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Waste Tank Safety Program

**Vapor Space Characterization
of Waste Tank 241-C-103:
Inorganic Results from Sample
Job 7B (May 12 – 25, 1994)**

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October 1994

Prepared for the U.S. Department of Energy
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Pacific Northwest Laboratory
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WASTE TANK SAFETY PROGRAM

VAPOR SPACE CHARACTERIZATION OF WASTE
TANK 241-C-103: INORGANIC RESULTS
FROM SAMPLE JOB 7B (5/12/94 - 5/25/94)

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SUMMARY

Samples of vapor obtained in May 1994 from the headspace of the Hanford single-shell waste storage tank 241-C-103 were analyzed for selected inorganic compounds at Pacific Northwest Laboratory. The work was performed to provide concentration information supporting safety and toxicological evaluations. The vapor samples were passed through analyte-specific solid sorbent traps which held the compounds by chemisorption until analysis. Samples were analyzed to determine the concentrations of ammonia, nitric oxide, nitrogen dioxide, sulfur oxides, and hydrogen cyanide. Samples were also analyzed to provide information on the total mass concentration of vapors in the headspace.

A summary of results is shown in Table 1. Throughout the multi-week sample job, average ammonia concentrations were uniform and ranged between 296 and 310 ppmv. The actual ammonia concentrations were more than 10-fold greater than the recommended exposure limit (REL) of 25 ppmv. The results of nitric oxide, sulfur oxides, and hydrogen cyanide samples were ~ 2 , ≤ 0.02 , and ≤ 0.04 ppmv, respectively, and were less or much less than the recommended exposure levels. The concentration of nitrogen dioxide was subject to potential sampling and analytical errors, but was estimated to be less than or much less than 0.4 ppmv. Only the nitrogen dioxide results failed to meet the target analytical detection limit of one-tenth of the REL. Fifty of 55 inorganic samples yielded an average mass concentration of 42.1 ± 2.7 mg/L. A series of 10 ammonia samples, also supported by gravimetric analyses, showed no sampling bias occurred between samples obtained from different sample ports.

TABLE 1. Summary of Inorganic Concentration Results from Samples Drawn from the Headspace of Waste Tank 241-C-103 in May 1994

<u>Compound</u>	<u>Formula</u>	<u>Recommended Exposure Limit (ppmv)</u>	<u>Vapor Concentration (ppmv)</u>
Ammonia	NH ₃	25	304
Nitric Oxide	NO	25	~ 2
Nitrogen Dioxide	NO ₂	1	$\leq 0.4^{(a)}$
Sulfur Oxides	SO _x	2	≤ 0.02
Hydrogen Cyanide	HCN	4.8	≤ 0.04
Total Mass	n/a	n/a	42 mg/L

(a) The probable NO₂ concentration was less. Results of most samples indicated NO₂ concentrations were ≤ 0.08 ppmv. Unknown analytical errors may have affected one set of samples, resulting in greater-than-actual concentrations (≤ 0.4 ppmv).

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1.0 INTRODUCTION

Gas samples drawn from a heated tube inserted into the vapor space of Hanford waste tank 241-C-103, referred to as C-103, were obtained by Westinghouse Hanford Company (WHC) on 5/12, 5/16, 5/17, 5/19 and 5/20, and 5/25/94. The job, Sample Job 7B, consisted of three parts and was performed after procedures were developed during Sample Job 7A in April 1994. Part 1 of the sample job was performed on 5/12, 5/16, and 5/17; Part 2 was performed on 5/19 and 5/20; and Part 3 was performed on 5/25/94. Samples targeted to identify and quantify selected inorganic compounds were obtained as part of the sample job, using analyte-specific solid-sorbent traps, and were analyzed at the request of WHC by staff at Pacific Northwest Laboratory (PNL)^(a). Inorganic compounds targeted during the sample job included ammonia, nitrogen oxides, sulfur oxides, hydrogen cyanide, and water.

The objective of this report is to provide analytical results for use in safety and toxicological evaluations of the vapor space of C-103. In addition to the samples, controls were analyzed that included blanks, spiked blanks, and spiked samples. These controls provided information about the suitability of sampling and analytical methods. Section 2.0 of this report contains information describing the methods and sampling procedures used. In Section 3.0, results of sample analyses are presented and discussed. Conclusions and recommendations are provided in Section 4.0. Details of the sampling job, validation of sampling methods and procedures, and information related to other organic and inorganic samples are not reported here.

(a) Operated by Battelle Memorial Institute for the U.S. Department of Energy under Contract DE-AC06-76RLO 1830.

2.0 SAMPLING METHODS AND ANALYSES

Samples were prepared and analyzed following procedures developed previously and practised during trial sample jobs performed in C-103. Analytical accuracy was estimated based on procedures used. Sample flow rate and volume information, corrected for actual conditions with the tank vaporspace, was provided by WHC and used to determine concentrations of inorganic compounds based on the analytical results. Sampling preparation and analysis were performed at Quality Assurance Impact Level III.

2.1 SAMPLING METHOD AND PROCEDURES

Standard glass tubes containing sorbent materials to trap vapors of NH_3 , NO_x , SO_x , HCN , and H_2O (SKC Inc., Eighty Four, Pennsylvania) were obtained and prepared to sample the vapor space of Tank C-103. The sorbent traps were selected based on their use by the Occupational Safety and Health Administration (OSHA) or the National Institute of Occupational Safety and Health (NIOSH) to perform workplace monitoring (NIOSH 6010; OSHA ID-182; OSHA ID-188; OSHA ID-190; OSHA ID-200), and because of available procedures and verification results associated with that particular application. An alternate approach, using gas bubblers, while providing the potential for reducing the detection limits for some analytes, was not selected because of complexity of handling and operation, and because the solid sorbent materials provided adequate results. Use of sorbent traps to characterize the complex mixture of compounds present in the vapor space of the tanks is also supported by an ongoing evaluation of available methods and preliminary laboratory validation studies. The ultimate selection of sorbent tubes to assist the characterization of waste tank vapor spaces is under continuing investigation.

The typical sorbent traps used consisted of a glass tube containing a sorbent material specific to the compound of interest. In general, the tubes contained two sorbent layers or sections; the first layer was the primary trap, and the second layer provided an indication of breakthrough. In the tubes, sorbent layers are generally held in packed layers separated by glass wool. The sorbent tubes received from the vendor had glass-sealed ends.

The type and nominal quantity of sorbent material varied by application. The NH_3 sorbent traps contained carbon beads impregnated with sulfuric acid; nominally, 500 mg were contained in the primary and 250 mg in the breakthrough sections. The NH_3 was trapped as ammonium. The NO_2 traps contained a zeolite impregnated with triethanolamine, with 400 mg in the primary and 200 mg in the breakthrough sections. The NO_2 was trapped as nitrite and nitrate ions. Glass tubes containing 800 mg of an oxidant such as chromate were used to convert NO to NO_2 . The

converted NO was then collected as nitrite and nitrate in an NO₂ trap. The SO_x traps consisted of a proprietary mix of metal hydroxides coated on carbon beads, with 100 mg in the primary and 50 mg in the breakthrough sorbent sections. The HCN traps contained soda lime, with 600 mg in the primary and 200 mg in the breakthrough sections. A fibrous plug at the inlet end of the HCN traps was removed during sample train preparation. The water traps contained 300 mg of silica gel in the primary and 150 mg in the breakthrough sorbent sections.

For Sample Job 7B, the sorbent traps were connected in two- and four-trap sorbent trains configured so sample flow passed in order through the traps targeting specific analytes and then through a desiccant trap. The ends of the glass tube traps were broken, and the traps were weighed and then connected to each other using uniform lengths of 3/8-in. PFA-grade Teflon tubing. The tubing was heated in hot air and forced over the open ends of the traps to form a tight seal. The inlets of the sorbent trains each consisted of a short section of tubing having a 3/8-in. stainless steel Swagelok nut, sealed using a cap. The trailing ends of the sorbent trains (the downstream end of the silica gel tubes) were each sealed with red plastic end caps provided by the manufacturer. The sorbent tube trains remained sealed except during the actual sampling periods. C-Flex tubing was provided by WHC to connect the downstream ends of the sorbent trains to the sampling exhaust manifold connections. Spare stainless steel caps and plastic end caps were provided. The Teflon and stainless steel components replaced C-Flex tubing, beginning during Sample Job 7A (the predecessor of Sample Job 7B) except in the exhaust line, to help address concerns related to potential thermal and chemical interferences. This was done despite the manufacturer's rating of "good" chemical compatibility for NH₃ and NO_x and "excellent" for SO_x.

Samples provided by PNL to trap inorganic compounds included samples, spiked samples, and spares, and single-tube blanks and spiked blanks. Specifically, the samples provided included 47 of the 1- or 2-tube trains for NH₃ and water, 39 of the 1- or 4-tube trains for NO_x and water, 6 of the 1- or 2-tube trains for SO_x and water, and 10 of the 1- or 2-tube trains for HCN and water. Five additional NO_x tubes spiked with nitrite for the NO₂ analysis were prepared and analyzed, but not shipped to the field. The relatively large number of blanks and spiked blanks were provided to aid initial efforts to validate sampling and analytical methods. All samples (single and multiple sorbent trap sets) were identified by a sample number.

Sorbent trains, blanks, and spiked blanks for inorganic analytes were prepared by PNL on 5/6, 5/17, and 5/23/94 for Parts 1, 2, and 3, respectively. Sorbent trains were disassembled, and individual capped sorbent tubes were submitted for chemical analyses on 5/13, 5/26, and 6/1/94 for Parts 1, 2, and 3, respectively. The samples of each type were prepared from same-lot batches, with the oxidizer sections of the NO_x sorbent trains having been stored previously in a

freezer. After sample preparation, all samples, spiked samples, blanks, and spiked blanks were stored in a freezer, primarily because of handling recommendations for the oxidizer tubes attached to some samples. After receipt of exposed and radiologically cleared samples from WHC and disassembly of the sorbent trains, samples were provided to the analytical laboratory at ambient temperature, and selected oxidizer sections were returned to a freezer for possible subsequent use in laboratory method validation studies.

2.2 ANALYTICAL METHODS

The sorbents trapped compounds of interest by chemisorption. Analytical results were based on extraction and analysis of selected ions. Analytical procedures used are compiled in PNL-MA-599. The NH_3 sorbent traps were extracted with deionized water (DIW) and analyzed using the selective ion electrode (SIE) procedure PNL-ALO-226 (Ammonia [Nitrogen] in Aqueous Samples). The NO_2 traps were desorbed in an aqueous triethanolamine and n-butanol solution and analyzed by suppressed-conductivity ion chromatography (SCIC) for nitrite according to PNL-ALO-212 (Determination of Inorganic Anions by Ion Chromatography) modified by altering eluent and eliminating non-target analytes from standards. Consequently, the molar mass of NO_2 and NO were determined by doubling the analytically determined molar mass of nitrite. The SO_x samples were desorbed in 0.015 N sodium hydroxide plus 1% hydrogen peroxide and analyzed by SCIC for sulfate ion following the modified PNL-ALO-212 procedure. The HCN samples were desorbed in 0.02 N sodium hydroxide and analyzed by amperometric detection ion chromatography according to PNL-ALO-271 (Procedure for Analysis of Free Cyanide in Water and Soil Sample Leachates).

2.3 ANALYTICAL ACCURACY

The accuracy of concentration measurements depends on errors associated with both sampling and analysis. Sampling information was provided by WHC. The accuracy of analytical results depends on the method used. For ammonia analyses, the accuracy of laboratory measurements by selective ion electrode was estimated to be $\pm 5\%$ relative, independent of concentration at 1 $\mu\text{g/mL}$ or greater levels. The uncertainty includes preparation of standards, purity of the ammonium salt used to prepare standards, potential operator bias, ambient temperature variations, etc. Unfortunately, no known NIST-traceable standard reference material (SRM) is available against which to compare our working standards. As for ammonia, no known NIST SRM is available for nitrite analyses (NO_2 and NO). Based on our experience in comparing nitrite working standards prepared from several different sources, and factors mentioned for ammonia above, the estimated maximum basis for samples derived from sampling for NO_2 is $\pm 10\%$, and for samples derived from sampling for NO is $\pm 5\%$ relative. For SO_x analysis, the IC

determination of sulfate derived from SO_x trapped in sorbent tubes is judged to be biased no more than 10% even at the very low concentrations of solutions actually analyzed. Our working standards exhibit no more than 2 to 3% difference at concentrations of 2 ppm or greater compared with an NIST standard reference material solution for sulfate. For HCN analyses, an NIST SRM for uncomplexed cyanide is not available. The estimated bias (accuracy) of the free cyanide measurements is no more than 5% relative for normal working range (which encompasses the concentration levels encountered in blanks and samples derived from sorbent tube leachates). The accuracy of measurements of sample mass is ± 0.05 mg, or much less than 1% of the mass changes of samples, and roughly 5% or less of the mass change of blanks.

2.4 VAPOR CONCENTRATION CALCULATIONS

Calculations were made to determine the concentration of the target compounds in actual tank conditions. Concentration, in parts-per-million by volume (ppmv), was determined by dividing the mass of the compound, in μmol , by the actual volume of the sample, in mol. The micromolar sample mass was determined by dividing the analytically determined mass, in μg , by the molecular weight of the compound, in g/mol. The actual molar volume of the sample was determined by dividing the actual sample volume, in L, by the molar volume of the sampled gas at actual tank conditions. *The actual sample volume was provided by WHC, corrected from standard temperature and pressure (STP) conditions (0°C and 760 torr) to actual tank conditions (38°C and pressures ranging from 738 to 743.5 torr), and corrected for the water vapor content of the sample.* Because vapor space temperature was considered to be constant, the molar volume was calculated, for a temperature of 38°C and pressure of 760 torr, to be 25.52 L/mol. That molar volume was then corrected for actual tank pressure in the calculation of vapor concentration for each sample. For example, the concentration of a sample containing 750 μg of ammonia and having an actual sample volume of 3.724 L at tank pressure of 743.5 torr was determined as

$$C_v = (750 \mu\text{g}/17 \text{ g/mol})(3.724 \text{ L}/[(25.52 \text{ L/mol})(760 \text{ torr}/743.5 \text{ torr})])^{-1} = 309.4 \text{ ppmv} \quad (2.1)$$

It should be noted that the concentration in ppmv could normally be determined without knowledge or correction for actual conditions if the molar sample volume were known; however, because the vapor space of C-103 is near-saturated with water vapor, and because the water vapor content of the sample flows was trapped before the mass flow meters, the total molar volume of the sample required a minor ($\sim 7\%$) correction for the contribution of water vapor to the total actual sample volume in the tank vapor space. This correction, and those for actual vapor space temperature and pressure, were made by WHC and incorporated into the reported actual sample volume (3.724 L in the above example).

3.0 ANALYTICAL RESULTS

Results of samples obtained from C-103 and analyzed for selected inorganic compounds are tabulated in Appendix A. Lists of the inorganic samples obtained by WHC for analysis by PNL, and the results of gravimetric analysis of the samples, are shown in Tables A.1, A.2, and A.3. Sample information provided by WHC included time of day, flow rate, duration, and standard and actual sample volumes. Sample volume uncertainty was not provided. Concentration results reported here are based on this information, and uncertainties are listed as plus or minus one standard deviation of the individual results for each set of samples. The inorganic samples were received from WHC on and before 5/26/94; the sample volume information was received on 6/16/94. Results of the analytical recovery of spiked blanks are shown in Table A.4, corrected for blank sorbent material background levels (sample results were not corrected for the percentage recoveries of spiked blanks). Results of the quantities of ammonia found in the samples are listed in Tables A.5 and A.6. Results of the quantities of NO and NO₂ are listed in Tables A.7 and A.8. Meteorological data during the days when samples were obtained are listed in Appendix B.

3.1 AMMONIA

The blank content, spike recovery, and repeatability of NH₃ samples were excellent, and provided an indication that the sorbent method used was suitable for the needs of tank vapor sampling. The ammonia results are shown in Tables A.4, A.5, and A.6. In all cases, the NH₃ sorbent trap was in the leading position (the first trap through which sample flow was drawn from the VSS manifold). The limit of detectability was 0.03 to 0.06 μmol , depending on the volume of desorbing solution used. The NH₃ levels in six field blanks were < 0.06 μmol . Because this level was insignificant compared with the sample results, no blank correction was performed. Analysis of three spiked blanks injected with a solution containing 22.3 μmol indicated a recovery of 107 to 111%, averaging $109 \pm 2\%$. Analysis of three additional spiked blanks injected with a solution containing 46.4 μmol indicated a recovery of 103 to 105%, averaging $104 \pm 1\%$. The low and high spike additions were selected based on quantities thought to equal one-half and one-times the quantity that would be obtained from the tank vapor space, based on past sampling jobs. Analytical results were not corrected for percentage recovery of NH₃ in spiked blanks. The quantity of NH₃ in the back sorbent layers of all blanks, spiked blanks, and samples was always less than 0.06; thus, breakthrough did not occur. Two sample leachates were spiked after initial analysis and yielded spike recovery percentages of $100 \pm 8\%$. Two samples were duplicated, and the two pairs yielded results that were within $\pm 5\%$ of each other.

Ten samples obtained during Part 1 were found to contain 42.9 to $46.4\ \mu\text{mol NH}_3$, averaging $44.4 \pm 1.4\ \mu\text{mol}$. Five samples from Part 2 contained $42.2 \pm 1.0\ \mu\text{mol}$. Also in Part 2, and corrected for spike additions, five low-spiked samples contained $42.8 \pm 2.3\ \mu\text{mol}$, and five high-spiked samples contained $42.7 \pm 2.6\ \mu\text{mol}$. These results indicate that the spike additions did not affect the analytical result. During the second day of Part 2, samples were obtained at two alternate elevations in the tank vapor space--as opposed to the "low" elevation generally used. Five samples obtained from the "medium" elevation contained $44.9 \pm 1.6\ \mu\text{mol}$, and five samples from the "high" elevation contained $43.8 \pm 0.7\ \mu\text{mol}$.

The concentration of NH_3 determined from the ten samples from Part 1 was $310 \pm 9\ \text{ppmv}$. No significant sample-port dependent bias was observed; the 5 samples from Ports 8 and 9 averaged $313 \pm 10\ \text{ppmv}$, and the 5 samples from Port 10 averaged $307 \pm 7\ \text{ppmv}$. The NH_3 concentrations from the low- and high-spiked samples were 300 ± 16 and $300 \pm 19\ \text{ppmv}$, respectively. The concentration of NH_3 from 5 samples obtained during the first day of Part 2 averaged $296 \pm 7\ \text{ppmv}$. On the second day of Part 2, the concentrations from the medium and high vapor space elevations were 307 ± 3 and $307 \pm 5\ \text{ppmv}$, respectively. The reason that the results from the low elevation were $\sim 4\%$ lower than from the other elevations was not determined; however, based partly on the results from Part 1 (during which all samples were obtained from the low elevation), no significant difference ($< 5\%$) was observed between the NH_3 concentrations at the 3 vapor space elevations.

Actual ammonia concentrations determined from these samples were more than 10-fold greater than the recommended exposure limit of $25\ \text{ppmv}$. The results compare well with those determined from Sample Ports 8 and 9 during Sample Job 7A, after estimated corrections to sample volumes for actual tank conditions. During that sample job, three samples from Ports 8 and 9 averaged $39 \pm 1\ \mu\text{mol NH}_3$ and indicated a concentration of roughly $280\ \text{ppmv}$. The three samples from Port 10 were determined to have been biased by sampling difficulties. This close comparison provides some indication that the composition of the vapor space in C-103 may be roughly constant over a period of many weeks.

3.2 NITROGEN OXIDES

The NO_x analysis was made by measuring the NO_2 collected as nitrite in sorbent traps located upstream and downstream of an oxidizer section. The oxidizer sections were included in the sorbent trains between the two sorbent traps to convert NO , which was not collected in the first sorbent trap, to NO_2 for collection in the downstream sorbent trap. Because NO_2 is thought to be trapped as equal quantities of nitrite and nitrate, but the analysis was specific for nitrite, the total quantity of NO_2 in the samples was determined from twice the nitrite content. After sampling, the

oxidizer sections from samples in Part 1 had turned a dull olive green color in the first 1 cm, with remaining length a dirty yellow color. Also after sampling, the oxidizers from Part 3 samples were colored similarly, with the length of the green coloration only about 0.2 cm.

Six blanks analyzed from Part 1 of Sample Job 7B indicated a nitrite content of 0.0060 ± 0.0002 μmol in the primary sorbent sections. Three of the breakthrough sections were analyzed and yielded a nitrite content of 0.0030 ± 0.0003 μmol . The ratio between the two results was equal to the ratio (2:1) of the sorbent material in the layers. The results of 5 blanks from Part 3 varied from 0.004 to 0.04 μmol , with a maximum equal to about 7-fold greater than past levels. The reason for this unexpected result was not known; however, because the low-spiked blanks and the samples yielded lower nitrite results than the blanks, it was assumed that the blanks, but not the samples, had been contaminated. Consequently, the blank corrections were made using the results of the Part 1 blanks. It should be noted that this approach is conservative in terms of the final result (NO and NO₂ concentrations).

Results for NO₂ (Tables A.4 and A.7) were affected by uncertainty associated with potential chemical interactions or because the concentration of NO₂ in the sample streams was very low. From Part 1, the nitrite results from three samples were 0.0050 ± 0.0011 and 0.0026 ± 0.0001 μmol from the front and back sorbent sections, respectively. The difference between the mean nitrite levels found in the samples and blanks (above) is not significant at the 90% confidence level, based on a t-test for the difference of the means. Thus, in the absence of unknown chemical interactions, the nitrite levels were ≤ 0.001 μmol (and the resulting vapor concentration of NO₂ was less than 0.004 ppmv). However, it should be noted that a possible interaction between NH₃ and nitrite (these sorbent traps were not protected by a preceding NH₃ trap) may have depleted nitrite levels by forming and releasing nitrite as N₂. In Part 3, spiked blanks, samples, and spiked samples were compared with blanks from Part 1 (above). Blanks spiked at 0.0064 ± 0.0001 μmol nitrite were found to contain about 0.0098 μmol nitrite for a percentage of recovery of 153%. Blank-corrected samples were found to contain 0.0017 ± 0.0026 μmol nitrite, indicating NO₂ concentrations ≤ 0.08 ppmv. The result of the spiked samples indicated NO₂ concentrations that were ≤ 0.43 ppmv. The results of NO₂ samples from Part 3 were apparently affected by unresolved analytical problems. Finally, it should be noted that NO₂ sorbent traps *protected by NH₃ sorbent traps* in Sample Job 7A resulted an NO₂ concentration less than 0.03 ppmv (corrected for STP).

Results for NO were determined from samples obtained during Parts 1 and 3 of Sample Job 7B and are shown in Tables A.4 and A.8. The sampling durations during Part 1 were extended to increase sample volumes. Nitrite levels in the 3 samples averaged 0.362 ± 0.017 μmol

in the front, and 0.025 ± 0.001 μmol in the back sorbent sections, each corrected for blank levels (above), for a total of 0.39 ± 0.02 μmol . The resulting average concentration of NO in the 15.4 and 14.9 L actual sample volumes was 1.33 ± 0.06 ppmv. The average blank-corrected nitrite results of 5 samples for NO during Part 3 were 0.109 ± 0.021 μmol in the front sections. Results from back sorbent sections were not yet available, but are expected to be $\sim 7\%$ of the results from the front sections. The spiked samples also obtained during Part 3 support this result. The spike-corrected front-section results of 5 samples spiked with 0.115 ± 0.008 μmol nitrite were 0.140 ± 0.008 μmol nitrite. The spike-corrected front-section results of 5 samples spiked with 0.826 ± 0.061 μmol nitrite were 0.091 ± 0.047 μmol nitrite. The relatively large uncertainty in the latter samples occurred because the result was a small difference between two large numbers, and the results were not considered reliable. With all actual sample volumes from Part 3 equal to 3.74 L, and based on the unspiked samples, the concentration of NO in the sample stream was 1.63 ± 0.31 ppmv (including the estimated contribution from breakthrough). It should be noted that the 15.2 and 3.74 L samples from Parts 1 and 3 provide results that differ by 20 to 35%; the observed relatively large quantity of condensation that formed in the sample trains during the 1-hour samples from Part 1 may have interfered with sampling or analysis, resulting in a lower calculated NO concentration. A slightly greater NO concentration of 2.10 ± 0.12 ppmv was determined from the low-spiked samples. These NO concentrations are less than one-tenth of the recommended exposure limit.

3.3 SULFUR OXIDES

Three 1-hour samples for SO_x obtained during Part 1 of Sample Job 7B indicated very little of the material was present in the sample stream. Analysis of the front and back sorbent sections for sulfate yielded 0.0195 ± 0.0039 and 0.0129 ± 0.0018 μmol , respectively. Analysis of the front and back sections of three blank traps yielded 0.0184 ± 0.0003 and 0.0129 ± 0.0016 μmol , respectively. The ratio of background sulfate present in the front to that in the back sorbent sections of the blanks only roughly approximated the ratio of sorbent mass in each section (2:1). Because of the small quantities of sulfate found in the samples relative to the quantities found in the blanks, the resulting mass of SO_x (= mass of sulfate) collected in the traps from the sample stream can only be reported as ≤ 0.0053 μmol in the front sorbent sections and ≤ 0.0023 μmol in the back sections. Conservatively assuming a 50% collection efficiency per sorbent layer, the total SO_x present in the sample stream was ≤ 0.010 μmol . With an actual sample volume of 14.9 L, and assuming the occurrence of no unknown chemical interferences, the concentration of SO_x in the sample stream was ≤ 0.02 ppmv. This is only 1% of the recommended exposure limit of 2 ppmv.

3.5 HYDROGEN CYANIDE

Five samples for HCN were obtained during Part 2 of Sample Job 7B and indicated that very little of that compound was present in the sample stream. Analysis of the front and back sorbent sections yielded 0.0116 ± 0.0015 and 0.0043 ± 0.0006 μmol HCN, respectively. Analysis of the front and back sections of five blank traps yielded 0.0109 ± 0.0004 and 0.0039 ± 0.0004 μmol , respectively. The ratio of background HCN present in the front to that in the back sorbent sections of the blanks was about equal to the ratio of sorbent mass in each section (3:1). Because of the small quantities of HCN found in the samples, compared with the quantities found in the blanks, the resulting mass of HCN collected in the traps from the sample stream can only be reported as ≤ 0.0026 μmol in the front sections and ≤ 0.0014 μmol in the back sections. Conservatively assuming a 50% collection efficiency per sorbent layer, the total HCN present in the sample stream was ≤ 0.005 μmol . With an actual sample volume of 3.74 L, and assuming effective transfer of HCN from the vapor space to the sorbent trap and the occurrence of no unknown chemical interferences, the concentration of HCN in the sample stream was ≤ 0.04 ppmv. This is more than 100-fold less than the recommended exposure limit of 4.8 ppmv.

3.6 VAPOR MASS CONCENTRATION

Glass sorbent tubes used to make the inorganic sample trains were weighed before (both pre- and post-spike) and after sampling from C-103. The results provide an indication of the total mass concentration of water and other trapped materials in the sample stream. Although individual traps were weighed, results of the combined mass change from each sample are listed in Tables A.1, A.2, and A.3. The change in mass of spiked tubes was used to determine the percentage recovery of spiked blanks and also to determine the spiked level of analyte in the spiked samples. In all cases, gravimetric analysis of representative blanks indicated no significant correction was needed; the average blanks changed in mass between - 0.008 and + 0.002 g, and represented less than 2% of the change in mass caused during sampling tank vapors. The primary material trapped in the sorbent trains was thought to be water, which could be present at ~ 46.3 mg/L if the $\sim 38^\circ\text{C}$ tank vapor space were saturated.

In general, the results of gravimetric analysis of samples were uniform. The average mass gain of 50 of 55 samples obtained with average sample volumes of 3.75 L was 0.158 ± 0.010 g. These results yield an actual mass concentration of 42.1 ± 2.7 mg/L and support the assumption that the vapor space is nearly saturated with water. In addition to water, another component of the mass concentration is the approximately 1 mg/L of semi-volatile normal paraffin hydrocarbons determined by Ligotke et al. (1994). In comparison, saturated water vapor would be expected to have concentrations of 44.0, 46.3, or 48.7 mg/L at temperatures of 37, 38, or 39°C , respectively.

The five samples excluded from the average included two with small mass gains presumably caused by loss of broken glass at the sorbent trap ends (S4029-A27-50X and S4033-A12-75X), and three samples that contained more mass than expected for unknown reasons either related to sampling or analysis (S4025-A06-04X, S4029-A06-29X, and S4029-A07-30X). The mass gained by the 60- or 62-min $\text{NO}_x/\text{H}_2\text{O}$ and $\text{SO}_x/\text{H}_2\text{O}$ samples was 0.517 ± 0.012 g (or ~ 34 mg/L) and 0.206 ± 0.026 g (or ~ 14 mg/L), respectively. The smaller mass changes in these long-duration samples may have been caused by observed condensation and saturation of the sorbent trains. Although condensation also occurred in the 15-min samples, the trailing desiccant trap was clearly saturated in the 60- and 62-min samples.

As was the case with the NH_3 results (above), the gravimetric Part 1 results of samples obtained from Ports 8 or 9 were just slightly greater than those obtained from Port 10. Results from Ports 8 or 9 averaged 44.0 ± 1.6 mg/L, and those from Port 10 averaged about 3% less at 42.7 ± 0.5 mg/L, indicating that sampling port selection did not significantly affect results. Also supporting the NH_3 results, the average Part 2 low elevation gravimetric results were about 4% less than the results of samples obtained at the medium and high elevations. However, the gravimetric results from the Part 2 low elevation samples were similar to those from Part 1 (only varying by 1% where the average NH_3 results varied by 5%). While the reason for this very minor discrepancy was not determined, it is important to note that such small differences are not expected to be resolvable by the sampling and analysis method and may not represent real concentration variations or sampling or analysis errors.

4.0 CONCLUSIONS AND RECOMMENDATIONS

Samples for selected inorganic compounds were exposed to flows from heated tubes inserted at three elevations in the vapor space of Tank C-103 during May 1994. The results of trial inorganic sampling methods, using off-the-shelf sorbent traps, indicated an ability to monitor NH_3 , NO , SO_x , HCN , and total vapor mass concentrations at or below one-tenth of the REL. Mixed results for NO_2 indicated an ability to monitor concentrations less than four-tenths or less than one-tenth of the REL. Concentrations of target compounds were determined using analytical results from the sorbent traps and actual (in-tank) sample volumes provided by WHC.

Average concentrations of NH_3 ranged from 296 to 310 ppmv and indicated uniform conditions (changing less than about 5%) may exist in the tank vapor space both at the three sampled elevations and over periods of many days. The results also compared well with re-evaluated results from Sample Job 7A, possibly indicating that the composition of the vapor space may remain roughly constant over periods of many weeks. The actual NH_3 concentrations were more than 10-fold greater than the recommended exposure limit of 25 ppmv. The concentrations of NO , SO_x , and HCN were determined to be about 2, ≤ 0.02 , and ≤ 0.04 ppmv, respectively, and, unless affected by unknown chemical interactions, the levels of the three compounds were less or much less than the recommended exposure levels. The concentration of NO_2 was subject to potential sampling and analytical errors and was only estimated. Gravimetric analysis of 50 of 55 inorganic samples yielded an average mass concentration of 42.1 ± 2.7 mg/L. Less about 1 mg/L from organic vapors, this result indicates a water vapor concentration about $10 \pm 5\%$ less than saturated conditions at a tank vapor space temperature of 38°C , neglecting any potential effects of the organic and other components in the vapor space on water vapor concentration.

Analyses of spiked blanks and spiked samples prepared for NH_3 and NO demonstrated good percentage recoveries and the absence of gross interferences. The nitrite-spiked NO_2 blanks and samples were potentially affected by analytical problems. Spiked samples were not prepared for SO_x or HCN because significant concentrations of those compounds were not expected. A series of 10 NH_3 samples, also supported by gravimetric analyses, showed no sampling port bias occurred between samples obtained from Ports 8 and 9 and samples obtained from Port 10.

5.0 REFERENCES

Ligotke, M.W., T.R. Clauss, J.S. Fruchter, R.B. Lucke, G.W. Dennis, G.M. Mong, R.E. Hohimer, M. McCulloch, M.T. Dana, and S.C. Goheen. 1994. Aerosol and Vapor Characterization of Tank 241-C-103: Data Report for In-Tank OVS Samples Obtained 12/02/93. PNL-9368, Pacific Northwest Laboratory, Richland, Washington.

NIOSH 6010. NIOSH Manual of Analytical Methods. Hydrogen Cyanide - Method 6010. August 1990. National Institute of Occupational Safety and Health.

OSHA ID-182. Nitrogen Dioxide in Workplace Atmospheres (Ion Chromatography). May 1991. Branch of Inorganic Methods Development, Occupational Safety and Health Administration Technical Center, Salt Lake City, Utah.

OSHA ID-188. Ammonia in Workplace Atmospheres - Solid Sorbent. July 1991. Branch of Inorganic Methods Development, Occupational Safety and Health Administration Technical Center, Salt Lake City, Utah.

OSHA ID-190. Nitric Oxide in Workplace Atmospheres. May 1991. Branch of Inorganic Methods Development, Occupational Safety and Health Administration Technical Center, Salt Lake City, Utah.

OSHA ID-200. Sulfur Dioxide in Workplace Atmospheres (Impregnated Activated Beaded Carbon). April 1992. Branch of Inorganic Methods Development, Occupational Safety and Health Administration Technical Center, Salt Lake City, Utah.

PNL-MA-599. Analytical Laboratory Operations Procedure Compendium. (The compendium includes PNL-ALO-212, PNL-ALO-226, and PNL-ALO-271). PNL-MA-599, Pacific Northwest Laboratory, Richland, Washington.

APPENDIX A

LISTS OF SAMPLES AND ANALYTICAL RESULTS OF BLANKS, SPIKED BLANKS, SAMPLES, AND SPIKED SAMPLES

TABLE A.1 List of PNL Inorganic Samples and Gravimetric Results Obtained From a Heated Tube Inserted in the Vapor Space of Tank C-103 on 5/12/94 (Sample Job 7B, Part 1). Estimated sample information was provided by WHC.

Sample	Type	Sample Elevation	Port	Planned Flow Rate (mL/min)	Actual Duration (min)	Actual Volume ^(a) (L)	Mass Gain (g)
S4025-A04-02X	NH ₃ /H ₂ O	low	8	200	15.0	3.93	0.173
S4025-A05-03X	NH ₃ /H ₂ O	low	10	200	15.0	3.72	0.161
S4025-A06-04X	NH ₃ /H ₂ O	low	9	200	15.0	3.72	0.243 ^(b)
S4025-A07-05X	NH ₃ /H ₂ O	low	10	200	15.0	3.72	0.159
S4025-A08-06X	NH ₃ /H ₂ O	low	8	200	15.0	3.72	0.162
S4025-A09-07X	NH ₃ /H ₂ O	low	10	200	15.0	3.72	0.157
S4025-A10-08X	NH ₃ /H ₂ O	low	9	200	15.0	3.72	0.160
S4025-A11-09X	NH ₃ /H ₂ O	low	10	200	15.0	3.72	0.158
S4025-A12-10X	NH ₃ /H ₂ O	low	8	200	15.0	3.72	0.164
S4025-A13-11X	NH ₃ /H ₂ O	low	10	200	15.0	3.72	0.160
S4025-A14-12X through S4025-A16-14X			NH ₃ /H ₂ O blanks				-0.001
S4025-B06-15X	NO _x /H ₂ O	low	9	200	62.0	15.39	0.530
S4025-A07-16X	NO _x /H ₂ O	low	10	200	62.0	15.39	0.514
S4025-A08-17X	NO _x /H ₂ O	low	9	200	60.0	14.90	0.506
S4025-A09-18X through S4025-A11-20X			NO _x /H ₂ O blanks				-0.008
S4025-A12-21X	SO _x /H ₂ O	low	10	200	60.0	14.90	0.235 ^(b)
S4025-A13-22X	SO _x /H ₂ O	low	9	200	60.0	14.90	0.188 ^(b)
S4025-A14-23X	SO _x /H ₂ O	low	10	200	60.0	14.90	0.194 ^(b)
S4025-A15-24X through S4025-A17-26X			SO _x /H ₂ O blanks				0.000

(a) Actual sample volumes, corrected for temperature, pressure, and water vapor, provided by WHC.

Uncertainty values were not provided with sample volume results.

(b) Values excluded from the analysis of mass concentration.

TABLE A.2 List of PNL Inorganic Samples and Gravimetric Results Obtained From a Heated Tube Inserted in the Vapor Space of Tank C-103 on 5/19 - 5/20/94 (Sample Job 7B, Part 2). Estimated sample information was provided by WHC.

Sample	Type	Sample Elevation	Port	Planned Flow Rate (mL/min)	Actual Duration (min)	Actual Volume ^(a) (L)	Mass Gain (g)
S4029-A04-27X	NH ₃ /H ₂ O	low	10	200	15.0	3.74	0.157
S4029-A05-28X	NH ₃ /H ₂ O	low	9	200	15.0	3.74	0.167
S4029-A06-29X	NH ₃ /H ₂ O	low	10	200	15.0	3.74	0.221 ^(b)
S4029-A07-30X	NH ₃ /H ₂ O	low	8	200	15.0	3.74	0.216 ^(b)
S4029-A08-31X	NH ₃ /H ₂ O	low	10	200	15.0	3.74	0.140
S4029-A09-32X	NH ₃ /H ₂ O	low	9	200	15.0	3.74	0.150
S4029-A10-33X	NH ₃ /H ₂ O	low	10	200	15.0	3.74	0.143
S4029-A11-34X	NH ₃ /H ₂ O	low	8	200	15.0	3.74	0.163
S4029-A12-35X	NH ₃ /H ₂ O	low	10	200	15.0	3.74	0.146
S4029-A13-36X	NH ₃ /H ₂ O	low	9	200	15.0	3.74	0.140
S4029-A14-37X through S4029-A16-39X			NH ₃ /H ₂ O blanks				-0.001
S4029-A17-40X through S4029-A19-42X			NH ₃ /H ₂ O low-spiked blanks				-0.002
S4029-A20-43X through S4029-A22-45X			NH ₃ /H ₂ O high-spiked blanks				0.000
S4029-A23-46X	NH ₃ /H ₂ O	low	10	200	15.0	3.74	0.161
S4029-A24-47X	NH ₃ /H ₂ O	low	8	200	15.0	3.74	0.164
S4029-A25-48X	NH ₃ /H ₂ O	low	10	200	15.0	3.74	0.161
S4029-A26-49X	NH ₃ /H ₂ O	low	9	200	15.0	3.74	0.157
S4029-A27-50X	NH ₃ /H ₂ O	low	8	200	15.0	3.74	0.124 ^(b)
S4029-A52-51X	HCN/H ₂ O	low	9	200	15.0	3.74	0.140
S4029-A53-52X	HCN/H ₂ O	low	10	200	15.0	3.74	0.148
S4029-A54-53X	HCN/H ₂ O	low	8	200	15.0	3.74	0.153
S4029-A55-54X	HCN/H ₂ O	low	10	200	15.0	3.74	0.159
S4029-A56-55X	HCN/H ₂ O	low	9	200	15.0	3.74	0.162
S4029-B05-56X	NH ₃ /H ₂ O	medium	9	200	15.0	3.74	0.177
S4029-B06-57X	NH ₃ /H ₂ O	medium	10	200	15.0	3.74	0.165
S4029-B07-58X	NH ₃ /H ₂ O	medium	8	200	16.0	3.99	0.179
S4029-B08-59X	NH ₃ /H ₂ O	medium	10	200	16.0	3.99	0.181
S4029-B09-60X	NH ₃ /H ₂ O	medium	9	200	15.0	3.74	0.165
S4029-B19-61X	NH ₃ /H ₂ O	high	8	200	15.0	3.74	0.178
S4029-B20-62X	NH ₃ /H ₂ O	high	10	200	15.0	3.74	0.162
S4029-B21-63X	NH ₃ /H ₂ O	high	9	200	15.0	3.74	0.165
S4029-B22-64X	NH ₃ /H ₂ O	high	10	200	15.0	3.74	0.164
S4029-B23-65X	NH ₃ /H ₂ O	high	8	200	15.0	3.74	0.161
S4029-A57-66X through S4029-A61-70X			HCN/H ₂ O blanks				0.002

(a) Actual sample volumes, corrected for temperature, pressure, and water vapor, provided by WHC.

Uncertainty values were not provided with sample volume results.

(b) Values excluded from the analysis of mass concentration.

TABLE A.3 List of PNL Inorganic Samples and Gravimetric Results Obtained From a Heated Tube Inserted in the Vapor Space of Tank C-103 on 5/25/94 (Sample Job 7B, Part 3). Estimated sample information was provided by WHC.

Sample	Type	Sample Elevation	Port	Planned Flow Rate (mL/min)	Actual Duration (min)	Actual Volume ^(a) (L)	Mass Gain (g)
S4033-A08-71X	NO _x /H ₂ O	low	10	200	15.0	3.74	0.154
S4033-A09-72X	NO _x /H ₂ O	low	9	200	15.0	3.74	0.154
S4033-A10-73X	NO _x /H ₂ O	low	10	200	15.0	3.74	0.153
S4033-A11-74X	NO _x /H ₂ O	low	8	200	15.0	3.74	0.146
S4033-A12-75X	NO _x /H ₂ O	low	10	200	15.0	3.74	0.098 ^(b)
S4033-A13-76X	NO _x /H ₂ O	low	9	200	15.0	3.74	0.146
S4033-A14-77X	NO _x /H ₂ O	low	10	200	15.0	3.74	0.148
S4033-A15-78X	NO _x /H ₂ O	low	8	200	15.0	3.74	0.147
S4033-A16-79X	NO _x /H ₂ O	low	10	200	15.0	3.74	0.148
S4033-A17-80X	NO _x /H ₂ O	low	9	200	15.0	3.74	0.148
S4033-A18-81X through S4033-A22-85X			NO _x (unspiked) and spiked H ₂ O blanks				-0.002 ^(c)
S4033-A23-86X through S4033-A27-90X			NO _x low-spiked NO blanks				-0.000 ^(c)
S4033-A28-91X through S4033-A32-95X			NO _x high-spiked NO blanks				-0.000 ^(c)
S4033-A33-96X	NO _x /H ₂ O	low	10	200	15.0	3.74	0.161
S4033-A34-97X	NO _x /H ₂ O	low	8	200	15.0	3.74	0.160
S4033-A35-98X	NO _x /H ₂ O	low	10	200	15.0	3.74	0.159
S4033-A36-99X	NO _x /H ₂ O	low	9	200	15.0	3.74	0.164
S4033-A37-W01	NO _x /H ₂ O	low	8	200	15.0	3.74	0.158
S4033-A38-W02 through S4033-A40-W04			NO _x high-, low-, and no-spiked NO spares				NA
S4033-xxx-W05 through S4033-xxx-W09			NO _x spiked NO ₂ blanks ^(d)				-0.001 ^(c)

(a) Actual sample volumes, corrected for temperature, pressure, and water vapor, provided by WHC.

Uncertainty values were not provided with sample volume results.

(b) Presumably affected by unrecovered loss of broken glass at tube end(s). Value was excluded from the analysis of mass concentration.

(c) Not a true blank for mass--blanks only contained one NO₂ or one NO and one H₂O sorbent trap. True NO_x/H₂O blanks were included in Part 1 of Sample Job 7B.

(d) The trip blanks spiked for NO₂ were not identified in the WHC sample and analysis plan.

TABLE A.4 Percentage Recovery Results of Inorganic Spiked Blanks Sent to the Field but not Opened During Sample Job 7B, Tank C-103 in May 1994. Spikes were applied to the center of front sorbent sections. Analysis of selected back sections yielded levels comparable to those found in the blanks.

Sample Identifier	Sample Job Part	Compound	Spike Added ^(a) (μmol)	Analytical Result ^(b) (μmol)	Percentage Recovery	
					Sample (%)	Average ^(c) (%)
S4025-A17-40X	2	NH ₃	22.3	24.0	108	109 $\pm$ 2 (Low NH ₃)
S4025-A18-41X	2	NH ₃	22.0	24.4	111	
S4025-A19-42X	2	NH ₃	22.7	24.2	107	
S4025-A20-43X	2	NH ₃	45.9	47.8	104	104 $\pm$ 1 (High NH ₃)
S4025-A21-44X	2	NH ₃	46.5	48.7	105	
S4025-A22-45X	2	NH ₃	46.7	48.1	103	
S4033-A23-86X	3	NO ₂ ⁻	0.112	0.105	94	106 $\pm$ 8 (Low NO)
S4033-A24-87X	3	NO ₂ ⁻	0.109	0.112	103	
S4033-A25-88X	3	NO ₂ ⁻	0.106	0.113	107	
S4033-A26-89X	3	NO ₂ ⁻	0.108	0.122	113	
S4033-A27-90X	3	NO ₂ ⁻	0.108	0.123	114	
S4033-A28-91X	3	NO ₂ ⁻	0.765	0.918	120	111 $\pm$ 7 (High NO)
S4033-A29-92X	3	NO ₂ ⁻	0.735	0.809	110	
S4033-A30-93X	3	NO ₂ ⁻	0.757	0.755	100	
S4033-A31-94X	3	NO ₂ ⁻	0.726	0.804	111	
S4033-A32-95X	3	NO ₂ ⁻	0.744	0.849	114	
S4033-xxx-W05	3	NO ₂ ⁻	0.0064	0.0094	147	153 $\pm$ 14 ^(d) (Low NO ₂)
S4033-xxx-W06	3	NO ₂ ⁻	0.0065	0.0087	134	
S4033-xxx-W07	3	NO ₂ ⁻	0.0063	0.0108	171	
S4033-xxx-W08	3	NO ₂ ⁻	0.0065	0.0101	155	
S4033-xxx-W09	3	NO ₂ ⁻	0.0064	0.0101	158	
S4033-A18-81X	3	H ₂ O	2780 ^(e)	2670	96	96 $\pm$ 1 (H ₂ O)
S4033-A19-82X	3	H ₂ O	2790	2640	95	
S4033-A20-83X	3	H ₂ O	2790	2680	96	
S4033-A21-84X	3	H ₂ O	2750	2640	96	
S4033-A22-85X	3	H ₂ O	2770	2660	96	

(a) The NH₃ spike solution was 10,000 ppm (3.142 g NH₄Cl per 100 mL), applied at volumes of 40 and 80 μL . The NO₂ spike solutions were a 35 μL volume of 1000 ppm NO₂⁻ (high NO spike), a 50 μL volume of 100 ppm NO₂⁻ (low NO spike), and a 30 μL volume of 10 ppm NO₂⁻ (NO₂ spike). The H₂O spike was 50 μL of distilled water.

(b) Analytical results for NO₂⁻ were not corrected for a blank level. Blank levels of 0.006 and 0.003 μmol , for the front and back sections of the sorbent tubes, respectively, will be used to correct the values in the interim report. No correction was necessary for NH₃ because blank levels were ≤ 0.06 μmol .

(c) Summary results are listed as average recovery ± 1 standard deviation.

(d) Results of the low NO₂ spiked-blanks may have been affected by analytical problems.

(e) Water measured in μg and converted to μmol by dividing by the molecular weight of water (18).

TABLE A.5 Ammonia Sample Results Obtained From a Heated Tube Inserted in the Vapor Space of Tank C-103 in May 1994 (Sample Job 7B).

Sample	Elevation in Vapor Space	Port	Mass Collected		Estimated(a)
			Front (μmol)	Back (μmol)	Concentration (ppmv)
<u>NH₃ Samples From Part 1 (Unspiked Samples):</u>					<u>310 ± 9(b)</u>
S4025-A04-02X	low	8	46.4	< 0.06	308
S4025-A05-03X	low	10	43.5	< 0.06	305
S4025-A06-04X	low	9	45.3	< 0.06	318
S4025-A07-05X	low	10	42.9	< 0.06	301
S4025-A08-06X	low	8	42.9	< 0.06	301
S4025-A09-07X	low	10	42.9	< 0.06	301
S4025-A10-08X	low	9	44.1	< 0.06	310
S4025-A11-09X	low	10	45.3	< 0.06	318
S4025-A12-10X	low	8	46.4	< 0.06	326
S4025-A13-11X	low	10	44.1	< 0.06	310
S4025-A14-12X	n/a	blank	0.07	< 0.06	n/a
S4025-A15-13X	n/a	blank	0.06	< 0.06	n/a
S4025-A16-14X	n/a	blank	0.07	< 0.06	n/a
<u>NH₃ Samples From Part 2 (Low-Spiked Samples):</u>					<u>300 ± 16</u>
S4029-A04-27X	low	10	68.4	NA(c)	310
S4029-A06-29X	low	10	69.9	NA	320
S4029-A08-31X	low	10	67.1	< 0.03	301
S4029-A10-33X	low	10	64.9	NA	285
S4029-A12-35X	low	10	64.5	NA	283
<u>NH₃ Samples From Part 2 (High-Spiked Samples):</u>					<u>300 ± 19</u>
S4029-A05-28X	low	9	92.9	0.04	313
S4029-A07-30X	low	8	94.2	NA	323
S4029-A09-32X	low	9	90.9	NA	299
S4029-A11-34X	low	8	88.4	NA	282
S4029-A13-36X	low	9	88.3	NA	281

(a) Concentrations were estimated based on analytical results less spiked quantities (24.2 ± 0.2 μmol [low spike] and 48.2 ± 0.5 μmol [high spike]), blank correction was negligible. Concentrations were calculated using WHC-reported tank vapor space pressures of 743.5 torr (Samples 02X - 11X) and 740.5 torr (Samples 27X - 36X) and actual sample volumes reported in Tables 1, 2, and 3.

(b) Underlined values represent the average ± 1 standard deviation for each set of samples.

(c) NA = not analyzed. Only selected back sorbent sections were analyzed.

TABLE A.6 Ammonia Sample Results Obtained Using Heated Tubes Sampling From Three Elevations in the Vapor space of Tank C-103 in May 1994 (Sample Job 7B).

Sample	Elevation in Vapor Space	Port	Mass Collected		Estimated(a) Concentration (ppmv)
			Front (μmol)	Back (μmol)	
<u>NH₃ Samples From Part 2:</u>					<u>296 ± 7(b)</u>
S4029-A23-46X	low	10	41.3	< 0.03	290
S4029-A24-47X	low	8	41.6	NA(c)	292
S4029-A25-48X	low	10	41.5	NA	291
S4029-A26-49X	low	9	43.1	< 0.03	302
S4029-A27-50X	low	8	43.3	NA	304
S4029-A14-37X	n/a	blank	0.03	< 0.03	n/a
S4029-A15-38X	n/a	blank	0.03	NA	n/a
S4029-A16-39X	n/a	blank	0.03	NA	n/a
<u>NH₃ Samples From Part 2:</u>					<u>307 ± 3</u>
S4029-B05-56X	medium	9	44.3	< 0.03	311
S4029-B06-57X	medium	10	43.1	NA	302
S4029-B07-58X	medium	8	46.7	NA	307
S4029-B08-59X	medium	10	46.5	NA	306
S4029-B09-60X	medium	9	43.9	NA	308
<u>NH₃ Samples From Part 2:</u>					<u>307 ± 5</u>
S4029-B19-61X	high	8	44.5	NA	312
S4029-B20-62X	high	10	44.1	NA	309
S4029-B21-63X	high	9	44.1	NA	309
S4029-B22-64X	high	10	43.5	< 0.03	305
S4029-B23-65X	high	8	42.6	NA	299

- (a) Concentrations were estimated based on analytical results, spiked samples were not used and blank correction was negligible. Concentrations were calculated using WHC-reported tank vapor space pressures of 740.5 torr (Samples 46X - 50X) and 740.6 torr (Samples 56X - 65X) and sample volumes reported in Tables 1, 2, and 3. Samples from the "low" elevation were obtained the day before samples were obtained from the "medium" and "high" elevations.
- (b) Underlined values represent the average ± 1 standard deviation for each set of samples.
- (c) NA = not analyzed. Only selected back sorbent sections were analyzed.

TABLE A.7 Nitrogen Dioxide (NO₂) Sample Results Obtained Using a Heated Tube Sampling From the Vapor space of Tank C-103 in May 1994 (Sample Job 7B).

Sample	Elevation in Vapor Space	Port	Nitrite Mass Collected		Estimated NO ₂ (a)
			Front (μmol)	Back (μmol)	Concentration (ppmv)
<u>NO₂ Samples From Part 1 (Unspiked Samples):</u>					<u>≤ 0.004(b)</u>
S4025-B06-15X	low	9	< 0.001(c)	< 0.001(c)	< 0.003
S4025-A07-16X	low	10	< 0.001	< 0.001	< 0.003
S4025-A08-17X	low	9	< 0.001	< 0.001	< 0.004
<u>NO₂ Samples From Part 3 (Unspiked Samples):</u>					<u>≤ 0.08</u>
S4033-A33-96X	low	10	< 0.001	NA(d)	< 0.015
S4033-A34-97X	low	8	< 0.001	NA	< 0.015
S4033-A35-98X	low	10	0.001	NA	0.015
S4033-A36-99X	low	9	0.004	NA	0.06
S4033-A37-W01	low	8	0.005	NA	0.08
<u>NO₂ Samples From Part 3 (Low-Spiked Samples):(e)</u>					<u>0.27 ± 0.16</u>
S4033-A09-72X	low	9	0.034	NA	0.51
S4033-A11-74X	low	8	0.022	NA	0.33
S4033-A13-76X	low	9	0.016	NA	0.24
S4033-A15-78X	low	8	0.008	NA	0.12
S4033-A17-80X	low	9	0.010	NA	0.15

- (a) Concentrations were estimated based on analytical results for nitrite; analyte concentrations were determined by doubling the nitrite levels. Concentrations were calculated using WHC-reported tank vapor space pressures of 743.5 torr (Samples 15X - 17X) and 740 torr (Samples 71X - 99X and W01) and actual sample volumes reported in Tables 1, 2, and 3. The NO levels in the back sections from Part 3 were not analyzed but were assumed to equal 7% of the levels in the front sections, based on results from Part 1, and concentrations for the Part 3 samples were determined by multiplying the spiked-blank corrected front section masses by 1.07.
- (b) Underlined values represent the average ± 1 standard deviation for each set of samples.
- (c) Listed nitrite masses were corrected for blank levels of 0.006 μmol (front sorbent sections) and 0.003 μmol (back sorbent sections). Blank levels from samples obtained during Part 3 were apparently contaminated and were not used (see Analytical Results Section).
- (d) NA = not analyzed.
- (e) Note that the low-spiked samples were positioned in front of the oxidizer tube in the sorbent trains containing the high-spiked NO sorbent tubes (which were trailing the oxidizer tube).

TABLE A.8 Nitric Oxide (NO) Sample Results Obtained Using a Heated Tube Sampling From the Vapor space of Tank C-103 in May 1994 (Sample Job 7B).

Sample	Elevation in Vapor Space	Port	Nitrite Mass Collected		Estimated NO(a) Concentration (ppmv)
			Front (μmol)	Back (μmol)	
<u>NO Samples From Part 1 (Unspiked Samples):</u>					<u>1.33 ± 0.06(b)</u>
S4025-B06-15X	low	9	0.381(c)	0.026(c)	1.38
S4025-A07-16X	low	10	0.347	0.025	1.26
S4025-A08-17X	low	9	0.361	0.025	1.35
<u>NO Samples From Part 3 (Unspiked Samples):</u>					<u>1.63 ± 0.31</u>
S4033-A33-96X	low	10	0.073	NA(d)	1.09
S4033-A34-97X	low	8	0.113	NA	1.69
S4033-A35-98X	low	10	0.113	NA	1.69
S4033-A36-99X	low	9	0.118	NA	1.77
S4033-A37-W01	low	8	0.126	NA	1.89
<u>NO Samples From Part 3 (Low-Spiked Samples):</u>					<u>2.10 ± 0.12</u>
S4033-A08-71X	low	10	0.127	NA	1.90
S4033-A10-73X	low	10	0.142	NA	2.13
S4033-A12-75X	low	10	0.147	NA	2.20
S4033-A14-77X	low	10	0.145	NA	2.17
S4033-A16-79X	low	10	0.140	NA	2.10
<u>NO Samples From Part 3 (High-Spiked Samples):</u>					<u>1.4 ± 0.7(e)</u>
S4033-A09-72X	low	9	0.039	NA	0.58
S4033-A11-74X	low	8	0.120	NA	1.81
S4033-A13-76X	low	9	0.041	NA	0.62
S4033-A15-78X	low	8	0.120	NA	1.81
S4033-A17-80X	low	9	0.134	NA	2.00

- (a) Concentrations were estimated based on analytical results for nitrite; analyte concentrations were determined by doubling the nitrite levels. Concentrations were calculated using WHC-reported tank vapor space pressures of 743.5 torr (Samples 15X - 17X) and 740 torr (Samples 71X - 99X and W01) and actual sample volumes reported in Tables 1, 2, and 3. The NO levels in the back sections from Part 3 were not analyzed but were assumed to equal 7% of the levels in the front sections, based on results from Part 1, and concentrations for the Part 3 samples were determined by multiplying the spiked-blank corrected front section masses by 1.07.
- (b) Underlined values represent the average ± 1 standard deviation for each set of samples.
- (c) Listed nitrite masses were corrected for blank levels of 0.006 μmol (front sorbent sections) and 0.003 μmol (back sorbent sections). Blank levels from samples obtained during Part 3 were apparently contaminated and were not used (see Analytical Results Section). In lieu of using the simple blank corrections, the low-spiked samples were corrected for a spiked-blank nitrite level of 0.115 ± 0.008 μmol, and the high-spiked samples were corrected for a spiked-blank nitrite level of 0.826 ± 0.061 μmol (see data, Table 4).
- (d) NA = not analyzed.
- (e) Analysis of the high-spike samples resulted in a large range of concentrations because the level of spike was much greater than the quantity of analyte corrected, and the concentration result thus depended on a small difference between 2 large values.

APPENDIX B

AMBIENT LOCAL METEOROLOGICAL CONDITIONS

APPENDIX B

AMBIENT LOCAL METEOROLOGICAL CONDITIONS

Meteorological conditions present at and near the site during sampling are summarized in Tables B.1, B.2, and B.3. Measurements were made at the C Tank Farm using a portable station 50 m to the northeast of the site, with wind measured at an elevation of 2 m. Summaries of temperature and atmospheric pressure at the C Tank Farm station for the month of May are shown in Figures B.1 and B.2. Some data are also available from the 200 East Area Meteorology Station located to the southwest of the tank farm, again with wind speed measured at an elevation of 2 m. Data from the 200 East Area station were unavailable for certain intervals. Precipitation and solar radiation measurements were obtained from the Hanford Meteorology Station (HMS), located between the 200 East and 200 West areas. Data from the 200 East Area and the HMS were provided for this report prior to performing formal quality control checks.

TABLE B.1 Hourly Average Meteorological Data Obtained at and Near Tank C-103 During Sample Job 7B, May 1994. Data shown in **bold type** were obtained during the actual tank sampling intervals. May 12 (Day 132) and May 16 (Day 136).

PST	C-Tank Farm Met. Station					200 East Met. Station			Hanford Met. Sta.	
Hour Ending (h)	Air Temp. (°C)	Relative Humidity (%)	Wind Direction (deg.)	Wind Speed (m/s)	Air Pressure (mBar)	Air Temp. (°C)	Wind Direction (deg.)	Wind Speed (m/s)	Precip. (mm)	Solar Radiation (W/m2)
Day 132 (May 12):										
0100	17.5	40	286	6.5	990	17.2	287	9.2	0.00	0
0200	16.9	46	293	7.0	991	16.7	296	10.1	0.00	0
0300	16.6	45	285	5.5	991	16.3	287	7.7	0.00	0
0400	15.7	45	279	4.4	991	15.5	282	6.6	0.00	0
0500	15.0	45	284	4.2	991	14.8	285	6.1	0.00	7
0600	15.4	45	289	4.6	991	15.3	290	6.2	0.00	84
0700	17.2	39	302	5.4	991	17.0	304	7.5	0.00	258
0800	19.4	29	305	4.8	992	19.1	308	6.6	0.00	391
0900	20.8	25	295	3.7	992	20.6	294	4.7	0.00	488
1000	21.8	23	295	2.3	991	21.8	290	3.3	0.00	614
1100	23.2	20	280	1.3	991	23.6	255	2.0	0.00	698
1200	24.4	17	249	0.7	990	24.9	238	1.0	0.00	823
1300	25.3	18	154	3.0	989	25.1	160	5.1	0.00	865
1400	26.2	16	137	2.0	988	25.9	147	2.5	0.00	768
1500	26.6	13	244	3.5	987	26.9	241	5.9	0.00	698
1600	26.7	14	256	3.7	987				0.00	558
1700	26.0	14	283	5.2	986	25.9	282	7.9	0.00	321
1800	24.1	15	304	7.7	987	23.8	307	10.8	0.00	230
1900	21.6	18	301	8.2	987	21.2	303	11.5	0.00	63
2000	18.4	29	300	7.6	988	18.0	304	11.1	0.00	0
2100	16.5	33	295	5.5	990				0.00	0
2200	15.2	37	291	5.2	991	14.9	296	7.5	0.00	0
2300	14.3	41	299	5.4	991	14.0	301	7.8	0.00	0
2400	13.5	42	293	5.4	992	13.2	295	7.9	0.00	0
Day 136 (May 16):										
0100	10.5	63	243	2.2	983	9.9	245	4.0	0.00	0
0200	10.2	63	237	2.6	983	9.7	241	4.8	0.00	0
0300	9.8	65	233	2.9	983	9.3	236	5.1	0.00	0
0400	9.1	69	228	1.5	984	8.5	235	3.4	0.00	0
0500	8.3	73	201	0.6	984	8.0	241	1.9	0.00	7
0600	9.8	66	235	1.7	984	10.1	237	3.1	0.00	98
0700	11.9	58	266	2.5	985	12.5	260	3.6	0.00	265
0800	13.9	51	267	2.0	985	14.5	256	2.6	0.00	447
0900	15.0	47	254	2.2	985	15.7	252	3.3	0.00	600
1000	16.4	43	253	1.9	985	17.2	251	3.1	0.00	761
1100	17.2	40	256	0.8	984	17.5	280	1.4	0.00	691
1200	18.5	37	239	0.8	984				0.00	663
1300	19.4	31	227	1.7	983				0.00	593
1400	20.1	27	252	1.5	983	20.5	241	2.5	0.00	572
1500	20.4	26	231	1.6	983	20.8	239	3.1	0.00	663
1600	20.8	25	258	1.4	982	20.9	270	1.7	0.00	405
1700	20.9	23	326	0.5	982	20.4	36	0.6	0.00	398
1800	19.6	29	76	1.4	982	19.5	106	2.1	0.00	84
1900	17.5	40	340	2.4	983				0.00	21
2000	16.0	44	278	2.3	983				0.00	0
2100	15.6	47	258	3.3	984	15.2	259	4.9	0.00	0
2200	14.2	51	292	4.5	984	14.0	293	6.4	0.00	0
2300	13.2	54	291	3.9	984	12.9	293	5.7	0.00	0
2400	12.8	54	291	4.8	984	12.6	293	6.7	0.00	0

TABLE B.2 Hourly Average Meteorological Data Obtained at and Near Tank C-103 During Sample Job 7B, May 1994. Data shown in **bold** type were obtained during the actual tank sampling intervals. May 17 (Day 137) and May 19 (Day 139).

PST	C-Tank Farm Met. Station					200 East Met. Station			Hanford Met. Sta.	
Hour Ending (h)	Air Temp. (°C)	Relative Humidity (%)	Wind Direction (deg.)	Wind Speed (m/s)	Air Pressure (mBar)	Air Temp. (°C)	Wind Direction (deg.)	Wind Speed (m/s)	Precip. (mm)	Solar Radiation (W/m2)
<u>Day 137 (May 17):</u>										
0100	12.2	56	295	4.4	984	12.0	297	6.4	0.00	0
0200	11.4	60	296	3.5	984	11.2	300	4.9	0.00	0
0300	10.9	61	290	4.4	985	10.8	295	6.1	0.00	0
0400	10.8	61	289	4.9	985	10.7	293	6.6	0.00	0
0500	10.8	61	287	4.8	985	10.7	290	6.5	0.00	7
0600	11.5	59	292	4.5	985	11.5	294	6.3	0.00	77
0700	13.5	52	297	4.3	986	13.5	299	5.9	0.00	230
0800	15.9	45	306	4.3	986	15.7	307	5.9	0.00	433
0900	17.8	38	344	3.1	986				0.00	530
1000	18.5	36	355	2.8	986				0.00	579
1100	19.4	33	337	1.8	986	19.0	348	3.0	0.00	572
1200	19.8	31	299	1.9	986	19.7	283	2.8	0.00	593
1300	20.8	28	314	2.0	986	20.6	323	2.9	0.00	740
1400	21.5	26	302	1.5	986	21.3	307	2.3	0.00	509
1500	21.6	26	271	1.8	986	21.6	276	2.8	0.00	468
1600	21.7	25	217	1.0	986	21.8	229	1.9	0.00	342
1700	21.9	25	257	1.7	986	21.9	254	2.7	0.00	216
1800	21.4	28	262	1.7	986	21.2	253	2.7	0.00	105
1900	19.8	34	305	4.6	987	19.4	305	6.5	0.00	28
2000	18.0	39	297	5.4	987	17.6	300	7.6	0.00	0
2100	16.7	42	292	5.1	988	16.4	294	7.1	0.00	0
2200	16.0	45	296	5.2	989	15.7	298	7.2	0.00	0
2300	15.4	47	294	5.9	989	15.0	295	8.0	0.00	0
2400	15.1	48	291	5.6	989	14.8	294	7.7	0.00	0
<u>Day 139 (May 19):</u>										
0100	14.1	71	294	3.4	988	13.9	302	5.1	0.00	0
0200	14.2	74	313	3.0	988	14.0	320	4.8	0.00	0
0300	14.0	75	346	1.7	988	13.8	353	3.2	0.00	0
0400	12.6	87	300	2.4	988	12.4	310	3.9	1.52	0
0500	12.7	86	289	3.4	988	12.5	297	4.7	0.51	0
0600	12.6	86	330	2.3	988	12.5	335	4.1	0.51	7
0700	12.1	89	320	3.3	988	12.0	326	5.3	1.52	21
0800	12.4	87	294	4.4	988	12.1	297	5.9	1.02	56
0900	14.2	82	302	4.6	987	14.0	305	6.6	0.00	488
1000	16.6	66	343	3.7	987				0.00	398
1100	16.5	59	46	3.8	987				0.00	202
1200	16.6	62	33	3.2	987				0.00	321
1300	16.3	69	38	2.8	987	15.9	52	4.0	0.00	412
1400	16.5	64	30	2.4	987				0.00	398
1500	17.2	56	17	2.5	987				0.00	342
1600	16.2	63	326	2.9	987	15.7	330	4.3	0.00	140
1700	16.3	62	322	3.2	987	15.8	323	5.2	0.00	133
1800	15.7	63	321	3.8	987	15.4	320	6.4	0.00	126
1900	14.8	67	311	4.1	987	14.6	313	6.2	0.00	28
2000	14.2	72	298	3.6	988	13.9	302	5.1	0.00	0
2100	13.8	76	290	3.3	988	13.6	294	4.8	0.00	0
2200	13.6	79	289	2.9	988	13.4	294	4.1	0.00	0
2300	13.6	80	274	2.3	988	13.3	277	3.1	0.00	0
2400	13.2	85	255	1.2	988	12.6	257	2.1	0.00	0

TABLE B.3 Hourly Average Meteorological Data Obtained at and Near Tank C-103 During Sample Job 7B, May 1994. Data shown in **bold type** were obtained during the actual tank sampling intervals. May 20 (Day 140) and May 25 (Day 145).

PST	C-Tank Farm Met. Station					200 East Met. Station			Hanford Met. Sta.	
Hour Ending (h)	Air Temp. (°C)	Relative Humidity (%)	Wind Direction (deg.)	Wind Speed (m/s)	Air Pressure (mBar)	Air Temp. (°C)	Wind Direction (deg.)	Wind Speed (m/s)	Precip. (mm)	Solar Radiation (W/m2)
<u>Day 140 (May 20):</u>										
0100	12.9	88	238	1.4	988				0.00	0
0200	12.6	88	254	1.5	988	12.0	260	2.6	0.00	0
0300	12.9	83	268	2.0	988	12.5	270	3.1	0.00	0
0400	12.6	84	272	2.2	988	12.3	274	3.3	0.25	0
0500	12.4	87	262	2.3	988	12.0	263	3.4	0.00	7
0600	12.7	87	245	2.3	988	12.2	250	3.5	0.25	21
0700	13.3	83	261	2.4	988	13.0	264	4.0	0.00	77
0800	14.2	79	263	2.9	988	14.0	261	4.6	0.00	154
0900	15.2	71	269	3.1	988	15.1	269	4.5	0.00	223
1000	16.5	63	277	2.4	988	16.4	278	3.3	0.00	272
1100	17.8	57	268	2.8	988	18.1	259	4.1	0.00	377
1200	18.7	53	260	2.5	988	18.5	262	3.8	0.00	209
1300	16.0	67	264	3.9	988	15.2	267	5.6	6.86	63
1400	14.7	79	112	0.5	987	14.8	77	0.9	0.76	119
1500	16.0	75	86	1.9	987	15.9	99	3.2	0.00	126
1600	16.4	70	60	2.4	987	16.2	71	3.8	0.00	84
1700	16.3	68	21	1.2	987	16.1	33	2.4	1.78	49
1800	16.1	68	290	1.7	988	15.8	305	3.2	0.76	77
1900	16.3	61	295	3.0	988				0.00	105
2000	16.1	54	270	3.6	988	15.7	265	5.3	0.00	7
2100	15.1	55	268	3.4	989				0.00	0
2200	14.5	56	274	4.1	989				0.00	0
2300	14.2	57	274	3.5	989				0.00	0
2400	13.5	61	269	2.4	989				0.00	0
<u>Day 145 (May 25):</u>										
0100	19.4	48	273	1.4	988	19.0	305	2.7	0.00	0
0200	19.0	49	252	1.5	987	18.2	286	2.4	0.00	0
0300	18.6	50	238	1.5	987	17.1	271	2.2	0.00	0
0400	17.8	52	238	1.5	987	16.4	267	2.6	0.00	0
0500	17.4	53	282	1.3	987	17.1	309	2.6	0.00	14
0600	19.0	49	309	0.8	987	19.0	305	2.0	0.00	119
0700	21.7	42	358	0.4	988				0.00	286
0800	24.2	38	346	0.9	987				0.00	440
0900	26.5	33	91	0.6	987	26.5	73	1.4	0.00	586
1000	28.4	27	186	0.7	987	27.8	114	1.1	0.00	642
1100	29.5	26	287	1.0	987		12	0.8	0.00	579
1200	29.8	26	313	2.6	987		323	3.5	0.00	544
1300	29.4	26	302	2.0	986		294	2.6	0.00	558
1400	30.5	23	16	0.2	986				0.00	726
1500	31.9	21	158	0.4	985	31.4	262	0.9	0.00	663
1600	31.9	21	311	1.1	984	31.6	333	1.7	0.00	405
1700	31.4	22	284	1.2	984	31.2	276	2.2	0.00	300
1800	30.0	22	305	5.1	983				0.00	230
1900	26.7	25	304	6.7	983				0.00	77
2000	23.7	31	302	5.6	984	23.3	303	7.7	0.00	7
2100	21.5	36	304	5.8	984	21.1	306	8.2	0.00	0
2200	20.4	37	299	7.0	984				0.00	0
2300	19.5	39	293	7.2	985	19.2	294	9.7	0.00	0
2400	18.8	43	287	5.8	985	18.5	289	7.8	0.00	0

FIGURE B.1 Hourly Average C Tank Farm Meteorology Station Air Temperature During Sample Job 7B, May 1994. Measurement height was 2 m. Dates during which sampling was performed are marked with an "X".

FIGURE B.2 Hourly Average C Tank Farm Meteorology Station Atmospheric Pressure During Sample Job 7B, May 1994. To correct the data for sea-level pressure, add 23 mb. Measurement height was 2 m. Dates during which sampling was performed are marked with an "X".

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