commercial and residential gas can emissions separately.

The main emphasis of this research is on lawn and garden uses of gas cans. Lawn and garden is the largest category in the NONROAD model that is refueled entirely by gas cans. Recreational vehicles (e.g., all-terrain vehicles and off-road motorcycles) are also refueled by gas cans, but their usage is not nearly as high as that for lawn and garden equipment; this topic is revisited in the Quality Assurance section. Recreational marine engines (e.g., outboard motorboats and personal watercraft) can be refueled by portable gasoline containers, but pressurized marine gas tanks are much more common than the ubiquitous “gas can.” Finally, some construction, commercial, agricultural and logging equipment may be refueled with gas cans, but NONROAD assumes that these types of equipment are all refueled at the gas pump.

¹ U.S. EPA. 1991. Nonroad Engine and Vehicle Emission Study – Report. EPA-460/3-91-02.

² <http://www.epa.gov/otaq/nonrdmdl.htm>

³ U.S. EPA. 1998. Refueling Emissions for Nonroad Engine Modeling. Report No. NR-013

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