DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	J. W. Osborne	Date May 31, 1995
Project Title/Work Order		EDT No. 612343
Tank 241-U-107 Vapor Sampling and Analysis Tank Characterization Report (WHC-SD-WM-ER-451)		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
RL					
S. O. Branch	S7-54	X			
C. R. Briggs	A5-55	X			
P. R. Hernandez	S7-54	X			
M. F. Jarvis	S7-54	X			
T. Noble	S7-54	X			
C. O. Olaiya	S7-54	X			
J. F. Thompson	S7-54	X			
ECOLOGY					
A. B. Stone	B5-18	X			
MACTEC					
J. P. Haney	S7-73	X			
S. T. Murff	S7-73	X			
PNL					
J. S. Fruchter	K6-96	X			
S. C. Goheen	P8-08	X			
J. L. Huckaby	K6-80	X			
M. W. Ligotke	P7-59	X			
WHC					
Central Files	L8-04	X			
H. Babad	S7-30	X			
D. R. Bratzel	S7-31	X			
D. R. Carls	R3-01	X			
R. J. Cash	S7-15	X			
G. T. Dukelow	S7-15	X			
S. J. Eberlein	R2-12	X			
L. F. Ermold	S7-84	X			
E. R. Hewitt	R3-01	X			
G. D. Johnson	S7-15	X			
T. J. Kelley	S7-30	X			
N. W. Kirch	R2-11	X			
J. G. Kristofzski	T6-06	X			
J. W. Lentsch	S7-15	X			
E. J. Lipke	S7-15	X			
N. G. McDuffie	S7-15	X			
J. E. Meacham	S7-15	X			
R. D. Mitchell	R3-01	X			
M. A. Payne	S7-84	X			
D. A. Turner	S7-15	X			
O.S.T.I. (2)	L8-07	X			

DISCLAIMER

5 Sto. 4

MAY 31 1995

ENGINEERING DATA TRANSMITTAL

1. EDT No. 612343

2. To: (Receiving Organization)	3. From: (Originating Organization)	4. Related EDT No.:
Distribution	Tank Vapor Characterization Program	N/A
5. Proj./Prog./Dept./Div.:	6. Cog. Engr.:	7. Purchase Order No.:
Characterization	J. W. Osborne	N/A
8. Originator Remarks: N/A		9. Equip./Component No.: N/A
		10. System/Bldg./Facility: N/A
11. Receiver Remarks: N/A		12. Major Assm. Dwg. No.: N/A
		13. Permit/Permit Application No.: N/A
		14. Required Response Date: N/A

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-ER-451	N/A	0	Tank 241-U-107 Vapor Sampling and Analysis Tank Characterization Report	N/A	2	1	1

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 4. Review 2. Release 5. Post-Review 3. Information 6. Dist. (Receipt Acknow. Required)	1. Approved 4. Reviewed no/comment 2. Approved w/comment 5. Reviewed w/comment 3. Disapproved w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name (K) Signature (L) Date (M) MSIN	(J) Name (K) Signature (L) Date (M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. J. W. Osborne 5-31-95			
1	1	Cog. Mgr. T. J. Kelley 5/31/95			
		QA			
		Safety			
		Env.			

18. J. W. Osborne 5-31-95
Signature of EDT Originator — Date

19.
Authorized Representative for Receiving Organization — Date

20. T. J. Kelley 5/31/95
Cognizant Manager — Date

21. DOE APPROVAL (if required) Ctrl. No.
[] Approved
[] Approved w/comments
[] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-ER-451, REV 0
Document Title:	Tank 241-U-107 Vapor Sampling and Analysis Tank Characterization Report
Release Date:	5/31/95

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz — May 31, 1995

SUPPORTING DOCUMENT	1. Total Pages 18

2. Title	3. Number	4. Rev No.
Tank 241-U-107 Vapor Sampling and Analysis Tank Characterization Report	WHC-SD-WM-ER-451	0

5. Key Words	6. Author
241-U-107, headspace vapor samples, organic analytes, VSS, SUMMA™, inorganic gases and vapors	Name: J. L. Huckaby Signature Organization/Charge Code 75600/N4AB1

7. Abstract

Tank 241-U-107 headspace gas and vapor samples were collected and analyzed to help determine the potential risks to tank farm workers due to fugitive emissions from the tank. 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 241-U-107 was vapor sampled in accordance with "Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution (Osborne et al., 1994).

8. RELEASE STAMP

DISCLAIMER

Tank 241-U-107 Vapor Sampling and Analysis Tank Characterization Report

X.0 INTRODUCTION

Tank U-107 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 U-107 was vapor sampled in accordance with *Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution* (Osborne et al. 1994). The gas and vapor data presented here represents the best available information on the tank U-107 headspace.

X.1 SAMPLING EVENT

Headspace gas and vapor samples were collected from tank U-107 using the vapor sampling system (VSS) on February 17, 1995 by WHC Sampling and Mobile Laboratories (WHC 1995). Sample collection and analysis were performed as directed by *Tank 241-U-107 Tank Characterization Plan* (Carpenter 1995). The tank headspace temperature was determined to be 22.6 °C. Air from the U-107 headspace was withdrawn from a single elevation via a 6.1-m long heated sampling probe mounted in riser 10, and transferred via heated tubing to the VSS sampling manifold. All heated zones of the VSS were maintained at approximately 60 °C. All tank air samples were collected between 12:03 p.m. and 3:45 p.m., with no anomalies noted.

Sampling media were prepared and analyzed by WHC, Oak Ridge National Laboratories (ORNL), and Pacific Northwest Laboratories (PNL). The 40 tank air samples and 2 ambient air control samples collected are listed in Table X-1 by analytical laboratory. Table X-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 (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 1995 and references therein.

X.2 INORGANIC GASES AND VAPORS

Analytical results of sorbent trap and SUMMA™,[1] canister tank air samples for selected inorganic gases and vapors are given in Table X-2 in parts per

[1] SUMMA is a trademark of Molectrics, Inc., Cleveland, Ohio.

million by volume (ppmv). Inorganic analyte sorbent traps and SUMMA™ canisters were prepared and analyzed by PNL (McVeety et al. 1995a).

X.2.1 Ammonia, Hydrogen, and Nitrous Oxide

The reported ammonia concentration, 453 ppmv, is about 18 times the National Institute of Occupational Safety and Health (NIOSH) 8-hr recommended exposure limit (REL) of 25 ppmv for ammonia (NIOSH 1995). Ammonia has been observed in virtually all of the passively ventilated waste tanks sampled to date, at concentrations ranging from about 3 ppmv in tank C-108 (Lucke et al. 1995), to 1040 ppmv in BY-108 (McVeety et al. 1995b).

The concentration of hydrogen in tank U-107 was determined to be 500 ppmv. Hydrogen in the waste tanks is of concern as a fuel. Given that the lower flammability limit (LFL) for hydrogen in air is about 4 % by volume, 500 ppmv hydrogen concentration in tank U-107 corresponds to about 1.3 % of its LFL. At this level, hydrogen is not a flammability concern in tank U-107.

The nitrous oxide concentration in tank U-107, 701 ppmv, is the second highest measured in any waste tank to date. It is about 28 times the NIOSH 8-hr REL of 25 ppmv for nitrous oxide (NIOSH 1995). Nitrous oxide, also known as laughing gas, has been detected in other passively ventilated waste tanks at average concentrations as low as about 12 ppmv in tank TX-105 (Klinger 1995), and as high as 763 ppmv in tank C-103 (Huckaby and Story 1994).

X.2.2 Carbon Monoxide and Carbon Dioxide

Carbon monoxide in the tank U-107 headspace, characterized as < 12 ppmv, is below the NIOSH 8-hr REL of 35 ppmv for carbon monoxide. In ambient air 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. However, elevated waste tank headspace carbon monoxide concentrations are common, and are thought to be due to the decomposition of organic waste in the tanks. Carbon monoxide has not been measured at very high levels in any of the waste tanks, the highest level measured to date was 26.7 ppmv in tank C-103 (Huckaby and Story 1994).

The carbon dioxide concentration in the tank U-107 headspace, measured to be < 64 ppmv, is significantly lower than it is in ambient air. Carbon dioxide is normally present in the ambient air at a concentration of 350 to 400 ppmv, and is typically lower than ambient in the waste tank headspaces. 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. The carbon dioxide in tank U-107, at < 64 ppmv, is typical of its value in other waste tanks sampled to date.

X.2.3 Nitric Oxide, Nitrogen Dioxide, Water and Tritium

Nitric oxide and nitrogen dioxide concentrations in the tank U-107 headspace were determined to be ≤ 0.06 and ≤ 0.03 ppmv, respectively. These are acid gases that would have very low equilibrium concentrations above the high pH sludge in tank U-107. The measurable presence of nitric oxide is not uncommon in the waste tank headspaces, and may be due to its formation from oxygen and nitrogen in the radiation field of the headspace. The NIOSH 8-hr REL is 25 ppmv for nitric oxide, and the 15-minute short term exposure limit (STEL) for nitrogen dioxide is 1 ppmv.

The water vapor concentration of tank U-107 was determined to be about 11.4 mg/L, at the measured tank headspace temperature of 22.6 °C and pressure of 982.8 mbar (737.3 torr), (WHC 1995). This corresponds to a water vapor partial pressure of 15.5 mbar (11.6 torr), to a dew point of 13.5 °C, and to a relative humidity of 57 %.

Silica gel sorbent traps were used to test 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).

X.2.4 Discussion of Inorganic Gases and Vapors

Aside from water vapor, the most abundant waste constituents in the tank U-107 headspace are nitrous oxide, hydrogen, and ammonia. These have been detected in most tank headspaces sampled to date, and are usually the dominate waste species. The concentrations of these 3 compounds is each higher in tank U-107 than in most other waste tanks.

The relative standard deviations of the inorganic gas and vapor results given in the last column in Table X-2 are excellent for the methods used. Relative standard deviations range from less than 1 % for nitrous oxide and hydrogen to 4.4 % for ammonia. Because 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.), small relative standard deviations suggest proper control was maintained both in the field and in the laboratories.

X.3 ORGANIC VAPORS

Organic vapors in the tank U-107 headspace were sampled using SUMMA™ canisters, which were analyzed by PNL, and triple sorbent traps (TSTs), which were analyzed by ORNL. Gas chromatography (GC) and mass spectroscopy (MS) were used by PNL and ORNL to separate, identify, and quantitate the analytes.

Descriptions of sample device cleaning, sample preparations, and analyses are given by Jenkins et al. (1995) and McVeety et al. (1995a).
SUMMA™ sample results should be considered to be the primary organic vapor data for tank U-107. 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.

X.3.1 Positively Identified Organic Compounds

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 from the Environmental Protection Agency (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.

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 U-107 and obtain concentration in ppmv of analyte in moist tank air, multiply by 0.984.

Table X-3 lists the organic compounds positively identified and quantitated in SUMMA™ samples. SUMMA™ analyses were performed according to the TO-14 methodology, except for analysis of methane, which was analyzed with the inorganic gases (McVeety et al. 1995a). Only 6 of the 39 TO-14 target analytes and 6 of the 14 additional target analytes were measured to be above the 0.005 ppmv detection limit of the analyses. Averages reported are from analyses of 3 SUMMA™ canister samples.

Jenkins et al. (1995) report the positive identification of 20 of 27 target analytes in TST samples. 1,1-Dichloroethene, butanal, 2-pentanone, hexanenitrile, heptanenitrile, dibutyl butylphosphonate, and tributyl phosphate were the only TST target analytes not detected. The average concentrations of the detected target analytes, from the analysis of 3 TSTs, are given in Table X-4. Despite calibration of the instrument over about a 20-fold concentration range, 18 of the compounds listed in Table X-4 were outside of the calibration range in at least 2 of the TST samples.

Eleven target analytes were common to both TST and SUMMA™ analyses. Table X-5 lists these, and their reported average concentrations in TST and SUMMA™ samples. Results from these 2 sampling and analytical methods are in fairly good agreement for toluene. As indicated in Table X-5, the reported concentrations of 1,1-dichloroethene, dichloromethane, butanenitrile, n-hexane, n-heptane, and n-decane in TST samples were near or below the SUMMA™ sample analytical detection limit, and in fair agreement with the SUMMA™ sample result of < 0.005.

The largest discrepancy between the target analyte results from the 2 methods is for acetonitrile, which was determined to be present at 0.12 ppmv in TST samples, and < 0.005 ppmv in SUMMA™ samples. Acetone, propanenitrile, and benzene measurements in the 2 sample types also disagree. None of these compounds, however, even assuming the higher concentrations to be correct, are at or above levels of concern. Benzene, propanenitrile, and acetonitrile have the lowest NIOSH RELs of the identified compounds in Table X-5, being 0.1, 6.0, and 20 ppmv, respectively.

The most abundant analytes in Tables X-3 and X-4 are trichlorofluoromethane, acetone, and acetonitrile, each of which was measured to be above 0.1 ppmv. At the reported concentrations, the target analytes do not individually or collectively represent a flammability hazard.

X.3.2 Tentatively Identified Organic Compounds

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 SUMMA™ 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 (i.e., molecules with more than about 15 carbon atoms) and some polar compounds with moderate volatility (i.e., butanal) from SUMMA™ samples has been problematic.

The list of tentatively identified compounds recovered from SUMMA™ samples, with estimated concentrations, is given in Table X-6. Compounds are listed in Table X-6 in the order by which they eluted chromatographically, and only non-

zero results are included in the reported averages. The list of tentatively identified compounds detected in TST samples, and their estimated concentrations, is given in Table X-7. Compounds are listed in Table X-7 according to the order by which the eluted chromatographically. The averages reported by ORNL in Table X-7 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. Estimated concentrations are in mg/m^3, 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. (1995) and McVeety et al. (1995a), respectively, and should be reviewed before this data is used for decision making. Concentrations given in Tables X-6 and X-7 should be considered rough estimates. Results in Tables X-6 and X-7 are presented in terms of observed chromatographic peaks, and are not adjusted for the occurrence of split peaks or the assignment of the same identity to different peaks (e.g., Cmpd # 21 and 22 in Table X-7). In these instances, the estimated concentration of a compound appearing in more than 1 peak is simply the sum of the individual peak estimates.

X.3.4 Discussion of Organic Compounds

A convenient way to consider the organic compounds listed in Tables X-3 through X-7 is to separate them into 2 categories: 1) Organic compounds added to tank U-107 as waste that are still evaporating; and 2) organic compounds that have been generated by reactions of the original waste.

The first category encompasses all organic compounds that were placed into the tank as waste. It includes the low concentrations of semivolatile straight-chain alkanes, which were used as diluents of tributyl phosphate in various plutonium extraction processes. These alkanes (i.e., n-undecane, n-dodecane, n-tridecane, n-tetradecane, and n-pentadecane) are often referred to in Hanford site literature as the normal paraffinic hydrocarbons (NPHs). Though NPHs are positively identified in tank U-107, their concentrations are very low compared to other NPH-rich tanks.

The various chlorine and fluorine containing compounds, such as tetrachloroethylene and trichlorofluoromethane, may also have been added to tank U-107 as waste. These may have been used as cleaning solvents, and may have been sent to the waste tanks when they became radiolytically contaminated.

The tentatively identified cyclosiloxane (i.e., Cmpd # 24 in Table X-7) is also in this category. Small quantities of siloxanes may have been introduced to the waste tank through their use as process defoaming agents, but they may also be present in the headspace due to their use in liquid traps at the tank's breather riser.

The second category includes all organic compounds that have been generated via radiolytic and chemical reactions of the waste. The majority of compounds

listed in Tables X-3 through X-7 fall into this category, including the alcohols, aldehydes, ketones, nitriles, alkenes, and volatile alkanes, all of which have been associated with the degradation of the NPHs.

The absence of tributyl phosphate in the tank U-107 samples does not necessarily indicate it is not present in the waste. The identification of the tributyl phosphate diluents and their degradation products is reason to expect tributyl phosphate may be present in the tank waste. 1-Butanol, which is one of the more abundant compounds in tank U-107 samples, is known to be a product of the hydrolysis of tributyl phosphate. Furthermore, informal tests by ORNL indicate that tributyl phosphate is adsorbed by the glass fiber filters used during sampling to protect the samples from radiolytic particulate contamination. Based on these considerations, the lack of tributyl phosphate in the tank U-107 headspace samples should not be taken as proof it is not present in the headspace.

On the basis of concentrations, alcohols are the dominate type of organic compound in the tank U-107 headspace. Methanol, ethanol, 1-propanol, 2-propanol, and 1-butanol account for about 63 % of the total estimated concentration of organic compounds in SUMMA™ samples. Similarly, about 64 % of the total estimated organic compound concentration in TST samples is due to the same 5 alcohols. The relative abundance of alcohols is common to both tanks U-106 and U-107. Also similar to tank U-106, and in contrast to tanks having higher NPH concentrations, tank U-107 has relatively few aldehydes and ketones.

The total organic vapor concentration of tank U-107 was estimated by Jenkins et al. to be about 6.4 mg/m^3 from the analysis of 3 TST samples by GC/MS. A similar summation of organic compounds measured in SUMMA™ samples from tank U-107 provides an estimated total organic vapor concentration of 17.1 mg/m^3. This disagreement is largely due to the different estimated concentrations of the dominant alcohols in the 2 sample types.

While these estimated total organic vapor concentrations are not completely equivalent to the total nonmethane organic compound (TNMOC) concentration obtained using the EPA task order 12 (TO-12) method, they are comparable. TNMOC measurements of other waste tanks have ranged from as high as about 5,000 mg/m^3 in tank C-103 (Rasmussen and Einfeld 1994), to as low as 0.18 mg/m^3 in tank C-111 (Rasmussen 1994), while the TNMOC concentration of clean ambient air ranges from about 0.03 to 0.1 mg/m^3.

The organic vapor concentrations in tank U-107 are moderately low compared to other waste tanks. The organic vapors in tank U-107 clearly indicate the presence of the semivolatile NPHs and their degradation products in the tank waste. The concentrations of short-chain alcohols are higher in tank U-107 than in waste tanks with higher NPH vapor concentrations. Conversely, ketones and aldehydes are less abundant in tank U-107 than in NPH-rich waste tanks. Though tributyl phosphate was not detected in any of the headspace samples, there is strong evidence that it is also present in the waste.

Table X-1
Tank U-107 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	0.2, 1.0 and 4.0	Organic vapors	12 tank air samples, + 2 trip blanks + 2 field blanks
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	Carbon Dioxide, Carbon Monoxide, Hydrogen, Methane, Nitrous Oxide, 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

Table X-2
Tank U-107 Inorganic Gas and Vapor Concentrations

Compound	CAS[1] number	Sample Type	Number of samples	Average (ppmv)	Standard Deviation (ppmv)	RSD[2] (%)
Ammonia, NH_3	7664-41-7	Sorbent Trap	6	453	20	4.4
Carbon Dioxide, CO_2	124-38-9	SUMMA™	3	< 64	--	--
Carbon Monoxide, CO	630-08-0	SUMMA™	3	< 12	--	--
Hydrogen, H_2	1333-74-0	SUMMA™	3	500	4.6	0.9
Nitric Oxide, NO	10102-43-9	Sorbent Trap	6	≤ 0.06	--	--
Nitrogen Dioxide, NO_2	10102-44-0	Sorbent Trap	6	≤ 0.03	--	--
Nitrous Oxide, N_2O	10024-97-2	SUMMA™	3	701	2.5	0.4
Water Vapor, H_2O	7732-18-5	Sorbent Trap	6	15,800 (11.4 mg/L)	200 (0.16 mg/L)	1.4

1. CAS = Chemical Abstracts Service.

2. RSD = relative standard deviation.

Table X-3
Tank U-107 Positively Identified Organic Compounds in SUMMA™ Samples

Cmpd #	Compound	CAS[1] Number	Average (ppmv)	Standard Deviation[2] (ppmv)	RSD[3] (%)
1	Propanone (acetone)	67-64-1	0.28	0.02	9
2	Trichlorofluoromethane	75-69-4	0.39	0.03	7
3	Propanenitrile[4]	107-12-0	0.062	--	--
4	Propanol	71-23-8	0.050	0.012	25
5	2-Butanone[5]	78-93-3	0.024	< 0.0015	--
6	Tetrahydrofuran	109-99-9	0.029	0.002	8
7	Benzene	71-43-2	0.032	0.002	6
8	Cyclohexane	110-82-7	0.084	0.005	6
9	Pyridine	110-86-1	0.038	0.032	83
10	Toluene	108-88-3	0.046	0.004	8
11 & 12	p-Xylene and m-Xylene[5,6]	106-42-3 108-38-3	0.018	< 0.005	--
13	Methane	74-82-8	< 12	--	--
Sum of positively identified compounds:			4.4	mg/m^3	

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. RSD = relative standard deviation.

4. Detected in only 1 sample.

5. Detected in only two samples.

6. m-xylene and p-xylene coelute and the reported value represents the sum of their concentrations.

Table X-4
Tank U-107 Positively Identified Organic Compounds in TST Samples

Cmpd #	Compound	CAS[1] Number	Average (ppmv)	Standard Deviation (ppmv)	RSD[2] (%)
1	Ethanenitrile (acetonitrile)	75-05-8	0.12	0.01	8
2	Propanone (acetone)	67-64-1	0.0080	0.0004	5
3	Dichloromethane (methylene chloride)	75-09-2	0.0032	0.0029	92
4	Propanenitrile	107-12-0	0.0036	0.0003	9
5	n-Hexane	110-54-3	0.0077	0.0023	30
6	Benzene	71-43-2	0.0029	0.0047	16
7	1-Butanol	71-36-3	0.070	0.005	7
8	Butanenitrile	109-74-0	0.0062	0.0009	14
9	n-Heptane	142-82-5	0.0030	0.0002	5
10	Toluene	108-88-3	0.032	0.002	7
11	Pentanenitrile	110-59-8	0.00038	0.00005	12
12	2-Hexanone	591-78-6	0.00062	0.00012	20
13	n-Octane	111-65-9	0.0024	0.0002	7
14	2-Heptanone	110-43-0	0.00071	0.00009	13
15	n-Nonane	111-84-2	0.0022	0.0002	10
16	2-Octanone	111-13-7	0.00046	0.00005	10
17	n-Decane	124-18-5	0.0030	0.0004	14
18	n-Undecane	1120-21-4	0.0025	0.0003	13
19	n-Dodecane	112-40-3	0.0041	0.0002	4
20	n-Tridecane	629-50-5	0.010	0.0002	2
Sum of positively identified compounds:			0.99		

1. CAS = Chemical Abstract Service.

2. RSD = relative standard deviation.

Table X-5
Tank U-107 Comparison of Organic Compounds in TST and SUMMA™ Samples

Compound	CAS[1] Number	TST Average (ppmv)	SUMMA™ Average (ppmv)
1,1-Dichloroethene (vinylidene chloride)	75-35-4	< 0.0023	< 0.005
Dichloromethane (methylene chloride)	75-09-2	0.0032	< 0.005
Propanone (acetone)	67-64-1	0.0080	0.28
Ethanenitrile (acetonitrile)	75-05-8	0.12	< 0.005
Propanenitrile	107-12-0	0.0036	0.062[2]
Butanenitrile	109-74-0	0.0062	< 0.005
Benzene	71-43-2	0.0029	0.032
Toluene	108-88-3	0.032	0.046
n-Hexane	110-54-3	0.0077	< 0.005
n-Heptane	142-82-5	0.0030	< 0.005
n-Decane	124-18-5	0.0030	< 0.005

1. CAS = Chemical Abstract Service.

2. Detected in only 1 sample.

Table X-6
Tank U-107 Tentatively Identified Organic Compounds in SUMMA™ Samples

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation[2] (mg/m^3)
1	Propene[3]	115-07-1	0.091	< 0.02
2	Propane	74-98-6	0.34	0.05
3	Dimethyl ether	115-10-6	0.072	0.005
4	Cyclopropane[3]	75-19-4	0.18	< 0.005
5	Isobutane	75-28-5	0.20	0.01
6	Methanol (methyl alcohol)	67-56-1	3.13	0.41
7	1-Butene[3]	106-98-9	0.13	< 0.025
8	Butane	106-97-8	0.24	0.02
9	Propane, 2,2-dimethyl-	463-82-1	0.12	0.02
10	1-Propene, 2-methyl-	115-11-7	0.072	0.007
11	Methane, dichlorofluoro-[4]	75-43-4	0.053	--
12	Ethanol	64-17-5	6.33	0.75
13	Isopropyl Alcohol[3]	67-63-0	0.29	< 0.015
14	n-Pentane	109-66-0	0.18	0.003
15	Butane, 2,2-dimethyl-[3]	75-83-2	0.22	< 0.01
16	Pentane, 2-methyl-	107-83-5	0.23	0.02
17	Pentane, 3-methyl-[4]	96-14-0	0.089	--
18	1-Butanol	71-36-3	0.91	0.02
19	Pyrazine[4]	290-37-9	0.054	--
Sum of tentatively identified compounds:			12.73	

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 X-7
Tank U-107 Tentatively Identified Organic Compounds in TST Samples

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
1	Methanol (methyl alcohol)	67-56-1	0.83	0.06
2	Ethanol	64-17-5	2.83	0.84
3	Trichlorofluoromethane	75-69-4	0.70	0.25
4	2-Propanol (isopropyl alcohol)	67-63-0	0.17	0.03
5	Butane, 2,2-dimethyl-	75-83-2	0.039	0.003
6	Butane, 2,3-dimethyl-	79-29-8	0.011	0.018
7	Pentane, 2-methyl-	107-83-5	0.088	0.011
8	1-Propanol	71-23-8	0.044	0.006
9	Pentane, 3-methyl-	96-14-0	0.039	0.006
10	Furan, tetrahydro-	109-99-9	0.057	0.045
11	Ethanal (acetaldehyde)	75-07-0	0.0081	0.0141
12	Isobutane	75-28-5	0.037	0.033
13	Pyrazine	290-37-9	0.13	0.01
14	Propane, 2-methyl-2-nitro-	594-70-7	0.037	0.006
15	N-Nitrosodimethylamine	62-75-9	0.044	0.013
16	2-Propanol, 1-(1-methylethoxy)-	3944-36-3	0.011	0.019
17	Pentanal, 3-methyl-	15877-57-3	0.039	0.024
18	Tetrachloroethylene	127-18-4	0.025	0.022
19	Pyrazine, methyl-	109-08-0	0.0044	0.0076
20	Ethylbenzene	100-41-4	0.0075	0.0131
21	p-Xylene	106-42-3	0.081	0.007
22	p-Xylene	106-42-3	0.0092	0.0160
23	Octane, 2,5,6-trimethyl-	62016-14-2	0.031	0.000
24	Phenol and cyclotetrasiloxane, octamethyl-		0.004	0.007
25	Octane, 3-ethyl-2, 7-dimethyl-	62183-55-5	0.0048	0.0083
26	Undecane, 2,2-dimethyl-	17312-64-0	0.0054	0.0093

Cmpd #	Compounds	CAS[1] Number	Average (mg/m^3)	Standard Deviation (mg/m^3)
27	1-Hexanol, 2-ethyl-	104-76-7	0.006	0.010
28	Nonane, 5-butyl-	17312-63-9	0.007	0.012
29	Benzyl Alcohol	100-51-6	0.0042	0.0073
30	Hexane, 2,2,3-trimethyl-	16747-25-4	0.0063	0.0110
31	Hexane, 2,2,5-trimethyl-	3522-94-9	0.0048	0.0083
32	Decane, 3-methyl-	13151-34-3	0.0063	0.0110
33	Heptane, 2,2,4-trimethyl-	14720-74-2	0.0027	0.0048
34	Naphthalene and others		0.0032	0.0056
35	Tetradecane	629-59-4	0.0056	0.0096
36	Benzenesulfonamide, N-butyl	3622-84-2	0.099	0.019
37	Isopropyl Palmitate	142-91-6	0.0045	0.0078
Sum of tentatively identified compounds:			5.43	

1. CAS = Chemical Abstract Service.

X.4 REFERENCES

EPA 1988, *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air*, PB90-127374, U.S. Environmental Protection Agency, Washington, D.C.

Carpenter, B. C., 1995, *Tank 241-U-107 Tank Characterization Plan*, WHC-SD-WM-TP-244 Rev. 0A, Westinghouse Hanford Company, Richland, Washington.

Hendrickson, R. W., 1995, *Tank Vapor Characterization Oak Ridge National Laboratories Quality Assurance Assessment*, TWRSQA-95-0012, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., 1995, *Waste Tank Headspace Gas and Vapor Characterization Reference Guide*, WHC-SD-WM-ER-430 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Huckaby, J. L., and M. S. Story, 1994, *Vapor Characterization of Tank 241-C-103*, WHC-EP-0780 Rev. 0, Westinghouse Hanford Company, Richland, Washington.

Jenkins, R. A, A. B. Dindal, C. Y. Ma, M. A. Palausky, J. T. Skeen, and C. K. Bayne, 1995, *Analysis of Tank 241-U-107 Headspace Components*, ORNL-CASD-FR-241U107.95 Rev. 0, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Klinger, G. S., T. W. Clauss, M. W. Ligotke, K. H. Pool, R. B. Lucke, B. D. McVeety, O. P. Bredt, J. S. Young, M. McCulloch, J. S. Fruchter, and S. C. Goheen, 1995, *Vapor Space Characterization of Waste Tank 241-TX-105: Results from Samples Collected Through the Vapor Sampling System on 12/20/94*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

Lucke, R. B., M. W. Ligotke, K. H. Pool, T. W. Clauss, A. K. Sharma, B. D. McVeety, M. McCulloch, J. S. Fruchter, and S. C. Goheen, 1995, *Vapor Space Characterization of Waste Tank 241-C-108: Results from Samples Collected Through the Vapor Sampling System on 8/5/94*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

Mahlum, D. D., J. Y. Young, and R. E. Weller, 1994, *Toxicologic Evaluation of Analytes from Tank 231-C-103*, PNL-10189, Pacific Northwest Laboratory, Richland, Washington.

McVeety, B. D., T. W. Clauss, M. W. Ligotke, K. H. Pool, R. B. Lucke, G. S. Klinger, K. B. Olsen, O. P. Bredt, J. S. Fruchter, and S. C. Goheen, 1995a, *Vapor Space Characterization of Waste Tank 241-U-107: Results from Samples Collected on 2/17/95*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

McVeety, B. D., T. W. Clauss, M. W. Ligotke, K. H. Pool, R. B. Lucke, G. S. Klinger, J. S. Young, M. McCulloch, J. S. Fruchter, and S. C. Goheen, 1995b, *Vapor Space Characterization of Waste Tank 241-BY-108: Results from Samples Collected on 10/27/94*, PNL-xxxxx UC-606, Pacific Northwest Laboratory, Richland, Washington.

NIOSH 1995, *NIOSH Pocket Guide to Chemical Hazards*, U.S. Department of Health and Human Resources, National Institute for Occupational Safety and Health, Cincinnati, Ohio.

Osborne, J. W., and J. L. Huckaby, 1994, *Program Plan for the Resolution of Tank Vapor Issues*, WHC-EP-0562 Rev. 1, Westinghouse Hanford Company, Richland, Washington.

Osborne, J. W., J. L. Huckaby, T. P. Rudolph, E. R. Hewitt, D. D. Mahlum, J. Y. Young, and C. M. Anderson, 1994, *Data Quality Objectives for Generic In-Tank Health and Safety Issue Resolution*, WHC-SD-WM-DQO-002, Westinghouse Hanford Company, Richland, Washington.

Rasmussen, R. A., 1994, *Air Samples Collected at Waste Tank 241-C-111 on September 13, 1994 by Westinghouse Hanford in 6-L SS SUMMA® Canisters*, Oregon Graduate Institute of Science and Technology, Beaverton, Oregon.

Rasmussen, R. A., and W. Einfeld, 1994, *Hanford Tank 103-C Analyses and Method Validation Development Phase*, SAND94-1807, Sandia National Laboratories, Albuquerque, New Mexico.

WHC 1995, *Vapor and Gas Sampling of Single-Shell Tank 241-U-107 Using the Vapor Sampling System*, WHC-SD-WM-RPT-152, Westinghouse Hanford Company, Richland, Washington.