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TANK 241C102 HEADSPACE GAS & VAPOR
CHARACTERIZATION RESULTS FOR SAMPLES COLLECTED
IN 8/1994

ENGINEERING CHANGE NOTICE

Page 1 of 21. ECN **626277**Proj.
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Page 2 of 2

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626277

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18. Change Impact Review: Indicate the related documents (other than the engineering documents identified on Side 1) that will be affected by the change described in Block 12. Enter the affected document number in Block 19.

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Conceptual Design Report	[]	Installation Procedure	[]	Component Index	[]
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OM Manual	[]	Operational Safety Requirement	[]	ICRS Procedure	[]
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Document Number Revision

20. Approvals

Signature	Date	Signature	Date
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Cog. Eng. D. R. Bratzel <i>DRB</i>	<i>9/25/95</i>	PE	
Cog. Mgr. T. J. Kelley <i>T. Kelley</i>	<i>9/25/95</i>	QA	
QA		Safety	
Safety		Design	
Environ.		Environ.	
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Characterization Results for Samples Collected in
August 1994

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**This document was reviewed following the
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9/27/95

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Tank 241-C-102 Headspace Gas and Vapor Characterization Results for Samples Collected in August 1994

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Date Published
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Prepared for the U.S. Department of Energy
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WHC-SD-WM-ER-459 Rev.1

**Tank 241-C-102 Headspace Gas and Vapor Characterization Results
for Samples Collected in August 1994**

September 22, 1995

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Acronyms and Abbreviations

CES	consensus exposure standard
EPA	Environmental Protection Agency
GC	gas chromatograph
GC/MS	gas chromatograph/mass spectrometer
LFL	lower flammability limit
MS	mass spectrometer
NFPA	National Fire Protection Association
NPH	normal paraffinic hydrocarbon
OGIST	Oregon Graduate Institute of Science and Technology
ORNL	Oak Ridge National Laboratory
PNL	Pacific Northwest Laboratory
ppmv	parts per million by volume, 1 ppmv = 10 ⁻⁴ vol%
TNMOC	total nonmethane organic carbon
TST	triple sorbent trap
vol%	percent by volume, 1 vol% = 10,000 ppmv
VSS	vapor sampling system
WHC	Westinghouse Hanford Company

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Tank 241-C-102 Headspace Gas and Vapor Characterization Results
for Samples Collected in August 1994

1.0 INTRODUCTION

1.1 Characterization Objectives

Tank C-102 headspace gas and vapor samples were collected and analyzed to help determine the potential risks of fugitive emissions to tank farm workers. The drivers and objectives of waste tank headspace sampling and analysis are discussed in *Program Plan for the Resolution of Tank Vapor Issues* (Osborne and Huckaby 1994). Tank C-102 was vapor sampled in accordance with *Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution* (Osborne et al. 1994). Results presented here represent the best available data on the headspace constituents of tank C-102.

1.2 Characterization Data Criteria

Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution describes parameters for data collection to ensure appropriate conclusions can be drawn from the data. Tank headspace characterization data were collected to help in the evaluation of 1) headspace flammability, and 2) identification and quantification of compounds of toxicological concern.

Single Shell Tank Interim Operational Safety Requirements (Dougherty 1995) specifies that combustible constituents in tank headspaces be maintained below 25 % of the lower flammability limit (LFL). This essentially agrees with National Fire Protection Association requirements that combustible concentrations be maintained at or below 25 % of the LFL (NFPA 1992). Current governing operating specifications for Watchlist tanks, such as tank BY-105, specify that combustible constituents be maintained at or below 20 % of the LFL (WHC 1995a).

Headspace characterization data are used by Westinghouse Hanford Company (WHC) Tank Waste Remediation Systems Industrial Hygiene as source term data in the industrial hygiene strategy to protect workers from tank fugitive emissions. Because selection of worker protective equipment must be based on industrial hygiene monitoring of the work place and not on source term data (29 CFR 1910.120), tank headspace characterization data can not be used for this purpose. Furthermore, because there are mechanisms by which headspace constituents can be either diluted or concentrated as they are released to the atmosphere, the headspace characterization data should not be considered to be representative of emissions at the point of emission.

These statements notwithstanding, the data quality objectives document specifies that the industrial hygiene group be advised if constituents with toxicological properties exceed 50 % of the appropriate consensus exposure standard (CES) for non-carcinogens, or 10 % of the appropriate CES for carcinogens. A CES is defined as the most stringent of known regulatory or recommended toxicological values for the workplace (Osborne et al. 1994).

1.3 Sampling Overview

Tank C-102 headspace characterization data presented here are from a single sampling event. Samples collected are thought to have been representative of the tank headspace when the tank was sampled (Meacham et al. 1995), and sample analyses were designed to provide a reasonably accurate and complete characterization of the significant headspace constituents. No assessment has been made of how the tank C-102 headspace composition changes with time, though studies of tank C-103 suggest that composition changes probably occur very slowly in passively ventilated tanks, such as tank C-102 (Huckaby and Story 1994).

1.4 Tank Headspace Dynamics

Tank C-102 is the second tank in a 3-tank cascade with tanks C-101 and C-103 and is connected to tank C-101 via a 7.4-cm (2.9-in.) inside diameter, 7.6-m (25-ft) long cascade line. Tanks C-101 and C-103 are connected by a similar cascade line. Since these cascade lines connect the headspaces of these tanks, gases and vapors originating from the wastes in tank C-101 or tank C-103 may be transferred to tank C-102 (unless the cascade lines are obstructed).

Barometric pressure typically rises and falls on a diurnal cycle, with an average daily exchange of air equal to about 0.46 % of each tank headspace (Huckaby 1994). When headspace samples were collected from these tanks, tanks C-101 and C-103 also received small streams of dry ambient air to protect waste surface level instruments from condensation of water vapor. The flowrate of this instrument air varied from about 1.4 to 1.7 m³/hr (50 to 60 ft³/hr), (Huckaby 1994).

The breather riser on tank C-101 was valved shut in December 1989, so that any air exchange with the atmosphere would occur via the cascade line to tank C-102. Furthermore, since December 1989 the cascade of tanks C-101, C-102, and C-103 has had only 1 breather riser open (either on tank C-102 or tank C-103). In the period before headspace samples were collected from tank C-102 (specifically since March 1993), the breather riser on tank C-103 had been valved shut, and the intended pathway for tanks C-101, C-102, and C-103 to breathe with the atmosphere was via the breather riser on tank C-102 (Conrad 1994).

Anderson (1990) notes, however, that the cascade line between tanks C-101 and C-102 was partially plugged in 1954. A comparison of vapor data indicates that the cascade line between tanks C-101 and C-102 does not effectively transport organic vapors, and may be blocked (Huckaby and Bratzel 1995). To determine the origin of gases and vapors in tank C-102, it is important to understand the extent to which tanks C-101 and C-103 breathe through tank C-102, because constituents detected in the headspace of tank C-102 may actually have originated from the waste in tanks C-101 or C-103¹. Sections 3.4 and 4.4 discuss what the available headspace data from tanks C-101, C-102, and C-103 indicate about whether tanks C-101 and C-103 breathe freely via their cascade lines with tank C-102.

¹ Tank C-103 is known to have a layer of semivolatile organic liquid floating on the aqueous waste (Pool and Bean 1994), and the highest total concentration of organic vapors of any waste tank known (Huckaby and Story 1994).

2.0 SAMPLING EVENT

Headspace gas and vapor samples were collected from tank C-102 using the vapor sampling system (VSS) on August 23, 1994 by WHC Sampling and Mobile Laboratories (WHC 1995). Sample collection and analysis were performed as directed by the sample and analysis plan² (WHC 1995, Appendix A). The tank headspace temperature was determined to be 25.8 °C. Air from the C-102 headspace was withdrawn via a 6.1-m long heated sampling probe mounted in riser 3, and transferred via heated tubing to the VSS sampling manifold. Heated zones of the VSS were maintained at approximately 50 °C. All samples were collected between 12:46 p.m. and 4:20 p.m., with no anomalies noted.

Sampling media were prepared and analyzed by WHC, Oak Ridge National Laboratories (ORNL), Pacific Northwest Laboratories (PNL), and Oregon Graduate Institute of Science and Technology (OGIST) through a contract with Sandia National Laboratories. The 39 tank air samples and 2 ambient air control samples collected are listed in Table 2-1 by analytical laboratory. Table 2-1 also lists the 14 trip blanks and 2 field blanks provided by the laboratories.

A general description of vapor sampling and sample analysis methods is given by Huckaby et al. (1995). The sampling equipment, sample collection sequence, sorbent trap sample air flow rates and flow times, chain of custody information, and a discussion of the sampling event itself are given in WHC (1995b).

² The current requirement that sampling and analysis parameters be specified by a tank characterization plan was not in effect for gas and vapor sampling until October 1, 1994.

3.0 INORGANIC GASES AND VAPORS

Analytical results of sorbent trap and SUMMA^{TM,3} canister tank air samples for selected inorganic gases and vapors are given in Table 3-1 in parts per million by volume (ppmv) in dry air. The concentration of water vapor given in Table 3-1 has been adjusted to tank conditions as given in Section 3.3. Inorganic analyte sorbent traps were prepared and analyzed by PNL (Klinger et al. 1995a), and SUMMATM canisters were analyzed for inorganic analytes by OGIST (Rasmussen 1994a).

PNL analyses sorbent traps for inorganic compounds were performed 26 days after sample collection (Ligothe 1995), and analyses of SUMMATM canisters were started by OGIST 21 days after the sample collection (Rasmussen 1994a). These analyses were conducted within the allowed 60-day holding time specified by the WHC quality assurance project plan (Keller 1994). The 60-day holding time was administratively chosen, and no holding time study has been performed to address the stability of compounds in SUMMATM canisters in the chemical matrix of the waste tank samples.

PNL results were produced at PNL quality assurance impact level 3. OGIST did not have a WHC-approved quality assurance project plan in place when performing analyses, so OGIST data have been placed in square brackets both in Table 3-1 and elsewhere in this report to indicate that they represent secondary results.

3.1 Ammonia, Hydrogen, and Nitrous Oxide

The ammonia concentration in C-102 headspace was determined to be 189 ppmv. Ammonia has been observed in virtually all of the waste tanks sampled to date, at concentrations ranging from about 3 ppmv in tank C-108 (Lucke et al. 1995a), to 1040 ppmv in BY-108 (McVeety et al. 1995). Given the LFL of ammonia in air is about 15 % by volume (vol%), the measured 189 ppmv corresponds to about 0.13 % of the LFL, and does not contribute appreciably to the flammability of the headspace.

The concentration of hydrogen in tank C-102 was determined to be [133 ppmv]. Hydrogen in the waste tanks is of concern as a fuel. Given that the LFL for hydrogen in air is about 4 vol%, the 133 ppmv hydrogen concentration in tank C-102 corresponds to about 0.3 % of its LFL. At this level hydrogen is not a flammability concern in tank C-102.

The nitrous oxide concentration in tank C-102 was measured at [154 ppmv]. Nitrous oxide has been detected in other waste tanks at concentrations as low as about 12 ppmv in tank TX-105 (Klinger et al. 1995b), and as high as about 868 ppmv in tank U-103 (Ligothe et al. 1995). Under the proper conditions, nitrous oxide can serve as an oxidizer to support combustion. However, Cashdollar et al. (1992) found that nitrous oxide had no significant effect on the flammability of hydrogen and air mixtures for hydrogen concentrations less than 20 vol%, and that "small amounts of nitrous oxide (relative to air) do not appear to have much effect on the flammability". Their results suggest the measured nitrous oxide concentration is much too low to have a significant effect on the flammability of the tank C-102 headspace.

³ SUMMA is a trademark of Molectrics, Inc., Cleveland, Ohio.

3.2 Carbon Monoxide and Carbon Dioxide

Carbon monoxide, measured to be [4.0 ppmv] in SUMMA™ samples, is at a much higher concentration in tank C-102 than it is in ambient air, where it typically ranges from 0.05 to 0.15 ppmv. Because different analytical methods have been used to measure carbon monoxide in the waste tanks sampled to date, the information on carbon monoxide has varied from tank to tank. Elevated waste tank headspace carbon monoxide concentrations are common, and are thought to be due to the decomposition of organic waste in the tanks. The [4.0 ppmv] of carbon monoxide in tank C-102 is the third highest measured in any waste tank to date; tanks C-103 and C-101 were determined to have [26.7 ppmv] and [15.5 ppmv], respectively, of carbon monoxide (Rasmussen and Einfeld 1994, Rasmussen 1994b).

The average carbon dioxide concentration in the tank C-102 headspace, [8.2 ppmv], is among the lowest measured in any waste tank to date. Normally present in the ambient air at a concentration of 350 to 400 ppmv, carbon dioxide is typically at a lower concentration in the waste tank headspaces than in ambient air. Carbon dioxide introduced by air exchange with the atmosphere is readily absorbed by caustic supernatant and interstitial liquids of the waste tanks, and converted to carbonate in solution.

3.3 Nitric Oxide, Nitrogen Dioxide, Water and Tritium

Nitric oxide and nitrogen dioxide concentrations in the tank C-102 headspace were determined to be 0.24 ppmv and ≤ 0.05 ppmv, respectively. These are both acid gases that would have very low equilibrium concentrations above the high pH sludge in tank C-102. The measurable presence of nitric oxide may be due to its formation from oxygen and nitrogen in the radiation field of the headspace. These constituents could potentially serve as oxidizers to support combustion, but at the measured concentrations would have a negligible effect on the flammability of the tank C-102 headspace.

The water vapor concentration of tank C-102 was determined to be about 20.4 mg/L, at the tank headspace temperature of 25.8 °C and pressure of 990 mbar (742.7 torr), (WHC 1995). This corresponds to a water vapor partial pressure of 28.1 mbar (21.1 torr), to a dew point of 23.0 °C, and to a relative humidity of 85 %.

Silica gel sorbent traps were used to sample for tritium. It is assumed that tritium produced by the waste combines with hydroxide ions to form tritium-substituted water. Evaporation of the tritium-substituted water would then result in airborne radioactive contamination. Silica gel sorbent traps adsorb virtually all (normal and tritium-substituted) water vapor from the sampled tank air, and are analyzed at the WHC 222-S laboratory. Radiochemical analysis of the silica gel trap indicated the total activity of the headspace to be less than 50 pCi/L (WHC 1995).

3.4 Discussion of Inorganic Gases and Vapors

Aside from water vapor, the most abundant waste constituents in the tank C-102 headspace are ammonia, nitrous oxide, and hydrogen. These have been detected in most tank headspaces sampled to date, and are usually the dominate waste species.

The relative standard deviations of the inorganic gas and vapor results given in the last column in Table 3-1 are good. Relative standard deviations range from 1 % for nitrous oxide, to 17 % for nitric oxide results. The precision reported depends both on sampling parameters (e.g., sample flow rate and flow time for

sorbent traps) and analytical parameters (e.g., sample preparation, dilutions, etc.), and the small relative standard deviations suggest good control was maintained both in the field and in the laboratories.

Table 3-2 lists, for comparison, selected sampling data and inorganic gas and vapor concentrations measured in tanks C-101, C-102, and C-103. The inorganic gases and vapors in these tanks are at concentrations that support the premise that tanks C-101 and C-103 breathe primarily via their cascade lines with tank C-102. To understand this, suppose that tank C-101 did breathe only via its cascade line to tank C-102 (as per the ventilation configuration). Then all the air inhaled by tank C-101 would have the composition of air in tank C-102, so that at steady state (neglecting any losses of constituents in transit), every headspace constituent in tank C-102 would be present in tank C-101 at a concentration at least as high as it is in tank C-102. Furthermore, any gases or vapors generated or released by the waste in tank C-101 would raise the concentration of these constituents in tank C-101 above the level in tank C-102. As indicated in Table 3-2, the concentrations of hydrogen, carbon dioxide, carbon monoxide, nitric oxide, and nitrous oxide are all significantly higher in tank C-101 than they are in tank C-102. Likewise, the concentrations of these same constituents, as well as ammonia, are higher in tank C-103 than in tank C-102.

Amongst the inorganic analytes listed in Table 3-2, only ammonia is at a higher concentration in tank C-102 than it is in tank C-101. This exceptional relationship of ammonia, if indeed tank C-101 breathed primarily via the cascade line with tank C-102, may be reasonable given its solubility in water. Aqueous condensate forming in the cascade line (the dewpoint of tank C-101 is about 30 °C, Huckaby and Bratzel 1995) might absorb enough of the ammonia vapor in transit to tank C-101 to cause this constituent to be lower in tank C-101 than in tank C-102.

Though the data from tanks C-101, C-102, and C-103 (with special allowance for ammonia in tank C-101) are consistent with the premise that tanks C-101 and C-103 breathe primarily via their cascade lines with tank C-102, the data do not prove that this is happening. The selected gas and vapor concentrations may be higher in tanks C-101 and C-103 than in tank C-102 simply because their generation rates are higher in those tanks.

4.0 ORGANIC VAPORS

Organic vapors in the tank C-102 headspace were sampled using SUMMA™ canisters, which were analyzed by OGIST and PNL, and triple sorbent traps (TSTs), which were analyzed by ORNL. ORNL and PNL used gas chromatographs (GCs) equipped with mass spectrometer (MS) detectors to separate, identify, and quantitate the analytes. A quantitative measurement of the total organic vapor concentration by the U.S. Environmental Protection Agency (EPA) task order 12 (TO-12) method was also performed by OGIST (EPA 1988, Rasmussen 1994a). Descriptions of sample device cleaning, sample preparations, and analyses are given by Jenkins et al. (1995a), Rasmussen (1994a), and Klinger et al. (1995a).

PNL SUMMA™ sample results should be considered to be the primary organic vapor data for tank C-102. PNL results were produced at PNL quality assurance impact level 3. Because tank C-102 analyses were initially assigned low priority by WHC, PNL SUMMA™ canister analyses for organic vapors were not performed until 222 days after sample collection (Ligotke 1995), greatly exceeding the specified 60-day holding time (Keller 1994). The 60-day holding time was administratively chosen, because no holding time study has been performed to address the stability of organic compounds in SUMMA™ canisters in the likely chemical matrix of the waste tanks.

ORNL analyses of TST samples from this and other waste tanks generally agree with, support, and augment the SUMMA™ sample results. However, because certain WHC quality assurance requirements were not satisfied by ORNL, the quality assurance assessment of ORNL by Hendrickson (1995) should be reviewed before results unique to the TST samples are used for decision making.

All TSTs prepared by ORNL had 3 surrogate compounds added to evaluate sample matrix effects, potential handling, storage, and shipment problems, and analytical instrumentation performance (Jenkins et al. 1995a). ORNL evaluated the surrogate recoveries using a statistical approach similar to that prescribed by *SW 846 Method 8260A Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) Capillary Column Technique* (EPA 1992). Using this approach, ORNL reported that all surrogates had standard deviation values within the 95 % confidence interval for variance, indicating that no bias was introduced in the measurement of analyte quantities (Jenkins 1995a).

4.1 Positively Identified Organic Analytes

Positive identification of organic analytes using the methods employed by PNL and ORNL involves matching the GC retention times and MS data from a sample with that obtained from the analysis of standards. The concentration of an analyte in the sample is said to be quantitatively measured if the response of the GC/MS has been established at several known concentrations of that analyte (i.e., the GC/MS has been calibrated for that analyte), and the MS response to the analyte in the sample is between the lowest and highest responses to the known concentrations (i.e., the analyte is within the calibration range).

ORNL and PNL were assigned different lists of organic compounds, or target analytes, to positively identify and measure quantitatively. The ORNL target analyte list was derived from a review of the tank C-103 headspace constituents by a panel of toxicology experts (Mahlum et al. 1994). The PNL target analyte list included 39 compounds of the EPA task order 14 (TO-14) method, which are primarily halocarbons and common industrial solvents (EPA 1988), plus 14 analytes selected mainly from the toxicology panel's review of tank C-103.

Table 4-1 lists the organic compounds positively identified and quantitated in SUMMA™ samples. Analysis for methane was performed by OGIST (Rasmussen 1994a), other SUMMA™ analyses were performed according to the EPA TO-14 methodology by PNL (EPA 1988, Klinger et al. 1995a). Only 2 of the 39 TO-14 target analytes (i.e., toluene and trichlorofluoromethane), but all 14 of the additional target analytes were above the 0.005 ppmv quantitation limit of the analyses. Averages reported are from analyses of 3 SUMMA™ canister samples.

Jenkins et al. (1995a) report the positive identification of 26 of 27 target analytes in TST samples. 1,1-Dichloroethene was the only TST target analyte not detected in the TST samples. The average concentrations of the positively identified compounds, from the analysis of 3 TSTs, are given in Tables 4-2, 4-3, and 4-4. Despite calibration of the instrument over about a 20-fold concentration range, 12 of the positively identified compounds were measured to be outside of the calibration range in at least 1 of the 3 TST samples. The average concentrations of the positively identified compounds are given in Tables 4-2, 4-3, and 4-4. Table 4-2 lists the positively identified, quantitated analytes, Table 4-3 lists the positively identified analytes which were not quantitated (because the measurement was outside the calibration range for at least 1 sample), and Table 4-4 lists the positively identified analytes which exceeded their practical holding times. Tables 4-2, 4-3, and 4-4 are mutually exclusive, so that no analyte appears in more than 1 of these tables. Data in Tables 4-3 and 4-4 may not be accurate to within $\pm 30\%$ as specified by Burnum (1995).

The ORNL practical holding time is defined as the holding time for which there is a 15 % risk that the concentration of an analyte in the sample will be below its initial concentration. As indicated in Table 4-4, butanal, 1-butanol, 2-pentanone, propanone, and n-pentanenitrile exceeded their practical holding times, and may have been affected by the 79 day period between sample collection and analysis (Jenkins 1995b). Jenkins et al. (1995b) describe the ORNL practical holding time study, and report the practical holding times for these five compounds. It should be noted that the contractual holding time for the TST samples was 60 days.

The concentrations of tributyl phosphate and dibutyl butylphosphonate reported in Table 4-3 probably underestimate the actual concentrations in the tank headspace. These compounds have very low volatility, and are thought to be adsorbed by glass fiber filters used during sampling to protect samples from radiolytic particulates.

Both PNL and ORNL report target analyte concentrations in ppmv of analyte in dry air. To correct for the measured water vapor content of tank C-102 and obtain concentration in ppmv of analyte in moist tank air, multiply the dry-air ppmv concentrations by 0.972.

Eleven target analytes were common to both TST and SUMMA™ analyses. Table 4-5 lists these, and their reported average concentrations in TST and SUMMA™ samples. Results from these 2 sampling and analytical methods are in good agreement for the nitriles (ethanenitrile, propanenitrile, and n-butanenitrile). The methods also agree reasonably well on the concentrations of propanone, n-heptane, and n-decane. However, as indicated in Table 4-5, the reported concentrations of dichloromethane, benzene, toluene, and n-hexane by the 2 methods are not in agreement. The differences in reported values are not significant except for benzene. Despite the relatively poor precision of the TST benzene measurements, it is advisable to assume (to be conservative) the higher benzene concentration of 0.32 ppmv is correct.

The most abundant analytes in Tables 4-1 through 4-4 are methane, propanone, n-dodecane, ethanenitrile, n-tridecane, 1-butanol, and n-undecane. At the reported concentrations, the target analytes do not individually or collectively represent a flammability hazard.

4.2 Tentatively Identified Organic Analytes

In addition to the target analytes, the ORNL and PNL analytical procedures allow the tentative identification of other organic compounds. Tentative identification of analytes was performed by comparing the MS molecular fragmentation patterns with a library of known MS fragmentation patterns. This method allows an organic analyte to be identified (with reasonable certainty) as an alkane, a ketone, an aldehyde, etc., and may also determine its molecular weight. The method usually does not, however, allow the unambiguous identification of structural isomers, and this ambiguity increases with analyte molecular weight. Many analytes can be tentatively identified with reasonable confidence without having to inject standards of each into the GC/MS to determine their GC retention times or specific MS patterns.

By the nature of the sampling devices, virtually all organic vapors present in the tank headspace are collected by both TST and SUMMATM samples. Analyses of the samples are designed to recover, separate, identify, and quantify the organic vapors in the samples. TSTs are not good for collecting highly volatile compounds (i.e., molecules more volatile than propane), but are quite good for most others. In contrast, the recovery of very low volatility compounds (e.g., molecules with more than about 15 carbon atoms) and some polar compounds with moderate volatility (e.g., butanal) from SUMMATM samples has been problematic.

The list of tentatively identified compounds recovered from SUMMATM samples, with estimated concentrations, is given in Table 4-6. Compounds are listed in Table 4-6 in the order by which they eluted chromatographically, and only non-zero results are included in the reported averages. Because the list of tentatively identified organic compounds in SUMMATM samples is rather long and difficult to analyze, the list has been sorted alphanumerically by compound name in Table 4-7, and also in order of decreasing estimated concentrations in Table 4-8. Numbers in the first columns of Tables 4-7 and 4-8 (Cmpd #) identify the location of the compounds in Table 4-6. Estimated concentrations are in mg/m³, based on dry air at 0 °C and 1.01 bar.

The list of tentatively identified compounds detected in TST samples, and their estimated concentrations, are given in Table 4-9. Compounds are listed in Table 4-9 according to the order by which they eluted chromatographically. The averages reported by ORNL in Table 4-9 are all 3-sample averages, and if an analyte was not detected in a sample, its concentration in that sample was considered to be zero for averaging purposes. Because the list of tentatively identified organic compounds in TST samples is rather long and difficult to analyse, the list has been sorted alphanumerically by compound name in Tables 4-10, and also in order of decreasing estimated concentrations in Table 4-11. Numbers in the first columns of Tables 4-10 and 4-11 (Cmpd #) identify the location of the compounds in Table 4-9. Estimated concentrations are in mg/m³, based on dry air at 0 °C and 1.01 bar.

The ORNL and PNL methods used to tentatively identify and estimate concentrations are described by Jenkins et al. (1995a) and Klinger et al. (1995a), respectively, and should be reviewed before this data is used for decision making. Concentrations given in Tables 4-6 through 4-11 should be considered rough estimates. Results in Tables 4-6 through 4-11 are presented in terms of observed chromatographic peaks, and are not adjusted for the occurrence of split peaks (e.g., Cmpd # 123 and 124 in Table 4-9) or the assignment of the same identity to different peaks (e.g., Cmpd # 105 and 113 in Table 4-9). In these instances, the estimated concentration of a compound appearing in more than 1 peak is simply the sum of the individual peak estimates.

4.3 Total Nonmethane Organic Carbon

OGIST measured the TNMOC concentration in 3 SUMMA™ canister samples using the EPA TO-12 method (Rasmussen 1994a). The sample mean was [313 mg/m³], with a standard deviation of about [5 mg/m³]. Though data on other tanks is limited, this value is much higher than typical for the waste tanks sampled to date.

A comparable analysis of 1 TST sample by gas chromatography with flame ionization detection indicated the organic vapor concentration to be 296 mg/m³ (Jenkins et al. 1995a). This is in excellent agreement with the EPA TO-12 result. EPA TO-12 method TNMOC measurements of other waste tanks have ranged from as high as [5,000 mg/m³] in tank C-103 (Rasmussen and Einfeld 1994), to as low as [0.18 mg/m³] in tank C-111 (Rasmussen 1994c), while the TNMOC concentration of clean ambient air ranges from about 0.03 to 0.1 mg/m³.

4.4 Discussion of Organic Analytes

It is useful to consider the organic vapors in the waste tanks in terms of their sources. Some organic compounds, particularly semivolatile compounds, were constituents of the waste sent to the tank farms, and are present in the tank headspaces because they are still evaporating from the wastes. Other organic compounds present in the tanks have been produced via chemical and radiolytic reactions of the original organic wastes. The most abundant of these degradation products in tank headspaces are volatile, and most contain functional groups.

Tank C-102 is known to have contained bulk quantities of a semivolatile organic liquid (Carothers 1988), and its presence is still evident in auger samples (Campbell et al. 1995). The high vapor concentrations of the semivolatile normal paraffinic hydrocarbons (NPHs), are understandable given their presence in the waste. In fact, the NPH vapor concentrations are perhaps lower than would be expected if tank C-103 were ventilated (as intended) via the cascade line to tank C-102. For example, ORNL measured the n-dodecane and n-tridecane vapor concentrations to be about 40 and 52 ppmv, respectively, in tank C-103, and only about 0.91 and 0.81 ppmv, respectively, in tank C-102.

The organic vapor distributions in tanks C-102 and C-103 are graphically illustrated in Figures 4-1 and 4-2. A total ion chromatogram for a SUMMA™ sample from tank C-102 is displayed in the upper half of both figures (the same chromatogram appears in both figures). In the lower halves of the figures, a similar total ion chromatogram for a SUMMA™ sample from tank C-103 is displayed. In Figure 4-1, the ordinate scale of the tank C-103 (lower) chromatogram has been adjusted to reveal detail comparable to that given in the tank C-102 (upper) chromatogram. Note, however, that in Figure 4-1 the tallest peaks of the tank C-103 (lower) chromatogram (i.e., at 44 and 48 minutes) are off-scale, and are truncated. In Figure 4-2, the ordinate scale of the tank C-103 (lower) chromatogram has been adjusted so that these tallest peaks are not off-scale.

In Figures 4-1 and 4-2, the abscissa of the chromatograms is elution time, and the ordinate is instrumental response. The mixture of organic compounds in each sample has been separated chromatographically so that, inasmuch as the separation is complete, individual analytes elute at different times and appear as individual peaks. Each peak height is roughly proportional to the concentration of the associated analyte present in the sample. Rough comparisons of the concentrations of compounds in tanks C-102 and C-103 can be made by considering that the propanone peak, appearing as a relatively tall peak at about 9 min in both chromatograms of Figure 4-1, is about 3.8 ppmv in the tank C-102 sample, and about 19.3 ppmv in the tank C-103 sample (Huckaby and Story 1994).

The tallest peak in the tank C-102 (upper) chromatogram of Figure 4-1, at about 18 min, is due to 1-butanol. The 5 next tallest peaks in the tank C-102 chromatogram are n-decane (at 36 min), n-undecane (at 40 min), n-dodecane (at 44 min), n-tridecane (at 48 min), and n-tetradecane (at 52 min). These are the semivolatile NPHs. Generally, the more volatile a compound is, the faster it elutes through the GC, so the volatile compounds are to the left in the chromatograms, and the semivolatile compounds are to the right.

Examination of Figures 4-1 and 4-2 indicates many similarities between the organic vapor distributions of tanks C-102 and C-103. Of particular interest are the peaks scattered amongst the NPH peaks between about 40 and 52 min in both chromatograms in Figure 4-2. These peaks are from semivolatile organic compounds, and are thought to be impurities of the NPH PUREX process diluent. The locations and relative heights of these peaks in the 2 chromatograms are so similar that either the semivolatile paraffinic liquids in tanks C-102 and C-103 came from the same batch of PUREX process diluent, and/or these headspace constituents are being transported via the cascade line from tank C-103 to tank C-102. Waste transfer history does suggest that the organic liquid currently present in tank C-103 may have come from tank C-102 (Carothers 1988).

The relationship between the organic vapors in tanks C-102 and C-101 has been examined by Huckaby and Bratzel (1995). A visual comparison of the organic vapor distributions in tanks C-102 and C-101 is provided in Figure 4-3 (Klinger et al. 1995a, Lucke et al. 1995b). The ordinate scales in these 2 chromatograms are different, as are the amounts of sample analyzed, but the peak height-to-concentration relationships are similar. Specifically, the tallest peak in the tank C-101 (lower) chromatogram, at about 44 min, has an estimated concentration of 15.2 mg/m³, while the corresponding peak in the tank C-102 (upper) chromatogram (also at about 44 min), has an estimated concentration of 13.5 mg/m³.

Comparison of the chromatograms in Figure 4-3 suggests that tank C-101 has its own supply of semivolatile organic waste, and that the cascade line between them does not allow significant transfer of semivolatile organic vapors from tank C-101 to tank C-102. Specifically, the non-NPH semivolatile paraffinic compounds present in tank C-102 are at relatively low concentrations and appear well-separated in the tank C-102 (upper) chromatogram in Figure 4-3. By contrast, the concentrations of compounds eluting between n-undecane (at 40 min) and n-tetradecane (at 52 min) in the tank C-101 chromatogram are so much higher that they are no longer separated by the GC. The major analytes in this region were tentatively identified as branched alkanes, cyclic alkanes, and alkenes (Huckaby and Bratzel 1995). Careful examination of the locations and relative heights of these non-NPH compound peaks suggests that there are strong similarities between the organic wastes, and that tank C-101 may have stored the same organic liquid waste as tanks C-102 and C-103.

TST sample chromatograms from tanks C-101, C-102, and C-103 are similar in character to the SUMMATM sample chromatograms (Jenkins et al. 1995c, 1995a, 1994). Like the chromatograms shown in Figures 4-1 and 4-3, the TST chromatograms indicate that tank C-101 has a much higher concentration of non-NPH semivolatile organic vapors than does tank C-102.

Given the apparent semivolatile organic waste similarities, it is not clear whether tank C-103 was breathing, as intended, via the cascade line with tank C-102 when their headspaces were sampled. Likewise, the data does not clearly indicate whether or not tank C-101 is breathing via its cascade line with tank C-102. However, the data do indicate that the cascade lines between tanks C-102 and C-103, and between tanks C-102 and C-101 do not transport significant amounts of the semivolatile organic vapors.

The volatile constituents identified in the SUMMATM and TST samples from tank C-102 are generally thought to be chemical and radiolytic reaction products of the semivolatile organic compounds.

Supporting this is the fact that several compounds of each homologous series are commonly found in this as well as other waste tanks. Specifically, the following homologous series of straight-chain compounds were identified in tank C-102 samples:

- 2-ketones, from propanone through 2-nonanone;
- aldehydes, including ethanal, from butanal through octanal;
- nitriles, from ethanenitrile through octanenitrile;
- alkanes, including methane, from propane through n-nonane; and
- 1-alkenes, from propene through 1-octene.

Similarities between the volatile organic compounds in tanks C-101, C-102, and C-103 are evident in Figures 4-1 and 4-3. Many peaks are common to the chromatograms of all 3 tanks, and many have similar relative peak heights. However, transport of these vapors from either tanks C-101 or C-103 would not completely account for the volatile compounds in tank C-102. The concentration of 1-butanol, for example, is much more prominent amongst the volatile constituents in tank C-102 than it is in either tanks C-101 or C-103. Furthermore, because the volatile organic vapors are thought to be produced by the degradation of the semivolatile organics (which appear to be very similar in tanks C-102 and C-103), the types and relative concentrations of volatile organic compounds in these tanks would be expected to be very similar, even if the cascade lines between them allowed no transport of vapors.

5.0 SUMMARY

The tank C-102 headspace was sampled in September 1994 for gases and vapors to address flammability and industrial hygiene concerns. Collection and analysis of samples has been reported. It was determined that no headspace constituents exceeded the flammability notification limits, but ammonia, measured to be 189 ppmv, exceeded the industrial hygiene notification limit specified in the current *Vapor Sampling and Analysis Plan* (Homi 1995).

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Table 2-1
Tank C-102 Gas and Vapor Sample Type and Number

Laboratory	Sampling Device	Nominal Sample Volume (L)	Target Analytes	Number of Samples
Oak Ridge National Laboratories	Triple Sorbent Trap	0.1	Organic vapors	8 tank air samples
		0.5	Organic vapors	8 tank air samples + 2 trip blanks + 2 field blanks
Oregon Graduate Institute of Science and Technology	SUMMA™ canister	6.0	Hydrogen, Nitrous Oxide, Carbon Dioxide, Carbon Monoxide, Methane, TNMOC ¹	3 tank air samples
Pacific Northwest Laboratories	Acidified Carbon Sorbent Trap	3.0	Ammonia	6 tank air samples + 3 trip blank
	Triethanolamine Sorbent Trap	3.0	Nitrogen Dioxide	6 tank air samples + 3 trip blank
	Oxidation Bed + Triethanolamine Sorbent Trap	3.0	Nitric Oxide	6 tank air samples + 3 trip blank
	Silica Gel Sorbent Trap	3.0	Water vapor	6 tank air samples + 3 trip blanks
	SUMMA™ canister	6.0	Organic vapors	3 tank air samples + 2 ambient air samples
WHC 222-S Laboratory	Silica Gel Sorbent Trap	1.0	Tritium-Substituted Water Vapor	1 tank air sample

¹ TNMOC = total nonmethane organic carbon.

Table 3-1
Tank C-102 Inorganic Gas and Vapor Concentrations
Analyses by Oregon Graduate Institute of Science and Technology and Pacific Northwest Laboratory

Compound	CAS ¹ number	Sample Type	Number of samples	Average ² (ppmv)	Standard Deviation ² (ppmv)	RSD ^{2,3} (%)
Ammonia, NH ₃	7664-41-7	Sorbent Trap	6	189	3	1.6
Carbon Dioxide, CO ₂	124-38-9	SUMMA™	3	[8.2]	[0.36]	[4]
Carbon Monoxide, CO	630-08-0	SUMMA™	3	[4.0]	[0.64]	[16]
Hydrogen, H ₂	1333-74-0	SUMMA™	3	[133]	[2.64]	[2]
Nitric Oxide, NO	10102-43-9	Sorbent Trap	6	0.24	0.04	17
Nitrogen Dioxide, NO ₂	10102-44-0	Sorbent Trap	6	≤ 0.05	—	—
Nitrous Oxide, N ₂ O	10024-97-2	SUMMA™	3	[154]	[1.53]	[1]
Water Vapor, H ₂ O	7732-18-5	Sorbent Trap	6	28,400 (20.4 mg/L)	1,500 (1.1 mg/L)	5

1 CAS = Chemical Abstracts Service.

2 Bracketed values are from OGIST and should be considered secondary results, non-bracketed values are from PNL and should be considered primary results.

3 RSD = relative standard deviation. Burnum (1995) specifies the RSD should be less than 25 %.

Table 3-2
Comparison of Tank C-101, C-102, and C-103 Headspace Constituents --
Inorganic Analyses by Oregon Graduate Institute of Science and Technology
and Organic Analyses by Oak Ridge National Laboratory¹

Tank:	C-101 ²	C-102	C-103 ³
Date sampled, (mo/day/yr)	9/1/94	8/23/94	4/7/94 - 5/25/94
Headspace temperature, (°C)	34	25.8	38
Ammonia, (ppmv)	98	189	304
Hydrogen, (ppmv)	[436]	[133]	[782]
Carbon dioxide, (ppmv)	[1426]	[8.2]	--
Carbon monoxide, (ppmv)	[15.5]	[4.0]	[26.7]
Nitric oxide, (ppmv)	1.5	0.24	1.5
Nitrogen dioxide, (ppmv)	≤ 0.04	≤ 0.05	≤ 0.04
Nitrous oxide, (ppmv)	[642]	[154]	[763]
Water vapor, (mg/m ³)	30.1	20.4	42.2
Water vapor, (% relative humidity)	80	85	91
Ethanenitrile (acetonitrile), (ppmv)	0.69	0.34	(9.1)
Propanone (acetone), (ppmv)	(1.0)	(2.2)	(8.8)
1-Butanol, (ppmv)	0.46	(7.6)	(28.4)
n-Dodecane, (ppmv)	(0.94)	(0.91)	(40.3)
n-Tridecane, (ppmv)	(0.61)	(0.81)	(52.0)
Total nonmethane organic compounds, (mg/m ³)	[256]	[313]	[3,000 - 5,000] ⁴

1 Where PNL inorganic gas or vapor data was unavailable, OGIST results are listed. OGIST data is given in brackets to indicate the data should be considered secondary results. Organic vapor results are from ORNL, with non-quantitative values in parentheses and quantitative values not in parentheses.

2 Data are from Huckaby and Bratzel 1995.

3 Tank C-103 was sampled on various dates; data are from Huckaby and Story 1994.

4 TNMOC concentrations were too high for precise measurement; this range is from Rasmussen and Einfeld 1994.

Table 4-1
Tank C-102 Quantitatively Measured Compounds in SUMMA™ Samples --
Analyses by Pacific Northwest Laboratory

Cmpd #	Compound	CAS ¹ Number	Average ² (ppmv)	Standard Deviation (ppmv)	RSD ³ (%)
1	Methane ⁴	74-82-8	[4.9]	[0.06]	[1.2]
2	Ethanenitrile (acetonitrile)	75-05-8	0.33	0.04	12
3	Propanone (acetone)	67-64-1	3.18	0.54	17
4	Trichlorofluoromethane	75-69-4	0.051	0.008	16
5	Propanenitrile	107-12-0	0.058	0.0004	0.7
6	Propanol	71-23-8	0.21	0.003	1.2
7	2-Butanone	78-93-3	0.72	0.013	1.8
8	n-Hexane	110-54-3	1.62	0.029	1.8
9	Tetrahydrofuran	109-99-9	0.28	0.005	1.7
10	n-Butanenitrile	109-74-0	0.083	0.002	2.5
11	Cyclohexane	110-82-7	0.031	0.002	6
12	n-Heptane	142-82-5	0.20	0.005	2.4
13	4-Methyl-2-Pentanone	108-10-1	0.046	0.003	6
14	Pyridine	110-86-1	0.019	0.001	5
15	Toluene	108-88-3	0.006	0.0004	7
16	Cyclohexanone	108-94-1	0.015	0.0008	5
17	n-Decane	124-18-5	0.64	0.042	6

1 CAS = Chemical Abstract Service.

2 Average of 3 samples.

3 RSD = relative standard deviation. Burnum (1995) specifies the RSD should be less than 25 %.

4 Methane results were performed by OGIST and should be considered a secondary result (Rasmussen 1994a). All others are from Klinger et al. (1995a).

Table 4-2
Tank C-102 Quantitatively Measured Organic Compounds in TST Samples --
Analyses by Oak Ridge National Laboratory¹

Cmpd #	Compound	CAS ² Number	Average ³ (ppmv)	Standard Deviation (ppmv)	RSD ⁴ (%)
1	Ethanenitrile (acetonitrile)	75-05-8	0.34	0.04	11
2	n-Hexane	110-54-3	0.097	0.008	8
3	n-Butanenitrile	109-74-0	0.061	0.005	9
4	n-Heptane	142-82-5	0.085	0.012	15
5	2-Hexanone	591-78-6	0.072	0.009	12
6	n-Octane	111-65-9	0.071	0.008	11
7	n-Hexanenitrile	628-73-9	0.030	0.001	4
8	2-Heptanone	110-43-0	0.079	0.024	31
9	n-Nonane	111-84-2	0.069	0.005	8
10	n-Heptanenitrile	629-08-3	0.032	0.005	15
11	2-Octanone	111-13-7	0.043	0.019	44
12	n-Decane	124-18-5	0.27	0.05	18

1 Results in this table are quantitative (as defined in Section 4.1).

2 CAS = Chemical Abstract Service.

3 Average of 3, 200 ml TST samples.

4 RSD = relative standard deviation. Burnum (1995) specifies the RSD should be less than 25 %.

Table 4-3
Tank C-102 Positively Identified Organic Compounds in TST Samples
Analyses by Oak Ridge National Laboratory¹

Cmpd #	Compound	CAS ² Number	Average ³ (ppmv)	Standard Deviation (ppmv)	RSD ⁴ (%)
1	Dichloromethane (methylene chloride)	75-09-2	0.043	0.045	104
2	Propanenitrile	107-12-0	0.043	0.001	3
3	Benzene	71-43-2	0.32	0.31	98
4	Toluene	108-88-3	0.082	0.072	88
5	n-Undecane	1120-21-4	0.70	0.13	19
6	n-Dodecane	112-40-3	0.91	0.10	11
7	n-Tridecane	629-50-5	0.81	0.15	19
8	Dibutyl butylphosphonate	78-46-6	0.0050	0.0012	24
9	Tributyl phosphate	126-73-8	0.075	0.007	10

1 Results in this table are not quantitative (as defined in Section 4.1) because measured values in at least 1 of the samples are outside instrument calibration limits.

2 CAS = Chemical Abstract Service.

3 Average of 3, 200 ml TST samples.

4 RSD = relative standard deviation. Burnum (1995) specifies the RSD should be less than 25 %.

Table 4-4
Tank C-102 Positively Identified Organic Compounds in TST Samples
for which Practical Holding Times were Exceeded --
Analyses by Oak Ridge National Laboratory¹

Cmpd #	Compound	CAS ² Number	Average ³ (ppmv)	Standard Deviation (ppmv)	RSD ⁴ (%)
1	Propanone ⁵ (acetone)	67-64-1	2.2	0.5	22
2	Butanal ⁵	123-72-8	2.6	1.7	64
3	1-Butanol ⁵	71-36-3	7.6	1.7	22
4	2-Pentanone ⁶	107-87-9	0.15	0.02	16
5	n-Pentanenitrile ⁵	110-59-8	0.030	0.001	5

1 Practical holding times are defined and discussed in Section 4.1.

2 CAS = Chemical Abstract Service.

3 Average of 3, 200 ml TST samples.

4 RSD = relative standard deviation. Burnum (1995) specifies the RSD should be less than 25 %.

5 The concentration of this analyte was not quantitatively measured (as defined in Section 4.1), because the measured concentration was outside of the instrumental calibration limits.

6 The concentration of this analyte is quantitatively measured (as defined in Section 4.1).

Table 4-5
Tank C-102 Comparison of Organic Compounds in TST and SUMMA™ Samples
Analyses by Oak Ridge National Laboratory
and Pacific Northwest Laboratory

Compound	CAS ¹ Number	TST Average ² (ppmv)	SUMMA™ Average ³ (ppmv)	PRD ⁴ (%)
1,1-Dichloroethene (vinylidene chloride)	75-35-4	< 0.00092	< 0.005	--
Dichloromethane (methylene chloride)	75-09-2	0.043	< 0.005	> 158
Propanone (acetone)	67-64-1	2.2	3.18	36
Ethanenitrile (acetonitrile)	75-05-8	0.34	0.33	3
Propanenitrile	107-12-0	0.043	0.058	30
n-Butanenitrile	109-74-0	0.061	0.083	30
Benzene	71-43-2	0.32	< 0.005	> 194
Toluene	108-88-3	0.082	0.006	173
n-Hexane	110-54-3	0.097	1.62	177
n-Heptane	142-82-5	0.085	0.20	81
n-Decane	124-18-5	0.27	0.64	81

1 CAS = Chemical Abstract Service.

2 Average of 3, 200 ml TST samples.

3 Average of 3 samples.

4 PRD = percent relative difference. Keller (1994) requires the PRD to be less than 20 %.

Table 4-6
Tank C-102 Tentatively Identified Compounds in SUMMA™ Samples
in Order of Chromatographic Elution --
Analyses by Pacific Northwest Laboratory

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
1	Propene	115-07-1	1.36	0.05
2	Propane	74-98-6	0.64	0.02
3	1-Propyne	74-99-7	0.60	0.02
4	Cyclopropane	75-19-4	0.25	0.01
5	Ethanal (acetaldehyde)	75-07-0	0.68	0.13
6	Methanol (methyl alcohol)	67-56-1	< 0.01	--
7	1-Butene	106-98-9	0.61	0.09
8	n-Butane	106-97-8	1.09	0.37
9	1-Propene, 2-methyl-	115-11-7	0.12	0.02
10	Ethanol	64-17-5	0.16	0.02
11	1-Pentene	109-67-1	0.30	0.05
12	n-Pentane	109-66-0	0.62	0.10
13	2-Pentanone	107-87-9	< 0.04	--
14	2-Pentene	109-68-2	< 0.03	--
15	Pentane, 2-methyl-	107-83-5	0.22	0.004
16	Butanal	123-72-8	0.77	0.03
17	1-Hexene	592-41-6	0.35	0.01
18	Nitric acid, ethyl ester	625-58-1	0.18	0.01
19	Nitrous acid, butyl ester ³	544-16-1	0.09	--
20	3-Buten-1-ol ³	627-27-0	0.08	--
21	Butanal, 3-methyl- ³	590-86-3	0.08	--
22	2-Butanone, 3-methyl-	563-80-4	0.13	0.003
23	1-Butanol	71-36-3	27.82	3.56
24	Nitric acid, 1-methylethyl ester	1712-64-7	0.15	0.01
25	2-Pentanone	107-87-9	1.61	0.03
26	Pentanal	110-62-3	0.90	0.01

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
27	1-Heptene	592-76-7	0.34	0.002
28	2-Pentanone, 3-methyl-	565-61-7	0.083	0.002
29	Pentanenitrile	110-59-8	0.16	0.001
30	1-Heptanol	53535-33-4	0.30	0.01
31	Unknown Alkyl Nitrate		0.083	0.004
32	Heptane, 2-methyl-	592-27-8	0.24	0.01
33	2-Hexanone	591-78-6	0.73	0.01
34	Hexanal	66-25-1	0.50	0.02
35	1-Octene	111-66-0	0.23	0.01
36	n-Octane	111-65-9	1.22	0.03
37	2-Hexanone, 5-methyl-	110-12-3	0.19	0.01
38	Hexanenitrile	628-73-9	0.14	0.003
39	2-Furanmethanol, tetrahydro- ⁴	97-99-4	0.074	0.01
40	2-Heptanone	110-43-0	0.86	0.06
41	Heptanal	111-71-7	0.39	0.01
42	n-Nonane	111-84-2	0.87	0.02
43	Nitric acid, pentyl ester	1002-16-0	0.16	0.01
44	2-Heptanone, 4-methyl-	6137-06-0	0.082	0.002
45	2-Heptanone, 6-methyl-	928-68-7	1.25	0.02
46	Cyclohexane, propyl-	1678-92-8	0.11	0.004
47	Heptanenitrile	629-08-3	0.41	0.02
48	4-Octanone	589-63-9	0.11	0.004
49	Unknown C10 Alkane		0.17	0.01
50	Unknown C10 Alkane		0.16	0.01
51	Unknown Alkane ³		0.15	--
52	2-Octanone	111-13-7	0.66	0.01
53	Cyclohexane, 1,1,2,3-tetramethyl-	6783-92-2	0.20	0.003
54	Octanal	124-13-0	0.25	0.03

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
55	Unknown C9 Alkene/Cycloalkane		0.21	0.003
56	Unknown C10 Alkene/Cycloalkane ⁴		0.10	0.01
57	Nitric acid, hexyl ester	20633-11-8	0.079	0.002
58	Unknown C10 Alkene/Cycloalkane ⁴		0.067	< 0.01
59	Unknown C10 Alkene/Cycloalkane		0.074	0.007
60	Unknown C11 Alkane		0.79	0.02
61	Unknown C11 Alkane		0.21	0.01
62	Unknown C10 Alkene/Cycloalkane		0.56	0.01
63	Unknown C11 Alkene/Cycloalkane		0.12	0.001
64	Octanenitrile ⁴	124-12-9	0.10	0.01
65	Unknown C11 Alkane		0.26	0.02
66	Unknown C11 Alkane		0.15	0.01
67	Unknown C11 Alkane		0.32	0.03
68	Unknown C11 Alkene/Cycloalkane		0.27	0.01
69	Unknown C11 Diene/Cycloalkene ³		0.07	—
70	Naphthalene, decahydro-, trans-	493-02-7	0.38	0.001
71	1-Undecene	821-95-4	0.23	0.01
72	Unknown C11 Alkene/Cycloalkane		0.29	0.03
73	n-Undecane	1120-21-4	11.29	1.06
74	Octane, 4-methyl- ³	2216-34-4	0.07	—
75	Unknown C11 Alkene/Cycloalkane		0.44	0.05
76	Unknown C12 Alkane		0.21	0.02
77	Unknown C12 Alkane		0.42	0.04
78	Unknown C11 Diene/Cycloalkene		0.22	0.06
79	Naphthalene, methyl-decahydro		0.68	0.10
80	Cyclohexane, pentyl-	4292-92-6	0.52	0.06
81	Unknown C12 Alkane		0.40	0.04
82	Naphthalene, methyl-decahydro		0.89	0.08

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
83	Unknown C12 Alkane		0.43	0.04
84	Unknown C12 Alkane		0.26	0.03
85	Unknown Ketone		0.19	0.02
86	Unknown C12 Alkene/Cycloalkane		0.30	0.03
87	n-Dodecane	112-40-3	12.29	1.05
88	Undecane, 2,6-dimethyl-	17301-23-4	2.56	0.26
89	Unknown C13 Alkene/Cycloalkane		0.10	0.01
90	Unknown C13 Alkene/Cycloalkane		1.03	0.11
91	Unknown C12 Alkane		0.56	0.05
92	Unknown C13 Alkene/Cycloalkane ⁴		0.39	0.04
93	Unknown C13 Alkane ³		0.46	--
94	Unknown C13 Alkane ³		0.17	--
95	Unknown Alkane ⁴		0.17	0.02
96	Octane, 2,3,7-trimethyl-	62016-34-6	2.51	0.24
97	Unknown C13 Alkene/Cycloalkane ⁴		0.10	< 0.01
98	n-Tridecane	629-50-5	12.05	0.64
99	Unknown C14 Alkene/Cycloalkane		0.39	0.05
100	Unknown Alkane		0.37	0.04
101	Unknown C13 Diene/Cycloalkene ⁴		0.096	0.005
102	Unknown C13 Alkene/Cycloalkane		0.56	0.06
103	Unknown C15 Alkene/Cycloalkane ³		0.10	--
104	Unknown Alkane ⁴		0.10	0.01
105	Unknown C15 Alkane		1.29	0.08
106	n-Tetradecane	629-59-4	4.44	0.16
107	Unknown Alkane ⁴		0.13	< 0.01
108	Unknown C15 Alkene/Cycloalkane ³		0.11	--
109	Unknown C15 Alkene/Cycloalkane ³		0.13	--
110	Unknown Alkane		0.32	0.01

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
111	n-Pentadecane	629-62-9	0.16	0.02
Sum of tentatively identified compounds:			108.7	

1 CAS = Chemical Abstract Service.

2 When the analyte was detected in only 2 samples, the entry is the relative difference (i.e., their difference divided by 2).

3 Detected in only one sample.

4 Detected in only two samples.

Table 4-7
Tank C-102 Tentatively Identified Compounds in SUMMA™ Samples
Sorted Alphanumerically --
Analyses by Pacific Northwest Laboratory

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
11	1-Pentene	109-67-1	0.30	0.05
35	1-Octene	111-66-0	0.23	0.01
3	1-Propyne	74-99-7	0.60	0.02
71	1-Undecene	821-95-4	0.23	0.01
27	1-Heptene	592-76-7	0.34	0.002
23	1-Butanol	71-36-3	27.82	3.56
7	1-Butene	106-98-9	0.61	0.09
17	1-Hexene	592-41-6	0.35	0.01
9	1-Propene, 2-methyl-	115-11-7	0.12	0.02
30	1-Heptanol	53535-33-4	0.30	0.01
45	2-Heptanone, 6-methyl-	928-68-7	1.25	0.02
44	2-Heptanone, 4-methyl-	6137-06-0	0.082	0.002
13	2-Pentanone	107-87-9	< 0.04	--
14	2-Pentene	109-68-2	< 0.03	--
33	2-Hexanone	591-78-6	0.73	0.01
25	2-Pentanone	107-87-9	1.61	0.03
37	2-Hexanone, 5-methyl-	110-12-3	0.19	0.01
52	2-Octanone	111-13-7	0.66	0.01
40	2-Heptanone	110-43-0	0.86	0.06
39	2-Furanmethanol, tetrahydro- ³	97-99-4	0.074	0.01
28	2-Pentanone, 3-methyl-	565-61-7	0.083	0.002
22	2-Butanone, 3-methyl-	563-80-4	0.13	0.003
20	3-Buten-1-ol ³	627-27-0	0.08	--
48	4-Octanone	589-63-9	0.11	0.004
16	Butanal	123-72-8	0.77	0.03

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
21	Butanal, 3-methyl- ³	590-86-3	0.08	--
46	Cyclohexane, propyl-	1678-92-8	0.11	0.004
53	Cyclohexane, 1,1,2,3-tetramethyl-	6783-92-2	0.20	0.003
80	Cyclohexane, pentyl-	4292-92-6	0.52	0.06
4	Cyclopropane	75-19-4	0.25	0.01
5	Ethanal (acetaldehyde)	75-07-0	0.68	0.13
10	Ethanol	64-17-5	0.16	0.02
41	Heptanal	111-71-7	0.39	0.01
32	Heptane, 2-methyl-	592-27-8	0.24	0.01
47	Heptanenitrile	629-08-3	0.41	0.02
34	Hexanal	66-25-1	0.50	0.02
38	Hexanenitrile	628-73-9	0.14	0.003
6	Methanol (methyl alcohol)	67-56-1	< 0.01	--
8	n-Butane	106-97-8	1.09	0.37
87	n-Dodecane	112-40-3	12.29	1.05
42	n-Nonane	111-84-2	0.87	0.02
36	n-Octane	111-65-9	1.22	0.03
111	n-Pentadecane	629-62-9	0.16	0.02
12	n-Pentane	109-66-0	0.62	0.10
106	n-Tetradecane	629-59-4	4.44	0.16
98	n-Tridecane	629-50-5	12.05	0.64
73	n-Undecane	1120-21-4	11.29	1.06
70	Naphthalene, decahydro-, trans-	493-02-7	0.38	0.001
79	Naphthalene, methyl-decahydro		0.68	0.10
82	Naphthalene, methyl-decahydro		0.89	0.08
18	Nitric acid, ethyl ester	625-58-1	0.18	0.01
24	Nitric acid, 1-methylethyl ester	1712-64-7	0.15	0.01
43	Nitric acid, pentyl ester	1002-16-0	0.16	0.01

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
57	Nitric acid, hexyl ester	20633-11-8	0.079	0.002
19	Nitrous acid, butyl ester ⁴	544-16-1	0.09	--
54	Octanal	124-13-0	0.25	0.03
74	Octane, 4-methyl- ³	2216-34-4	0.07	--
96	Octane, 2,3,7-trimethyl-	62016-34-6	2.51	0.24
64	Octanenitrile ⁴	124-12-9	0.10	0.01
26	Pentanal	110-62-3	0.90	0.01
15	Pentane, 2-methyl-	107-83-5	0.22	0.004
29	Pentanenitrile	110-59-8	0.16	0.001
2	Propane	74-98-6	0.64	0.02
1	Propene	115-07-1	1.36	0.05
88	Undecane, 2,6-dimethyl-	17301-23-4	2.56	0.26
31	Unknown Alkyl Nitrate		0.083	0.004
49	Unknown C10 Alkane		0.17	0.01
50	Unknown C10 Alkane		0.16	0.01
51	Unknown Alkane ³		0.15	--
55	Unknown C9 Alkene/Cycloalkane		0.21	0.003
56	Unknown C10 Alkene/Cycloalkane ⁴		0.10	0.01
58	Unknown C10 Alkene/Cycloalkane ⁴		0.067	< 0.01
59	Unknown C10 Alkene/Cycloalkane		0.074	0.007
60	Unknown C11 Alkane		0.79	0.02
61	Unknown C11 Alkane		0.21	0.01
62	Unknown C10 Alkene/Cycloalkane		0.56	0.01
63	Unknown C11 Alkene/Cycloalkane		0.12	0.001
65	Unknown C11 Alkane		0.26	0.02
66	Unknown C11 Alkane		0.15	0.01
67	Unknown C11 Alkane		0.32	0.03
68	Unknown C11 Alkene/Cycloalkane		0.27	0.01

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
69	Unknown C11 Diene/Cycloalkene ³		0.07	—
72	Unknown C11 Alkene/Cycloalkane		0.29	0.03
75	Unknown C11 Alkene/Cycloalkane		0.44	0.05
76	Unknown C12 Alkane		0.21	0.02
77	Unknown C12 Alkane		0.42	0.04
78	Unknown C11 Diene/Cycloalkene		0.22	0.06
81	Unknown C12 Alkane		0.40	0.04
83	Unknown C12 Alkane		0.43	0.04
84	Unknown C12 Alkane		0.26	0.03
85	Unknown Ketone		0.19	0.02
86	Unknown C12 Alkene/Cycloalkane		0.30	0.03
89	Unknown C13 Alkene/Cycloalkane		0.10	0.01
90	Unknown C13 Alkene/Cycloalkane		1.03	0.11
91	Unknown C12 Alkane		0.56	0.05
92	Unknown C13 Alkene/Cycloalkane ⁴		0.39	0.04
93	Unknown C13 Alkane ³		0.46	—
94	Unknown C13 Alkane ³		0.17	—
95	Unknown Alkane ⁴		0.17	0.02
97	Unknown C13 Alkene/Cycloalkane ⁴		0.10	< 0.01
99	Unknown C14 Alkene/Cycloalkane		0.39	0.05
100	Unknown Alkane		0.37	0.04
101	Unknown C13 Diene/Cycloalkene ⁴		0.096	0.005
102	Unknown C13 Alkene/Cycloalkane		0.56	0.06
103	Unknown C15 Alkene/Cycloalkane ³		0.10	—
104	Unknown Alkane ⁴		0.10	0.01
105	Unknown C15 Alkane		1.29	0.08
107	Unknown Alkane ⁴		0.13	< 0.01
108	Unknown C15 Alkene/Cycloalkane ³		0.11	—

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
109	Unknown C15 Alkene/Cycloalkane ³		0.13	—
110	Unknown Alkane		0.32	0.01
Sum of tentatively identified compounds:			108.7	

1 CAS = Chemical Abstract Service.

2 When the analyte was detected in only 2 samples, the entry is the relative difference (i.e., their difference divided by 2).

3 Detected in only two samples.

4 Detected in only one sample.

Table 4-8
Tank C-102 Tentatively Identified Compounds in SUMMA™ Samples
Sorted by Estimated Concentration --
Analyses by Pacific Northwest Laboratory

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
23	1-Butanol	71-36-3	27.82	3.56
87	n-Dodecane	112-40-3	12.29	1.05
98	n-Tridecane	629-50-5	12.05	0.64
73	n-Undecane	1120-21-4	11.29	1.06
106	n-Tetradecane	629-59-4	4.44	0.16
88	Undecane, 2,6-dimethyl-	17301-23-4	2.56	0.26
96	Octane, 2,3,7-trimethyl-	62016-34-6	2.51	0.24
25	2-Pentanone	107-87-9	1.61	0.03
1	Propene	115-07-1	1.36	0.05
105	Unknown C15 Alkane		1.29	0.08
45	2-Heptanone, 6-methyl-	928-68-7	1.25	0.02
36	n-Octane	111-65-9	1.22	0.03
8	n-Butane	106-97-8	1.09	0.37
90	Unknown C13 Alkene/Cycloalkane		1.03	0.11
26	Pentanal	110-62-3	0.90	0.01
82	Naphthalene, methyl-decahydro		0.89	0.08
42	n-Nonane	111-84-2	0.87	0.02
40	2-Heptanone	110-43-0	0.86	0.06
60	Unknown C11 Alkane		0.79	0.02
16	Butanal	123-72-8	0.77	0.03
33	2-Hexanone	591-78-6	0.73	0.01
79	Naphthalene, methyl-decahydro-		0.68	0.10
5	Ethanal (acetaldehyde)	75-07-0	0.68	0.13
52	2-Octanone	111-13-7	0.66	0.01
2	Propane	74-98-6	0.64	0.02
12	n-Pentane	109-66-0	0.62	0.10

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
7	1-Butene	106-98-9	0.61	0.09
3	1-Propyne	74-99-7	0.60	0.02
62	Unknown C10 Alkene/Cycloalkane		0.56	0.01
102	Unknown C13 Alkene/Cycloalkane		0.56	0.06
91	Unknown C12 Alkane		0.56	0.05
80	Cyclohexane, pentyl-	4292-92-6	0.52	0.06
34	Hexanal	66-25-1	0.50	0.02
93	Unknown C13 Alkane ³		0.46	--
75	Unknown C11 Alkene/Cycloalkane		0.44	0.05
83	Unknown C12 Alkane		0.43	0.04
77	Unknown C12 Alkane		0.42	0.04
47	Heptanenitrile	629-08-3	0.41	0.02
81	Unknown C12 Alkane		0.40	0.04
92	Unknown C13 Alkene/Cycloalkane ⁴		0.39	0.04
41	Heptanal	111-71-7	0.39	0.01
99	Unknown C14 Alkene/Cycloalkane		0.39	0.05
70	Naphthalene, decahydro-, trans-	493-02-7	0.38	0.001
100	Unknown Alkane		0.37	0.04
17	1-Hexene	592-41-6	0.35	0.01
27	1-Heptene	592-76-7	0.34	0.002
67	Unknown C11 Alkane		0.32	0.03
110	Unknown Alkane		0.32	0.01
30	1-Heptanol	53535-33-4	0.30	0.01
11	1-Pentene	109-67-1	0.30	0.05
86	Unknown C12 Alkene/Cycloalkane		0.30	0.03
72	Unknown C11 Alkene/Cycloalkane		0.29	0.03
68	Unknown C11 Alkene/Cycloalkane		0.27	0.01
65	Unknown C11 Alkane		0.26	0.02

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
84	Unknown C12 Alkane		0.26	0.03
54	Octanal	124-13-0	0.25	0.03
4	Cyclopropane	75-19-4	0.25	0.01
32	Heptane, 2-methyl-	592-27-8	0.24	0.01
71	1-Undecene	821-95-4	0.23	0.01
35	1-Octene	111-66-0	0.23	0.01
78	Unknown C11 Diene/Cycloalkene		0.22	0.06
15	Pentane, 2-methyl-	107-83-5	0.22	0.004
61	Unknown C11 Alkane		0.21	0.01
55	Unknown C9 Alkene/Cycloalkane		0.21	0.003
76	Unknown C12 Alkane		0.21	0.02
53	Cyclohexane, 1,1,2,3-tetramethyl-	6783-92-2	0.20	0.003
85	Unknown Ketone		0.19	0.02
37	2-Hexanone, 5-methyl-	110-12-3	0.19	0.01
18	Nitric acid, ethyl ester	625-58-1	0.18	0.01
95	Unknown Alkane ⁴		0.17	0.02
49	Unknown C10 Alkane		0.17	0.01
94	Unknown C13 Alkane ³		0.17	--
29	Pentanenitrile	110-59-8	0.16	0.001
43	Nitric acid, pentyl ester	1002-16-0	0.16	0.01
50	Unknown C10 Alkane		0.16	0.01
10	Ethanol	64-17-5	0.16	0.02
111	n-Pentadecane	629-62-9	0.16	0.02
24	Nitric acid, 1-methylethyl ester	1712-64-7	0.15	0.01
66	Unknown C11 Alkane		0.15	0.01
51	Unknown Alkane ³		0.15	--
38	Hexanenitrile	628-73-9	0.14	0.003
107	Unknown Alkane ⁴		0.13	< 0.01

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
109	Unknown C15 Alkene/Cycloalkane ³		0.13	--
22	2-Butanone, 3-methyl-	563-80-4	0.13	0.003
9	1-Propene, 2-methyl-	115-11-7	0.12	0.02
63	Unknown C11 Alkene/Cycloalkane		0.12	0.001
108	Unknown C15 Alkene/Cycloalkane ³		0.11	--
48	4-Octanone	589-63-9	0.11	0.004
46	Cyclohexane, propyl-	1678-92-8	0.11	0.004
89	Unknown C13 Alkene/Cycloalkane		0.10	0.01
103	Unknown C15 Alkene/Cycloalkane ³		0.10	--
56	Unknown C10 Alkene/Cycloalkane ⁴		0.10	0.01
64	Octanenitrile ⁴	124-12-9	0.10	0.01
104	Unknown Alkane ⁴		0.10	0.01
97	Unknown C13 Alkene/Cycloalkane ⁴		0.10	< 0.01
101	Unknown C13 Diene/Cycloalkene ⁴		0.096	0.005
19	Nitrous acid, butyl ester ³	544-16-1	0.09	--
28	2-Pentanone, 3-methyl-	565-61-7	0.083	0.002
31	Unknown Alkyl Nitrate		0.083	0.004
44	2-Heptanone, 4-methyl-	6137-06-0	0.082	0.002
21	Butanal, 3-methyl- ³	590-86-3	0.08	--
20	3-Buten-1-ol ³	627-27-0	0.08	--
57	Nitric acid, hexyl ester	20633-11-8	0.079	0.002
39	2-Furanmethanol, tetrahydro- ⁴	97-99-4	0.074	0.01
59	Unknown C10 Alkene/Cycloalkane		0.074	0.007
69	Unknown C11 Diene/Cycloalkene ³		0.07	--
74	Octane, 4-methyl- ³	2216-34-4	0.07	--
58	Unknown C10 Alkene/Cycloalkane ⁴		0.067	< 0.01
6	Methanol (methyl alcohol)	67-56-1	< 0.01	--
13	2-Pentanone	107-87-9	< 0.04	--

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard ² Deviation (mg/m ³)
14	2-Pentene	109-68-2	< 0.03	--
Sum of tentatively identified compounds:			108.7	

1 CAS = Chemical Abstract Service.

2 When the analyte was detected in only 2 samples, the entry is the relative difference (i.e., their difference divided by 2).

3 Detected in only one sample.

4 Detected in only two samples.

Table 4-9
Tank C-102 Tentatively Identified Organic Compounds in TST Samples
in Order of Chromatographic Elution --
Analyses by Oak Ridge National Laboratory

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
1	Methane, trichlorofluoro-	75-69-4	0.51	0.88
2	2-Butanone	78-93-3	0.55	0.95
3	Furan, tetrahydro	109-99-9	0.89	0.79
4	2(3H)-furanone, dihydro-3,5-dimethyl-	5145-01-7	0.24	0.22
5	Cyclobutane, 1,2-diethyl-, trans- & cis-		0.15	0.27
6	Cyclopropane, propyl-	2415-72-7	0.11	0.19
7	Benzene, ethyl-	100-41-4	0.090	0.155
8	Heptanal	111-71-7	0.10	0.17
9	Xylene	1330-20-7	0.40	0.39
10	Styrene	100-42-5	0.11	0.19
11	Xylene	1330-20-7	0.12	0.21
12	C8-Alkanone		0.82	0.34
13	1,1,2,3-tetramethylcyclohexane	6783-92-2	0.22	0.20
14	Nonane, 4-methyl-	17301-94-9	0.12	0.20
15	3-Buten-2-ol	598-32-3	1.1	0.48
16	Benzene, (1-methylethyl)-	98-82-8	0.079	0.136
17	Cyclohexane, 1-methyl-3-propyl-	4291-80-9	0.20	0.17
18	2-Decene, (E)-	20063-97-2	0.14	0.13
19	Cyclohexane, (3-methyl-pentyl)-	61142-38-9	0.11	0.19
20	Cyclohexane, 1,5-diethyl-2,3-dimethyl	74663-66-4	0.095	0.165
21	Nonane, 2,6-dimethyl-	17302-28-2	1.1	0.2
22	Benzene, 1-propenyl-	637-50-3	0.21	0.18
23	4,5-Nonadiene	821-74-9	0.10	0.17
24	Cyclohexane, (1-methylpropyl)-	7058-01-7	0.24	0.06

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
25	1,1-dimethyl-2-propylcyclohexane		0.30	0.03
26	Decane, 5-methyl-	13151-35-4	0.44	0.04
27	Decane, 4-methyl-	2847-72-5	0.34	0.08
28	Decane, 2-methyl-	6975-98-0	1.0	0.2
29	Naphthalene, decahydro-, trans-	493-02-7	0.53	0.10
30	Decane, 3-methyl-	13151-34-3	0.53	0.03
31	Benzene, 1-methyl-2-propyl-	1074-17-5	0.14	0.25
32	4-Nonanone	4485-09-0	0.13	0.23
33	C4-benzene & others		0.14	0.24
34	5-Undecene	4941-53-1	0.44	0.01
35	2-Nonanone	821-55-6	1.0	0.1
36	2-Decene, 4-methyl-, (Z)	74630-30-1	0.11	0.19
37	5-Undecene, (E)-	764-97-6	0.18	0.32
38	1-Undecene, 4-methyl-	74630-39-0	0.41	0.36
39	Cyclopropane, octyl-	1472-09-9	0.62	0.12
40	Undecane, 5-methyl-	1632-70-8	0.82	0.19
41	Naphthalene, decahydro-2-methyl-	2958-76-1	0.39	0.54
42	Undecane, 2,8-dimethyl-	17301-25-6	0.097	0.168
43	Undecane, 4,8-dimethyl-	17301-33-6	0.083	0.143
44	Undecane, 3,8-dimethyl-	17301-30-3	2.0	0.7
45	Mixture		0.11	0.20
46	Benzene, (2-methyl-2-propenyl)-	3290-53-7	0.099	0.171
47	1-Dodecene	112-41-4	0.14	0.13
48	5-Undecene, 7-methyl-, (E)-	74630-66-3	0.12	0.21
49	3-Undecene, 2-methyl-, (Z)-	74630-48-1	1.1	1.7
50	Methyldecahydronaphthalene		3.1	0.5
51	6-Methylundecane	17302-33-9	1.8	1.3
52	Undecane, 4-methyl-	2980-69-0	1.1	0.4

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
53	Undecane, 2-methyl-	7045-71-8	2.3	1.1
54	Benzene, pentyl-	538-68-1	0.46	0.48
55	Undecane, 3-methyl-	1002-43-3	1.2	0.6
56	4-Undecene, 4-methyl-	61142-40-3	0.99	0.64
57	Undecane, 3-methyl-	1002-43-3	0.16	0.28
58	C13-Alkane		0.25	0.43
59	Cyclododecane	294-62-2	1.3	0.2
60	Naphthalene, decahydro-1,2-dimethyl-	3604-14-6	0.71	0.18
61	4-Dodecene, (E)-	7206-15-7	0.30	0.12
62	Undecane, 2,4-dimethyl-	17312-80-0	0.046	0.079
63	Undecane, 2,6-dimethyl-	17301-23-4	3.4	0.2
64	Undecane, 4,7-dimethyl-	17301-32-5	0.43	0.05
65	Dimethyl-decahydro naphthalene + others		0.31	0.27
66	4-Undecene, 5-methyl- (Z)-	74630-69-6	0.045	0.077
67	Undecane, 2,10-dimethyl- & others		0.14	0.24
68	Cyclopentane, 1-pentyl-2-propyl-	62199-51-3	0.078	0.135
69	Cyclohexane, 2-butyl-1, 1,3-trimethyl-	54676-39-0	1.7	0.2
70	Undecane, 5-ethyl-	17453-94-0	0.19	0.05
71	3-Hexadecyne	61886-62-2	0.25	0.01
72	Cyclohexane, (4-methylpentyl)-	61142-20-9	0.84	0.06
73	Dodecane, 4-methyl-	6117-97-1	0.78	0.06
74	Dodecane, 2-methyl-	1560-97-0	1.5	0.1
75	2-Hexanone, 3-cyclohexyliden-4-ethyl-		0.18	0.16
76	Dodecane, 4,6-dimethyl-	61141-72-8	3.8	0.4
77	2-Butenoic acid, 2-propenyl ester & others		0.27	0.48
78	Benzene, (1-methylpentyl)-	6031-02-3	0.15	0.26

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
79	Trimethyldecahydronaphthalene		0.48	0.09
80	3-Undecanone	2216-87-7	0.13	0.23
81	6-Tridecane, 7-methyl-	24949-42-6	1.1	0.1
82	Undecane, 3,8-dimethyl-	17301-30-3	0.055	0.096
83	Alkane		0.16	0.16
84	Heptane, 3-ethyl-5-methyl-	52896-90-9	0.19	0.33
85	Alkane		0.10	0.17
86	Decane, 6-ethyl-2-methyl-	62108-21-8	0.37	0.63
87	Undecane, 5-ethyl-	17453-94-0	0.48	0.45
88	Cyclooctane, 1-methylpropyl- and others		0.14	0.12
89	Cyclooctane, butyl-	16538-93-5	0.055	0.096
90	C4-Cyclohexane		0.095	0.165
91	C12-alkene and C7-benzene		0.19	0.16
92	C8-cyclohexane		0.41	0.29
93	C14-alkene		0.32	0.14
94	C7-Cyclohexane		0.93	0.06
95	Tridecane, 4-methyl-	26730-12-1	0.51	0.11
96	Dodecane, 3-methyl-	17312-57-1	0.29	0.51
97	Tridecane, 2-methyl-	1560-96-9	0.70	0.22
98	C8-Cyclohexene		0.30	0.26
99	5-Undecanone, 2-methyl-	50639-02-6	0.13	0.22
100	Dodecane, 2,7,10-trimethyl-	74645-98-0	2.6	0.2
101	Heptane, 2-phenyl-	2132-84-5	0.24	0.27
102	C8-Cyclohexane		0.043	0.074
103	3-Dodecanone	1534-27-6	0.35	0.12
104	Tetradecane	629-59-4	4.5	1.8
105	Tridecane, 4,8-dimethyl-	55030-62-1	0.29	0.51
106	1,1'-biphenyl	92-52-4	0.92	0.86

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
107	2-Hexenoic acid, 2-hexenyl ester, (E,E)-	54845-28-2	0.052	0.090
108	1,1-Biphenyl,2-methyl-	643-58-3	0.48	0.57
109	Benzene, 1,1'-methylenebis- and others		0.24	0.22
110	Tridecane, 4-methyl-	26730-12-1	0.087	0.151
111	C8-cyclohexane		0.068	0.117
112	Dodecane, 2,6,11-trimethyl-	31295-56-4	0.055	0.096
113	Tridecane, 4,8-dimethyl-	55030-62-1	0.047	0.081
114	Hexadecane	544-76-3	0.56	0.07
115	2-Undecanone, 6,10-dimethyl-	105-42-0	0.059	0.103
116	Dimethyl-naphthalene		0.17	0.29
117	Benzene, (1-methylheptyl)-	777-22-0	0.031	0.053
118	Dodecane, 2-methyl-8-propyl-	55045-07-3	0.45	0.78
119	Pentadecane, 2-methyl-	1560-93-6	0.056	0.096
120	5-Undecanone, 2-methyl-	50639-02-6	0.15	0.26
121	3-Tridecanone	1534-26-5	0.21	0.14
122	Pentadecane	629-62-9	0.77	0.63
123	1,1'-Biphenyl, 2-methyl-	643-58-3	0.067	0.116
124	1,1'-Biphenyl, 2-methyl-	643-58-3	0.039	0.067
125	9H-Fluorene	86-73-7	0.077	0.134
126	Benzenesulfonamide, N-butyl-	3622-84-2	0.23	0.04
Sum of tentatively identified compounds:			67.03	

¹ CAS = Chemical Abstract Service.

Table 4-10
Tank C-102 Tentatively Identified Organic Compounds in TST Samples
Sorted Alphanumerically --
Analyses by Oak Ridge National Laboratory

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
38	1-Undecene, 4-methyl-	74630-39-0	0.41	0.36
47	1-Dodecene	112-41-4	0.14	0.13
106	1,1'-biphenyl	92-52-4	0.92	0.86
25	1,1-dimethyl-2-propylcyclohexane		0.30	0.03
123	1,1'-Biphenyl, 2-methyl-	643-58-3	0.067	0.116
108	1,1-Biphenyl,2-methyl-	643-58-3	0.48	0.57
124	1,1'-Biphenyl, 2-methyl-	643-58-3	0.039	0.067
13	1,1,2,3-tetramethylcyclohexane	6783-92-2	0.22	0.20
36	2-Decene, 4-methyl-, (Z)	74630-30-1	0.11	0.19
35	2-Nonanone	821-55-6	1.0	0.1
115	2-Undecanone, 6,10-dimethyl-	105-42-0	0.059	0.103
75	2-Hexanone, 3-cyclo- hexyliden-4-ethyl-		0.18	0.16
2	2-Butanone	78-93-3	0.55	0.95
107	2-Hexenoic acid, 2-hexenyl ester, (E,E)-	54845-28-2	0.052	0.090
77	2-Butenoic acid, 2-propenyl ester & others		0.27	0.48
18	2-Decene, (E)-	20063-97-2	0.14	0.13
4	2(3H)-furanone, dihydro-3,5-dimethyl-	5145-01-7	0.24	0.22
15	3-Buten-2-ol	598-32-3	1.1	0.48
103	3-Dodecanone	1534-27-6	0.35	0.12
49	3-Undecene, 2-methyl-, (Z)-	74630-48-1	1.1	1.7
121	3-Tridecanone	1534-26-5	0.21	0.14
80	3-Undecanone	2216-87-7	0.13	0.23
71	3-Hexadecyne	61886-62-2	0.25	0.01
32	4-Nonanone	4485-09-0	0.13	0.23

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
66	4-Undecene, 5-methyl- (Z)-	74630-69-6	0.045	0.077
56	4-Undecene, 4-methyl-	61142-40-3	0.99	0.64
61	4-Dodecene, (E)-	7206-15-7	0.30	0.12
23	4,5-Nonadiene	821-74-9	0.10	0.17
120	5-Undecanone, 2-methyl-	50639-02-6	0.15	0.26
48	5-Undecene, 7-methyl- (E)-	74630-66-3	0.12	0.21
37	5-Undecene, (E)-	764-97-6	0.18	0.32
99	5-Undecanone, 2-methyl-	50639-02-6	0.13	0.22
34	5-Undecene	4941-53-1	0.44	0.01
81	6-Tridecane, 7-methyl-	24949-42-6	1.1	0.1
51	6-Methylundecane	17302-33-9	1.8	1.3
125	9H-Fluorene	86-73-7	0.077	0.134
83	Alkane		0.16	0.16
85	Alkane		0.10	0.17
7	Benzene, ethyl-	100-41-4	0.090	0.155
16	Benzene, (1-methylethyl)-	98-82-8	0.079	0.136
22	Benzene, 1-propenyl-	637-50-3	0.21	0.18
31	Benzene, 1-methyl-2-propyl-	1074-17-5	0.14	0.25
46	Benzene, (2-methyl-2-propenyl)-	3290-53-7	0.099	0.171
54	Benzene, pentyl-	538-68-1	0.46	0.48
78	Benzene, (1-methylpentyl)-	6031-02-3	0.15	0.26
109	Benzene, 1,1'-methylenebis- and others		0.24	0.22
117	Benzene, (1-methylheptyl)-	777-22-0	0.031	0.053
126	Benzenesulfonamide, N-butyl-	3622-84-2	0.23	0.04
91	C12-alkene and C7-benzene		0.19	0.16
58	C13-Alkane		0.25	0.43
93	C14-alkene		0.32	0.14
90	C4-Cyclohexane		0.095	0.165

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
33	C4-benzene & others		0.14	0.24
94	C7-Cyclohexane		0.93	0.06
12	C8-Alkanone		0.82	0.34
111	C8-cyclohexane		0.068	0.117
92	C8-cyclohexane		0.41	0.29
98	C8-Cyclohexene		0.30	0.26
102	C8-Cyclohexane		0.043	0.074
5	Cyclobutane, 1,2-diethyl-, trans- & cis-		0.15	0.27
59	Cyclododecane	294-62-2	1.3	0.2
17	Cyclohexane, 1-methyl-3-propyl-	4291-80-9	0.20	0.17
19	Cyclohexane, (3-methyl-pentyl)-	61142-38-9	0.11	0.19
20	Cyclohexane, 1,5-diethyl- 2,3-dimethyl-	74663-66-4	0.095	0.165
24	Cyclohexane, (1-methylpropyl)-	7058-01-7	0.24	0.06
69	Cyclohexane, 2-butyl-1, 1,3-trimethyl-	54676-39-0	1.7	0.2
72	Cyclohexane, (4-methylpentyl)-	61142-20-9	0.84	0.06
88	Cyclooctane, 1-methylpropyl- and others		0.14	0.12
89	Cyclooctane, butyl-	16538-93-5	0.055	0.096
6	Cyclopropane, propyl-	2415-72-7	0.11	0.19
39	Cyclopropane, octyl-	1472-09-9	0.62	0.12
68	Cyclopentane, 1-pentyl-2-propyl-	62199-51-3	0.078	0.135
26	Decane, 5-methyl-	13151-35-4	0.44	0.04
27	Decane, 4-methyl-	2847-72-5	0.34	0.08
28	Decane, 2-methyl-	6975-98-0	1.0	0.2
30	Decane, 3-methyl-	13151-34-3	0.53	0.03
86	Decane, 6-ethyl-2-methyl-	62108-21-8	0.37	0.63

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
65	Dimethyl-decahydro naphthalene + others		0.31	0.27
116	Dimethyl-naphthalene		0.17	0.29
73	Dodecane, 4-methyl-	6117-97-1	0.78	0.06
74	Dodecane, 2-methyl-	1560-97-0	1.5	0.1
76	Dodecane, 4,6-dimethyl-	61141-72-8	3.8	0.4
96	Dodecane, 3-methyl-	17312-57-1	0.29	0.51
100	Dodecane, 2,7,10-trimethyl-	74645-98-0	2.6	0.2
112	Dodecane, 2,6,11-trimethyl-	31295-56-4	0.055	0.096
118	Dodecane, 2-methyl-8-propyl-	55045-07-3	0.45	0.78
3	Furan, tetrahydro-	109-99-9	0.89	0.79
8	Heptanal	111-71-7	0.10	0.17
84	Heptane, 3-ethyl-5-methyl-	52896-90-9	0.19	0.33
101	Heptane, 2-phenyl-	2132-84-5	0.24	0.27
114	Hexadecane	544-76-3	0.56	0.07
1	Methane, trichlorofluoro-	75-69-4	0.51	0.88
50	Methyldecahydronaphthalene		3.1	0.5
45	Mixture		0.11	0.20
29	Naphthalene, decahydro-, trans-	493-02-7	0.53	0.10
41	Naphthalene, decahydro-2-methyl-	2958-76-1	0.39	0.54
60	Naphthalene, decahydro-1,2-dimethyl-	3604-14-6	0.71	0.18
14	Nonane, 4-methyl-	17301-94-9	0.12	0.20
21	Nonane, 2,6-dimethyl-	17302-28-2	1.1	0.2
119	Pentadecane, 2-methyl-	1560-93-6	0.056	0.096
122	Pentadecane	629-62-9	0.77	0.63
10	Styrene	100-42-5	0.11	0.19
104	Tetradecane	629-59-4	4.5	1.8
95	Tridecane, 4-methyl-	26730-12-1	0.51	0.11
97	Tridecane, 2-methyl-	1560-96-9	0.70	0.22

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
105	Tridecane, 4,8-dimethyl-	55030-62-1	0.29	0.51
110	Tridecane, 4-methyl-	26730-12-1	0.087	0.151
113	Tridecane, 4,8-dimethyl-	55030-62-1	0.047	0.081
79	Trimethyldecahydronaphthalene		0.48	0.09
40	Undecane, 5-methyl-	1632-70-8	0.82	0.19
42	Undecane, 2,8-dimethyl-	17301-25-6	0.097	0.168
43	Undecane, 4,8-dimethyl-	17301-33-6	0.083	0.143
44	Undecane, 3,8-dimethyl-	17301-30-3	2.0	0.7
52	Undecane, 4-methyl-	2980-69-0	1.1	0.4
53	Undecane, 2-methyl-	7045-71-8	2.3	1.1
55	Undecane, 3-methyl-	1002-43-3	1.2	0.6
57	Undecane, 3-methyl-	1002-43-3	0.16	0.28
62	Undecane, 2,4-dimethyl-	17312-80-0	0.046	0.079
63	Undecane, 2,6-dimethyl-	17301-23-4	3.4	0.2
64	Undecane, 4,7-dimethyl-	17301-32-5	0.43	0.05
67	Undecane, 2,10-dimethyl- & others		0.14	0.24
70	Undecane, 5-ethyl-	17453-94-0	0.19	0.05
82	Undecane, 3,8-dimethyl-	17301-30-3	0.055	0.096
87	Undecane, 5-ethyl-	17453-94-0	0.48	0.45
9	Xylene	1330-20-7	0.40	0.39
11	Xylene	1330-20-7	0.12	0.21
Sum of tentatively identified compounds:			67.03	

1 CAS = Chemical Abstract Service.

Table 4-11
Tank C-102 Tentatively Identified Organic Compounds in TST Samples.
Sorted by Estimated Concentration --
Analyses by Oak Ridge National Laboratory

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
104	Tetradecane	629-59-4	4.5	1.8
76	Dodecane, 4,6-dimethyl-	61141-72-8	3.8	0.4
63	Undecane, 2,6-dimethyl-	17301-23-4	3.4	0.2
50	Methyldecahydronaphthalene		3.1	0.5
100	Dodecane, 2,7,10-trimethyl-	74645-98-0	2.6	0.2
53	Undecane, 2-methyl-	7045-71-8	2.3	1.1
44	Undecane, 3,8-dimethyl-	17301-30-3	2.0	0.7
51	6-Methylundecane	17302-33-9	1.8	1.3
69	Cyclohexane, 2-butyl-1, 1,3-trimethyl-	54676-39-0	1.7	0.2
74	Dodecane, 2-methyl-	1560-97-0	1.5	0.1
59	Cyclododecane	294-62-2	1.3	0.2
55	Undecane, 3-methyl-	1002-43-3	1.2	0.6
49	3-Undecene, 2-methyl-, (Z)-	74630-48-1	1.1	1.7
81	6-Tridecane, 7-methyl-	24949-42-6	1.1	0.1
15	3-Buten-2-ol	598-32-3	1.1	0.48
52	Undecane, 4-methyl-	2980-69-0	1.1	0.4
21	Nonane, 2,6-dimethyl-	17302-28-2	1.1	0.2
28	Decane, 2-methyl-	6975-98-0	1.0	0.2
35	2-Nonanone	821-55-6	1.0	0.1
56	4-Undecene, 4-methyl-	61142-40-3	0.99	0.64
94	C7-Cyclohexane		0.93	0.06
106	1,1'-biphenyl	92-52-4	0.92	0.86
3	Furan, tetrahydro	109-99-9	0.89	0.79
72	Cyclohexane, (4-methylpentyl)-	61142-20-9	0.84	0.06
12	C8-Alkanone		0.82	0.34

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
40	Undecane, 5-methyl-	1632-70-8	0.82	0.19
73	Dodecane, 4-methyl-	6117-97-1	0.78	0.06
122	Pentadecane	629-62-9	0.77	0.63
60	Naphthalene, decahydro-1,2-dimethyl-	3604-14-6	0.71	0.18
97	Tridecane, 2-methyl-	1560-96-9	0.70	0.22
39	Cyclopropane, octyl-	1472-09-9	0.62	0.12
114	Hexadecane	544-76-3	0.56	0.07
2	2-Butanone	78-93-3	0.55	0.95
29	Naphthalene, decahydro-, trans-	493-02-7	0.53	0.10
30	Decane, 3-methyl-	13151-34-3	0.53	0.03
1	Methane, trichlorofluoro-	75-69-4	0.51	0.88
95	Tridecane, 4-methyl-	26730-12-1	0.51	0.11
108	1,1-Biphenyl,2-methyl-	643-58-3	0.48	0.57
87	Undecane, 5-ethyl-	17453-94-0	0.48	0.45
77	2-Butenoic acid, 2-propenyl ester & others		0.27	0.48
79	Trimethyldecahydronaphthalene		0.48	0.09
54	Benzene, pentyl-	538-68-1	0.46	0.48
118	Dodecane, 2-methyl-8-propyl-	55045-07-3	0.45	0.78
34	5-Undecene	4941-53-1	0.44	0.01
26	Decane, 5-methyl-	13151-35-4	0.44	0.04
64	Undecane, 4,7-dimethyl-	17301-32-5	0.43	0.05
92	C8-cyclohexane		0.41	0.29
38	1-Undecene, 4-methyl-	74630-39-0	0.41	0.36
9	Xylene	1330-20-7	0.40	0.39
41	Naphthalene, decahydro-2-methyl-	2958-76-1	0.39	0.54
86	Decane, 6-ethyl-2-methyl-	62108-21-8	0.37	0.63
103	3-Dodecanone	1534-27-6	0.35	0.12
27	Decane, 4-methyl-	2847-72-5	0.34	0.08

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
93	C14-alkene		0.32	0.14
61	4-Dodecene, (E)-	7206-15-7	0.30	0.12
98	C8-Cyclohexene		0.30	0.26
25	1,1-dimethyl-2-propylcyclohexane		0.30	0.03
96	Dodecane, 3-methyl-	17312-57-1	0.29	0.51
105	Tridecane, 4,8-dimethyl-	55030-62-1	0.29	0.51
65	Dimethyl-decahydro naphthalene + others		0.31	0.27
5	Cyclobutane, 1,2-diethyl-, trans- & cis-		0.15	0.27
71	3-Hexadecyne	61886-62-2	0.25	0.01
58	C13-Alkane		0.25	0.43
24	Cyclohexane, (1-methylpropyl)-	7058-01-7	0.24	0.06
101	Heptane, 2-phenyl-	2132-84-5	0.24	0.27
4	2(3H)-furanone, dihydro-3,5-dimethyl-	5145-01-7	0.24	0.22
126	Benzenesulfonamide, N-butyl-	3622-84-2	0.23	0.04
109	Benzene, 1,1'-methylenebis- and others		0.24	0.22
13	1,1,2,3-tetramethylcyclohexane	6783-92-2	0.22	0.20
121	3-Tridecanone	1534-26-5	0.21	0.14
22	Benzene, 1-propenyl-	637-50-3	0.21	0.18
17	Cyclohexane, 1-methyl-3-propyl-	4291-80-9	0.20	0.17
84	Heptane, 3-ethyl-5-methyl-	52896-90-9	0.19	0.33
91	C12-alkene and C7-benzene		0.19	0.16
70	Undecane, 5-ethyl-	17453-94-0	0.19	0.05
37	5-Undecene, (E)-	764-97-6	0.18	0.32
116	Dimethyl-naphthalene		0.17	0.29
75	2-Hexanone, 3-cyclohexyliden-4-ethyl-		0.18	0.16
57	Undecane, 3-methyl-	1002-43-3	0.16	0.28

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Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
83	Alkane		0.16	0.16
78	Benzene, (1-methylpentyl)-	6031-02-3	0.15	0.26
120	5-Undecanone, 2-methyl-	50639-02-6	0.15	0.26
67	Undecane, 2,10-dimethyl- & others		0.14	0.24
33	C4-benzene & others		0.14	0.24
31	Benzene, 1-methyl-2-propyl-	1074-17-5	0.14	0.25
18	2-Decene, (E)-	20063-97-2	0.14	0.13
47	1-Dodecene	112-41-4	0.14	0.13
80	3-Undecanone	2216-87-7	0.13	0.23
32	4-Nonanone	4485-09-0	0.13	0.23
99	5-Undecanone, 2-methyl-	50639-02-6	0.13	0.22
11	Xylene	1330-20-7	0.12	0.21
88	Cyclooctane, 1-methylpropyl- and others		0.14	0.12
14	Nonane, 4-methyl-	17301-94-9	0.12	0.20
48	5-Undecene, 7-methyl- (E)-	74630-66-3	0.12	0.21
10	Styrene	100-42-5	0.11	0.19
6	Cyclopropane, propyl-	2415-72-7	0.11	0.19
19	Cyclohexane, (3-methyl-pentyl)-	61142-38-9	0.11	0.19
45	Mixture		0.11	0.20
36	2-Decene, 4-methyl-, (Z)	74630-30-1	0.11	0.19
8	Heptanal	111-71-7	0.10	0.17
23	4,5-Nonadiene	821-74-9	0.10	0.17
85	Alkane		0.10	0.17
46	Benzene, (2-methyl-2-propenyl)-	3290-53-7	0.099	0.171
42	Undecane, 2,8-dimethyl-	17301-25-6	0.097	0.168
90	C4-Cyclohexane		0.095	0.165
20	Cyclohexane, 1,5-diethyl-2,3-dimethyl	74663-66-4	0.095	0.165

Cmpd #	Compound	CAS ¹ Number	Average (mg/m ³)	Standard Deviation (mg/m ³)
7	Benzene, ethyl-	100-41-4	0.090	0.155
110	Tridecane, 4-methyl-	26730-12-1	0.087	0.151
43	Undecane, 4,8-dimethyl-	17301-33-6	0.083	0.143
16	Benzene, (1-methylethyl)-	98-82-8	0.079	0.136
68	Cyclopentane, 1-pentyl-2-propyl-	62199-51-3	0.078	0.135
125	9H-Fluorene	86-73-7	0.077	0.134
111	C8-cyclohexane		0.068	0.117
123	1,1'-Biphenyl, 2-methyl-	643-58-3	0.067	0.116
115	2-Undecanone, 6,10-dimethyl-	105-42-0	0.059	0.103
119	Pentadecane, 2-methyl-	1560-93-6	0.056	0.096
89	Cyclooctane, butyl-	16538-93-5	0.055	0.096
112	Dodecane, 2,6,11-trimethyl-	31295-56-4	0.055	0.096
82	Undecane, 3,8-dimethyl-	17301-30-3	0.055	0.096
107	2-Hexenoic acid, 2-hexenyl ester, (E,E)-	54845-28-2	0.052	0.090
113	Tridecane, 4,8-dimethyl-	55030-62-1	0.047	0.081
62	Undecane, 2,4-dimethyl-	17312-80-0	0.046	0.079
66	4-Undecene, 5-methyl- (Z)-	74630-69-6	0.045	0.077
102	C8-Cyclohexane		0.043	0.074
124	1,1'-Biphenyl, 2-methyl-	643-58-3	0.039	0.067
117	Benzene, (1-methylheptyl)-	777-22-0	0.031	0.053
Sum of tentatively identified compounds:			67.03	

¹ CAS = Chemical Abstract Service.

Figure 4-1
Total Ion Chromatograms for SUMMA™ Samples from Tanks C-102 and C-103 (Expanded Ordinate Scale)

SUMMA sample total ion chromatogram for tank C-102 (Klinger et al. 1995b).

SUMMA sample total ion chromatogram for tank C-103 -- enlarged ordinate scale.

Figure 4-2
Total Ion Chromatograms for SUMMA™ Samples from Tanks C-102 and C-103 (Full Ordinate Scale)

SUMMA sample total ion chromatogram for tank C-102 (Klinger et al. 1995b).

SUMMA sample total ion chromatogram for tank C-103 -- full ordinate scale.

Figure 4-3
Total Ion Chromatograms for SUMMA™ Samples from Tanks C-102 and C-101

SUMMA sample total ion chromatogram for tank C-102 (Klinger et al. 1995b).

SUMMA sample total ion chromatogram for tank C-101 (Lucke et al. 1995a).

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