Collecting Mir Source and Reclaimed Water for Postflight Analysis

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(NASA 2 Operational Accomplishment Report)

INTRODUCTION

Approximately fifty percent of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water transferred from the Shuttle. This experiment is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems, and to provide inflight testing of water collection hardware.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain the concentrations of potentially harmful contaminants at acceptably safe levels.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS)

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology

Compare the chemical composition of Mir and Shuttle humidity condensate

Provide inflight testing of water collection hardware being developed to collect water samples on ISS

Provide a better understanding of the interaction between atmospheric and water contaminants

Previous Mission Experience

This experiment has flown during the Mir 18/NASA 1, Mir 19, and Mir 20/STS-74 missions.

RESEARCH OPERATIONS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

On 7/21/96, Mir 21/NASA 2 crewmembers report a "metallic" aftertaste in the potable water from the Mir condensate water processor system. Ground personnel instructed the crewmembers to turn off the condensate water processor which produces potable water from humidity condensate until the problem could be evaluated. The processor remained off throughout the remainder of this mission. As a consequence, the crew relied on Russian ground supplied water and water transferred from the Shuttle for drinking. Therefore, all samples collected after this time were ground supplied water instead of recycled water.

One additional session for water collection was performed on 7/22/96, when hot and cold water were collected as a response to the comments by the crew. These samples were not received on the ground upon the return of STS-79.

Two condensate samples were collected from 6/18-22/96 and 7/23-26/96, but were not returned on STS-79. Two additional samples of condensate taken from the EDV tanks from 9/10-12/96 and 9/16-18/96 were collected in water collection bags containing a microbial preservative

(thioglycolate) which will interfere with some of the chemical analysis of these samples.

Postflight Anomalies

Two humidity condensate samples and 2 water samples collected in flight were not returned on STS-79.

Completeness/Quality of Data

Data for this experiment are derived from analysis of water samples returned from the mission. Sample analyses are in progress. Two water samples (one SVO-ZV, one cold) were not collected in flight as planned. For these samples, no data will be available. Also, no data will be available for those samples not returned on STS-79 (2 humidity condensate, 1 hot water, 1 cold water).

DISCUSSION

Status of Data Analysis

Chemical analysis of the potable water and humidity condensate samples is in progress. Analyses completed to date include conductivity, pH, turbidity, nonpurgeable organic carbon (NPOC), total organic carbon (TOC), silver, chromium, zinc, alcohols, acetone, semivolatile organics, formaldehyde, ethylene glycol, and propylene glycol. Analyses yet to be completed include color, taste, odor, total hardness, total solids, chemical oxygen demand (COD), anions, cations, metals, volatile organics, organic acids, amines, and urea.

Preliminary Research Findings

Preliminary results show that one recycled water sample collected on 7/15/96 contained 45.5 mg/L of ethylene glycol, which exceeds the U.S. Environmental Protection Agency (EPA) maximum contaminant limit of 7 mg/L. In addition, two ground supplied water samples collected on 9/5/96 and 9/23/96 from the SVO-ZV and the cold water ports had TOC values that exceeded the NASA limit of 500 µg/L TOC and the Russian limit of 25 mg/L TOC taken from the Joint U.S. /Russian Potable Water Specifications for International Space Station (see Table 1). These samples contained 30.5 mg/L and 32 mg/L TOC, respectively. It is likely that this was caused by formates, counterions to the calcium and magnesium that is added to the ground supplied water to render it acceptable for potable water use by the Russians. Therefore, the excess levels of TOC detected in these samples should not represent a health hazard to the crewmembers. Testing is continuing to verify that the major contribution to the TOC is the nontoxic formate counterions. U.S. turbidity levels were also exceeded in three of the water samples collected. These samples had turbidity levels ranging from 1.04 - 4.24 NTU. The maximum contaminant level for this parameter is 1.00 NTU.

Conclusions

The metallic aftertaste reported by the crew is under investigation. Taste testing performed at NASA-Johnson Space Center and at the Institute for Biomedical Problems indicates that high ethylene glycol level such as that reported in one of the regenerated water samples, do not cause the metallic aftertaste in the water, as reported by the crew. In addition, preliminary data indicates that the high TOC values seen in the ground supplied water may be attributed to the presence of formate counterions which may be present in these samples.

TABLE 1. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH1	5.5-9.0 pH units	5.5-9.0 pH units
Color2	15 Pt-Co units	20 degrees
Taste2	3 TTN	2 grade
Odor2	3 TON	2 grade
Total Dissolved Solids3	100-1,000 mg/L	100-1,000 mg/L
Turbidity2	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20oC	5% volume @1 ATM, 20oC
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual4	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria2	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 µg/L	200 µg/L
Total Phenols	1 µg/L	1 µg/L
Total Organic Carbon	500 µg/L	25,000 µg/L
Uncharacterized TOC	100 µg/L	no limit
Oxygen Consumption (COD)	no limit	100 mg/L

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

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(NASA 2 Preliminary Research Report)

INTRODUCTION

Approximately fifty percent of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water that is transferred from the Shuttle. This experiment is being conducted to determine the potability of the recycled water, to assess the reliability of the water supply systems, and to provide inflight testing of water collection hardware.

Hypothesis

Detailed analysis of reclaimed waters will confirm that the Mir water reclamation system and the ground supplied water system deliver water for crew consumption that meets established water quality requirements.

Objectives

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit to determine potability

Characterize the chemical composition of Mir recycled water to determine potability

Evaluate the efficiency of on board water processors to aid in the development of ISS water processing and monitoring technology

Characterize the chemical composition of Mir humidity condensate to support development of the water recycling and monitoring systems for the International Space Station (ISS)

Provide inflight testing of water collection hardware being developed to collect water samples on ISS

Background/History

Historically, water provided for crew consumption during U.S. space missions has either been launched from the ground or produced as a byproduct of fuel cell operation. Reclamation and purification of spacecraft wastewaters, as practiced on the Russian Space Station Mir, will be required for supplying crewmembers of the International Space Station with potable and hygiene water.

METHODS/SCIENCE OPERATIONS

Functional Objectives

FO1. Preflight collection of ground-supplied water at RSC Energia, Kalingrad, Russia

FO2. Water Sampling Hardware Setup

FO3. Inflight collection of hot, cold, and SVO-ZV (ground supplied) water

FO4. Inflight collection of humidity condensate

FO5. Postflight analysis of samples

Hardware Items

Major hardware items used inflight for this experiment:

HW1. Water Experiment Kit - NASA provided

HW2. Disinfectant/Antiseptic Wipes - NASA provided

HW3. Potable Water Samplers (with Mir port adapter interfaces) - NASA provided

HW4. Waste bags and Chemical Archive Sample Bags - NASA provided

HW5. Self Sealing Storage Bags - NASA provided

HW6. Atmospheric Condensate Sampler - RSA provided

Major hardware items used postflight for this experiment:

HW7. HP 5890 Gas Chromatograph (GC) with HP5971A Mass Spectrometer (MS) - NASA provided

HW8. Waters Quanta 4000 Capillary Electrophoresis System - NASA provided

HW9. OI 700 Carbon Analyzer - NASA provided

HW10. Sievers Model 800 Total Organic Carbon Analyzer - NASA provided

HW11. HP 7694 Headspace sampler with a HP 5890 GC and 5972 Mass Selective Detector - NASA provided

HW12. HP 5989 Mass Spectrometer (MS) with a 1090 Liquid Chromatograph with Particle beam & Thermospray interfaces - NASA provided

HW13. pH meter - RSA and NASA provided

HW14. Conductivity meter - RSA provided

Method/Protocol

During inflight water sampling sessions on board Mir, the water experiment kit was unstowed from its storage location. The water experiment kit contained the disinfectant wipes, potable water samplers, waste bags, chemical archive sample bags, and storage bags needed for water sampling. A prepackaged disinfectant wipe containing 1 ml of benzalkonium chloride in 250 ml of water, was retrieved from the kit and used to disinfect the Mir galley-hot, galley-cold, or SVO-ZV water port. Next, a potable water sampler was connected to the port. A waste bag was then connected to the potable water sampler. Using the waste bag, 50 ml of water was collected and discarded. Next, 750 ml of water was collected into the chemical archive sample bag. The chemical archive sample bag was placed in a self sealing storage bag and stowed for return on the Shuttle. These procedures were used to collect galley-hot, galley-cold, and SVO-ZV (ground supplied) water for postflight chemical analysis for this experiment. Following the collection of the chemical samples, microbiological samples were obtained for a separate experiment.

Postflight chemical analysis of samples occurred at Johnson Space Center (JSC) and the Institute for Biomedical Problems (IBMP). Following recovery of the samples on the ground, the samples were allocated (See Table 2) for distribution to the water analysis laboratories at JSC and IBMP. Parameters tested at JSC included total carbon (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, nonvolatiles, formaldehyde), and silver. Parameters tested by IBMP included conductivity, pH, color, chemical oxygen demand, total solids, calcium, magnesium, total hardness, and silver.

RESULTS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

None.

Inflight Anomalies

Mir 21

On 7/21/96, Mir 21/NASA 2 crewmembers reported a "metallic" aftertaste in the potable water from the Mir condensate water processor system. This system produces potable water from humidity condensate. Ground personnel instructed the crewmembers to turn off the condensate water processor until the problem could be evaluated. As a consequence, the crew relied on Russian ground supplied water and water transferred from the Shuttle for drinking. The condensate water processor was returned to operational status on 10/17/96. As a result, all samples collected between 7/21/96 and 10/17/96 were ground supplied water instead of recycled water.

One additional session for water collection was performed on 7/22/96, when hot and cold water were collected as a response to the comments by the crew. These samples were not received on the ground upon return of STS-79.

Mir 22

During the time that the condensate recovery system (CRS) was not operational, the humidity condensate was collected in EDV tanks. Two EDV tanks were filled during the respective periods of 9/10-12/96 and 9/16-18/96. Samples from each EDV tank were collected in water sample bags containing a microbial preservative (thioglycolate) which interferes with the chemical analysis of these samples. This chemical interferes with the total organic carbon analysis by increasing the amount of organic carbon in the sample.

Postflight Anomalies

Two condensate samples were collected from 6/18-22/96 and 7/23-26/96, but were not returned on STS-79. These samples were subsequently found and returned on STS-81 in January 1997.

Completeness/Quality of Data

Data for this experiment are derived from analysis of water samples returned from the mission. Two water samples (one cold on Mir 21 MD177, one SVO-ZV on Mir 22 MD38) were not collected inflight as planned. For these samples, no data will be available. Also, no data will be

available for those samples not returned to the ground (1 hot water, 1 cold water). Sample analyses are pending on the two humidity condensate samples returned on STS-81.

Tables, Graphs, and Figures Index

Table 1. Data Collection Sessions/Functional Objectives

Table 2. Allocation of Mir 21/NASA2/Mir 22/STS-79 Samples

Table 3. Joint U.S./Russian Potable Water Specifications for International Space Station

Table 4. Regenerated Water Results

Table 5. Ground Supplied Water Results

Table 6. Humidity Condensate Results

Figure 1. Sample Collection Methodology

DISCUSSION

Status of Data Analysis

Analyses completed to date include conductivity, pH, turbidity, nonpurgeable organic carbon (NPOC), total organic carbon (TOC), silver, chromium, zinc, acetone, formaldehyde, ethylene glycol, propylene glycol, color, taste, odor, total hardness, total solids, chemical oxygen demand (COD), anions, cations, metals, volatile organics, organic acids, and amines. Those analyses yet to be completed are amines, urea, semivolatile organics, alcohols, and the organic carbon recoveries for the humidity condensate samples.

Preliminary Research Findings

Six recycled water samples were collected during Mir 21. All parameters tested met the Joint U.S./Russian water quality specifications (see Table 3) except the NASA standards for turbidity, total phenols, and total organic carbon. Turbidity levels ranged from 1.04 NTU to 5.50 NTU. The NASA limit for turbidity is 1 NTU. Total organic carbon (TOC) levels in the reclaimed water also exceeded NASA spacecraft limits. TOC levels ranged from 5.2 to 23.7 mg/L compared to the NASA limit of 0.5 mg/L. These levels, however, do not exceed the Russian water quality limit of 25 mg/L. In addition, total phenol levels were slightly above the 1 µg/L in two samples; one sample had a phenol level of 1.1 µg/L and the other sample had 1.2 µg/L of phenol.

Ground supplied samples were collected preflight and inflight for Mir 21 and Mir 22. Preflight samples were collected from RSC Energia in Kaliningrad, Russia, on November 2, 1995, and June 3, 1996. Inflight samples of water from the SVO-ZV port were collected on March 27, August 15, September 5, and September 23, 1996. Turbidity levels on the preflight samples exceeded the Joint U.S./Russian water quality specification of 1 NTU. These samples showed turbidity levels ranging from 7.19 to 7.43 NTU. Both the preflight and inflight ground supplied water samples exceeded the U.S. standard of 0.5 mg/L for TOC. TOC levels ranged from 6.56 mg/L to 9.30 mg/L in these samples. Also, chloroform concentrations in six of the ground supplied water samples exceeded the EPA maximum contaminant levels of 5 µg/L for methylene chloride. At this time, there are no NASA or Russian Space Agency (RSA) specifications for this compound.

Humidity condensate samples were collected during Mir 21 and Mir 22. Four samples were collected during Mir 21 using Russian supplied hardware. Two Mir 22 samples were collected using the U.S. provided water experiment kit. The Mir 22 samples were collected during a reported 1,2 ethanediol (ethylene glycol) coolant leak in the Kvant. At that time, no condensate was being recycled, instead the condensate was routed to several water storage tanks known as EDVs. These humidity condensate samples, along with samples collected during Mir 21, show 1,2 ethanediol concentrations ranging from nondetectable to 62 mg/l. Levels seen above 12 mg/L are thought to have resulted from the coolant leaks.

Ionic species identified in the humidity condensate samples include chloride (0.18 - 6.20 mg/L), fluoride (nondetectable - 0.24 mg/L), sulfate (nondetectable - 114 mg/L), lithium (nondetectable - 4.7 mg/L), sodium (0.12 - 123.4 mg/L), potassium (nondetectable - 9.8 mg/L), magnesium (nondetectable - 0.1 mg/L) and calcium (nondetectable - 3.33 mg/L). Volatile organic compounds detected above method detection limits include acetaldehyde, acetone, 2-butanone, carbon disulfide, methylene chloride, tetrahydrofuran, and o-xylene. Approximately sixty different semivolatile organic compounds were present in the Mir humidity condensate. Those detected at the highest levels include benzothiazole (28.7 - 159.0 µg/L) 3-t-butylphenol (98.0- 867.6 µg/L), caprolactam (nondetectable - 3572.6 µg/L), n,n-dimethylacetamide (nondetectable - 695.7 µg/L), n,n-dimethylformamide (nondetectable - 3098.5 µg/L), 4-ethylmorpholine (nondetectable - 393.0µg/L) and tetramethythiourea (9.1 - 1291.4 µg/L). Methanol, 1-methoxy-2-propanol, 1,2-propanediol, formaldehyde, and 1,2 ethanediol were also detected above minimum detection limits in these samples. 1,2 Ethanediol (ethylene glycol) was detected at levels ranging from nondetectable to 62 mg/L, while propanediol levels ranged from nondetectable to 1690 µg/L.

Conclusions

Findings from the analysis of the reclaimed water show that the water met all requirements of the Joint NASA/RSA spacecraft water quality standards. It is noted,

however, that the NASA requirements for TOC, turbidity, and phenol were exceeded. Although the exceedance of these specifications is noteworthy, the reclaimed water is considered potable. The ground supplied water is also considered potable, although it exceeded the NASA requirements for TOC and turbidity, and the U.S. EPA maximum contaminant level for chloroform. As noted, selected parameters were exceeded, but not to a degree which would adversely affect the potability of the water.

The humidity condensate had significantly lower levels of alcohols and organic acids as compared to the Shuttle condensate. TOC levels were also much lower than levels previously measured in the Shuttle. Compounds detected in the Mir condensate which were much higher than those measured on the Shuttle include acetaldehyde, acetone, 1,2-ethanediol, and 1,2-methoxy-2-propanol. One source of 1,2-methoxy-2-propanol is from the Sharpie® markers used on board Mir.

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TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

Mission	Session Name	FO#	HW#	Scheduled Day	Actual Day	Samples Parameters
Mir 21	ground supplied water collection at RSC Energia, Kalingrad Russia	1,5	7,8,9, 10,11,12 13,14	N/A	L-120 2 Nov 95	1000 ml of water Split: 1000 US, 0 ml RSA
Mir 21	hot water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD10	MD10 1 Mar 96	860 ml of water Split: 517.5 ml US, 342.5 ml RSA
Mir 21	humidity condensate collection	4,5	6,7,8, 9,10,11 12,13,14	MD10-MD13	MD13 4 Mar 96	25 ml of condensate Split: 21 ml US, 4 ml RSA
Mir 21	hot water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD28	MD28 19 Mar 96	770 ml of water Split: 517.5 ml US, 252.5 ml RSA
Mir 21	cold water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD28	MD28 19 Mar 96	855 ml of water Split: 517.5 ml US, 337.5 ml RSA
Mir 21	humidity condensate collection	4,5	6,7,8, 9,10,11 12,13,14	MD28-31	MD28-31 19-22 Mar 96	89 ml of condensate Split: 58.5 ml US, 30.5 ml RSA
Mir 21	hot water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD35	MD36 27 Mar 96	747.9 ml of water Split: 487.5 ml US, 260.4 ml RSA
Mir 21	cold water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD35	MD36 27 Mar 96	309.5 ml of water Split: 196.5 ml US, 113 ml RSA
Mir 21	SVO-ZV (ground supplied) water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD35	MD36 27 Mar 96	24 ml of water Split: 22 ml US, 2 ml RSA
Mir 21	humidity condensate collection	4,5	6,7,8, 9,10,11 12,13,14	unknown	MD124 22 Jun 96	80 ml of condensate Split: 55 ml US, 25 ml RSA
Mir 21	hot water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD146	MD146 15 Jul 96	748 ml of water Split: 520 ml US, 228ml RSA
Mir 21	humidity condensate collection	4,5	6,7,8, 9,10,11 12,13,14	unknown	MD154-157 23-26 Jul 96	73 ml of condensate Split: 50 ml US, 23 ml RSA

TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

Mission	Session Name	FO#	HW#	Scheduled Day	Actual Day	Samples Parameters
Mir 21	hot water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD177	MD177 15 Aug 96	768.5 ml of water Split: 520 ml US, 248.5ml RSA
Mir 22	ground supplied water collection at RSC Energia, Kalingrad Russia	1,5	7,8,9, 10,11,12 13,14	N/A	L-74 3 Jun 96	1000 ml of water Split: 1000 US, 0 ml RSA
Mir 22	hot water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD19	MD19 5 Sep 96	250 ml of water Split: 186 ml US, 64 ml RSA
Mir 22	cold water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD19	MD19 5 Sep 96	309.5 ml of water Split: 196.5 ml US, 113 ml RSA
Mir 22	SVO-ZV (ground supplied water) collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD19	MD19 5 Sep 96	862 ml of water Split: 520 ml US, 342 ml RSA
Mir 22	humidity condensate collection	4,5	6,7,8, 9,10,11 12,13,14	unknown	MD24-26 10-12 Sep 96	214 ml of condensate Split: 131 ml US, 83 ml RSA
Mir 22	humidity condensate collection	4,5	6,7,8, 9,10,11 12,13,14	unknown	MD30-32 16-18 Sep 96	347 ml of condensate Split: 211 ml US, 136 ml RSA
Mir 22	cold water collection	2,3,5	2,3,4, 5,7,8 9,10,11, 12,13,14	MD35	MD38 23 Sep 96	789 ml of water Split: 520 ml US, 269 ml RSA

TABLE 2. SAMPLE ALLOCATION TABLE

JSC Sample No.	96-0401-03	96-0403-01	96-0401-04	96-0401-05	96-0403-02	96-0408-02	96-0408-03	96-0408-04	97-0124-21
Mission	Mir21	Mir21	Mir21	Mir21	Mir21	Mir21	Mir21	Mir21	Mir21
Sample Description	Reclaimed Water	Condensate	Reclaimed Water	Reclaimed Water	Condensate	Reclaimed Water	Reclaimed Water	Stored Water	Condensate
Sample Location	Galley-Hot	CRS	Galley-Hot	Galley-Cold	CRS	Galley-Hot	Galley-Cold	SVO-ZV	CRS
Sample Date	3/1/96	3/4/96	3/19/96	3/19/96	3/19-22/96	3/27/96	3/27/96	3/27/96	6/22/96
Analysis/Aliquot	mL	mL	mL	mL	mL	mL	mL	mL	mL
pH, conductivity, Turbidity	Semivol split	After RSA al	Semivol split	Semivol split	After RSA al	Semivol split	Semivol split	Before alloc	BNA Split
Alcohols	15	1	15	15	1	5	1	1	2
Formaldehyde	15	1	15	15	1	5	1	1	2
Glycols/Nonvolatiles	15	1	15	15	1	5	1	1	2
Organic Acids, Amines, Anions, Cations	2.5	2	2.5	2.5	2.5	2.5	2.5	2	5
Semivolatiles	250	5	250	250	40	250	50	5	25
Metals	50	3	50	50	5	50	25	4	10
TOC	125	2	125	125	2	125	100	2	3
Volatiles	45	6	45	45	6	45	16	6	6
Iodine and Iodide	0	0	0	0	0	0	0	0	0
Fluoride	0	0	0	0	0	0	0	0	0
Micro	0	0	0	0	0	0	0	0	0
Archive	0	0	0	0	0	0	0	0	0
NASA Total	517.5	21	517.5	517.5	58.5	487.5	196.5	22	55
RSA Chemical	342.5	0	252.5	337.5	26.5	258.5	104.5	0	21
RSA Microbiological	0	4	0	0	4	4	4	2	4
RSA TOTAL	342.5	4	252.5	337.5	30.5	262.5	108.5	2	25
Total (mL)	860	25	770	855	89	750	305	24	80

JSC Sample No.	96-0927-03	97-0124-22	96-0927-04	96-0927-08	96-0927-05	96-0927-06	96-0928-02	96-0928-03	96-0927-07
Mission	Mir21	Mir21	Mir21	Mir21	Mir21	Mir21	Mir22	Mir22	Mir22
Sample Description	Stored Water	Condensate	Stored Water	Stored Water	Stored Water	Stored Water	Condensate	Condensate	Stored Water
Sample Location	Galley-Hot	CRS	Galley-Hot	Galley-Hot	Galley-Cold	SVO-ZV	EDV	EDV	Galley-Cold
Sample Date	7/15/96	7/23-26/96	8/15/96	9/5/96	9/5/96	9/5/96	9/10-12/1996	9/16-18/1996	9/23/96
Analysis/Aliquot	mL	mL	mL	mL	mL	mL	mL	mL	mL
pH, conductivity, Turbidity	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split
Alcohols	15	2	15	5	5	15	5	5	15
Formaldehyde	15	2	15	5	5	15	5	5	15
Glycols/Nonvolatiles	15	2	15	5	5	15	5	5	15
Organic Acids, Amines, Anions, Cations	5	5	5	5	5	5	5	5	5
Semivolatiles	250	25	250	50	100	250	50	100	250
Metals	50	5	50	25	50	50	25	50	50
TOC	125	3	125	75	100	125	25	25	125
Volatiles	45	6	45	16	45	45	16	16	45
Iodine and Iodide	0	0	0	0	0	0	0	0	0
Fluoride	0	0	0	0	0	0	0	0	0
Micro	0	0	0	0	0	0	0	0	0
Archive	0	0	0	0	0	0	0	0	0
NASA Total	520	50	520	186	315	520	131	211	520
RSA Chemical	228	19	248.5	64	111	342	83	136	269
RSA Microbiological	0	4	0	0	0	0	0	0	0
RSA TOTAL	228	23	248.5	64	111	342	83	136	269
Total (mL)	748	73	768.5	250	426	862	214	347	789

TABLE 3. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH1	5.5-9.0 pH units	5.5-9.0 pH units
Color2	15 Pt-Co units	20 degrees
Taste2	3 TTN	2 grade
Odor2	3 TON	2 grade
Total Dissolved Solids3	100-1,000 mg/L	100-1,000 mg/L
Turbidity2	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20oC	5% volume @1 ATM, 20oC
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual4	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria2	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 µg/L	200 µg/L
Total Phenols	1 µg/L	1 µg/L
Total Organic Carbon (TOC)	500 µg/L	25,000 µg/L
Uncharacterized TOC	100 µg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1] pH range applies only before iodination

[2] Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3] The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4] Range of required level if iodine is used as a biocide

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir21 galley-hot regenerated water 3/1/96 96-0401-03	Mir21 galley-hot regenerated water 3/19/96 96-0401-04	Mir21 galley-cold regenerated water 3/19/96 96-0401-05	Mir21 galley-hot regenerated water 3/27/96 96-0408-02	Mir21 galley-cold regenerated water 3/27/96 96-0408-03	Mir21 galley-hot regenerated water 7/15/96 96-0927-03
Conductivity	µS/cm	U.S.			32.2	43.5	44.8	42.7	81.3	15.1
Conductivity	µS/cm	Russia			NA	NA	NA	NA	NA	15.3
pH	pH units	Russia	5.5-9.0	NASA/RSA	NA	NA	NA	NA	NA	6.1
pH	pH units	U.S.	5.5-9.0	NASA/RSA	6.40	6.48	6.50	6.98	6.56	6.08
Turbidity	NTU	U.S.	1/1.5 mg/L	NASA/RSA	3.27	5.50	4.10	4.50	2.90	1.04
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	10	10	10	10	10	10
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	0	0	1	1	0	0
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	NA	NA	NA	NA	NA	NA
Total Solids	mg/L	Russia	1.5	NASA/RSA	NA	NA	NA	NA	NA	NA
Total Hardness	meq/L	Russia	7	NASA/RSA	0.109	0.14	0.16	NA	NA	0.2
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	7.5	10	10	15	30	85
Anions										
Bromide	mg/L	U.S.			ND	ND	ND	ND	ND	NA
Chloride	mg/L	U.S.	200	NASA/RSA	0.39	0.32	0.39	0.34	1.11	ND
Fluoride	mg/L	U.S.	1.5	NASA/RSA	ND	ND	ND	ND	3.68	ND
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	ND	ND	ND	ND	ND	ND
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			ND	ND	ND	ND	ND	ND
Phosphate	mg/L	U.S.			ND	ND	ND	ND	ND	ND
Sulfate	mg/L	U.S.	250	NASA/RSA	ND	0.16	ND	0.15	0.396	ND
Cations										
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	ND	ND	ND	ND	ND	ND
Calcium	mg/L	U.S.	100	NASA/RSA	8.76	11.5	12.8	9.74	20.0	4.42
Lithium	mg/L	U.S.			ND	ND	ND	ND	ND	0.42
Magnesium	mg/L	U.S.	50	NASA/RSA	0.24	0.32	0.26	0.26	0.50	ND
Potassium	mg/L	U.S.			1.02	ND	1.02	ND	0.31	ND
Sodium	mg/L	U.S.			1.28	0.13	0.30	0.39	1.73	ND
Minerals										
Ammonium (NH4)	mg/L	Russia	2	NASA/RSA	NA	NA	NA	NA	NA	0.78
Calcium	mg/L	Russia	100	NASA/RSA	NA	NA	NA	NA	NA	2.0
Magnesium	mg/L	Russia	50	NASA/RSA	NA	NA	NA	NA	NA	1.2
Metals										
Calcium	µg/L	U.S.	100000	NASA/RSA	NA	NA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA	NA	NA	NA	NA	NA
Sodium	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Potassium	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Silver	µg/L	U.S.	500	NASA/RSA	131	316	294	240	99	35
Silver ion	µg/L	Russia	500	NASA/RSA	<50	<50	ND	80	ND	NA
Aluminum	µg/L	U.S.		NASA	NA	NA	NA	NA	NA	NA
Arsenic	µg/L	U.S.	10	NASA	ND	ND	ND	ND	ND	ND
Barium	µg/L	U.S.	1000	NASA	5.0	5.2	3.2	3.2	6.4	ND
Cadmium	µg/L	U.S.	5	NASA	ND	ND	ND	ND	0.9	ND
Chromium	µg/L	U.S.	100	NASA	0.6	0.5	0.5	ND	ND	0.3
Cobalt	µg/L	U.S.		NASA	NA	NA	NA	NA	NA	NA
Copper	µg/L	U.S.	1000	NASA	6.3	14.3	9.0	16.7	7.8	14.1
Iron	µg/L	U.S.	300	NASA	20.5	23.0	38.8	26.5	30.5	9.3
Mercury	µg/L	U.S.	2	NASA	NA	NA	NA	ND	0.8	NA
Manganese	µg/L	U.S.	50	NASA	3.9	4.8	3.7	3.5	4.0	1.6
Molybdenum	µg/L	U.S.		NASA	NA	NA	NA	NA	NA	NA

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir21 galley-hot regenerated water 3/1/96 96-0401-03	Mir21 galley-hot regenerated water 3/19/96 96-0401-04	Mir21 galley-cold regenerated water 3/19/96 96-0401-05	Mir21 galley-hot regenerated water 3/27/96 96-0408-02	Mir21 galley-cold regenerated water 3/27/96 96-0408-03	Mir21 galley-hot regenerated water 7/15/96 96-0927-03
Metals (contd.)										
Nickel	µg/L	U.S.	100	NASA	5.6	16.6	16.4	8.8	9.3	8.1
Lead	µg/L	U.S.	50	NASA	0.9	2.7	2.4	4.8	4.0	1.7
Selenium	µg/L	U.S.	10	NASA	ND	ND	ND	ND	ND	ND
Zinc	µg/L	U.S.	5000	NASA	34.2	32.8	23.0	27.4	46.0	19
Palladium	µg/L	U.S.		NASA	NA	NA	NA	NA	NA	NA
Silicon	µg/L	U.S.		NASA	NA	NA	NA	NA	NA	NA
Total Organic Carbon										
TIC (OI 1010)	mg/L	U.S.			1.28	1.55	1.42	0.773	0.263	1.04
POC (OI 1010)	mg/L	U.S.			NA	NA	NA	NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.			6.35	8.64	8.74	8.39	5.15	23.7
TOC (OI 1010)	mg/L	U.S.	0.5/25	NASA/RSA	NA	NA	NA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.			NA	NA	NA	NA	NA	2.68
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	NA	NA	NA	NA	NA	25.1
TOC (Sievers 800)	mg/L	Russia	0.5/25	NASA/RSA	NA	NA	NA	NA	NA	NA
Volatile Organics										
Acetaldehyde	µg/L	U.S.			ND	ND	ND	ND	ND	50.85
Acetone	µg/L	U.S.			17.1	ND	ND	49.6	39.3	8.89
Bromodichloromethane	µg/L	U.S.	100 (Proposed)	EPA	ND	ND	ND	ND	ND	ND
Bromoform	µg/L	U.S.	100 (Proposed)	EPA	ND	ND	ND	ND	ND	ND
2-Butanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Carbon disulfide	µg/L	U.S.	1000	EPA	8.0	5.2	9.6	5.8	ND	ND
Chloroform	µg/L	U.S.	100 (Proposed)	EPA	ND	ND	ND	ND	ND	ND
Dibromochloromethane	µg/L	U.S.	60 (Proposed Goal)	EPA	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPA Lifetime HA	ND	ND	ND	ND	ND	ND
Diethyl ether	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Iodomethane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Linolool	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Methylene chloride	µg/L	U.S.	5	EPA	ND	ND	ND	ND	4.5	ND
4-Methyl-2-pentanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Toluene	µg/L	U.S.	1000	EPA	ND	ND	ND	ND	ND	ND
Trichloroethene	µg/L	U.S.	5	EPA	1.8	2.0	2.3	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND	ND	ND	ND
o-Xylene	µg/L	U.S.	Total Xylenes 10000.0	EPA	ND	ND	ND	ND	ND	ND
Extractable Organics										
Acetophenone	µg/L	U.S.			ND	ND	ND	0.1	41.0	ND
2-Aminonaphthalene	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Aniline	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Azobenzene	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Benzaldehyde	µg/L	U.S.			ND	ND	ND	ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir21 galley-hot regenerated water 3/1/96 96-0401-03	Mir21 galley-hot regenerated water 3/19/96 96-0401-04	Mir21 galley-cold regenerated water 3/19/96 96-0401-05	Mir21 galley-hot regenerated water 3/27/96 96-0408-02	Mir21 galley-cold regenerated water 3/27/96 96-0408-03	Mir21 galley-hot regenerated water 7/15/96 96-0927-03
Extractable Organics (contd.)										
Benzoic acid	µg/L	U.S.			ND	ND	ND	4.6	ND	ND
Benzothiazole	µg/L	U.S.			3.5	3.7	5.0	8.5	110.7	1.6
Benzyl alcohol	µg/L	U.S.			1.9	0.9	ND	1.0	ND	ND
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	1.0	1.0	ND	ND	ND	ND
2-Butoxyethanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND	ND	ND	ND	3.5	ND
N-Butylbenzenesulfonamide	µg/L	U.S.			0.5	0.5	0.5	ND	2.7	ND
3-t-Butylphenol	µg/L	U.S.			ND	ND	ND	ND	113.4	ND
Caffeine	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Caprolactam	µg/L	U.S.			ND	ND	ND	ND	27.4	ND
tris-2-Chloroethyl phosphate	µg/L	U.S.			ND	ND	ND	0.9	5.8	ND
Cyclohexanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Decamethylcyclopentasiloxane	µg/L	U.S.			ND	0.8	0.8	ND	5.6	1.1
1,4 Diacetylbenzene	µg/L	U.S.			ND	ND	ND	ND	5.6	ND
1,3- Dichlorobenzene	µg/L	U.S.	600	EPA	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND	ND	ND	ND
Di-n-butylamine	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	0.4	0.2	0.1	0.6	1.4	0.2
N,N-Dibutylformamide	µg/L	U.S.			ND	ND	ND	ND	8.8	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			3.7	ND	2.0	ND	ND	ND
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			0.1	ND	ND	ND	ND	ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			ND	ND	ND	ND	15.8	ND
2,4-Di-t-butylphenol	µg/L	U.S.			1.0	1.1	1.3	ND	ND	ND
N,N-Diethylformamide	µg/L	U.S.			ND	ND	ND	ND	30.9	ND
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND	ND	ND	ND	0.5	ND
Diethylene glycol monoethyl ether	µg/L	U.S.			ND	ND	ND	ND	25.0	ND
Diethyl phthalate	µg/L	U.S.	5000	EPA Lifetime HA	0.1	0.1	0.1	0.1	3.4	0.2
N,N-Dimethylacetamide	µg/L	U.S.			ND	ND	ND	ND	43.9	ND
N,N-Dimethylbenzylamine	µg/L	U.S.			ND	ND	ND	ND	2.1	ND
Dimethylcarbamyl chloride	µg/L	U.S.			ND	ND	ND	ND	3.2	ND
N,N-Dimethylformamide	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Dimethyl phthalate	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Dipropylene glycol methyl ether	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND	ND	ND	ND	1.4	ND
Eicosane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Ethoxyethanol	µg/L	U.S.			ND	ND	ND	ND	7.7	ND
2-Ethylhexanoic acid	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Ethyl-1-hexanol	µg/L	U.S.			1.5	ND	ND	ND	ND	ND
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	ND	ND	ND	ND	ND	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	700	EPA HA	1.8	3.1	11.3	1.9	27.9	0.4
4-Ethylmorpholine	µg/L	U.S.			ND	ND	ND	ND	31.8	ND
4-Ethylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
1-Formylpiperidine	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Heneicosane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Heptanone	µg/L	U.S.			ND	ND	ND	0.4	ND	ND
2-Hexanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

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Extractable Organics (contd.)										
2-Hydroxybenzothiazole	µg/L	U.S.			1.1	1.1	1.3	1.4	6.8	ND
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND	ND	ND	ND	11.4	ND
Indole	µg/L	U.S.			0.2	0.2	0.3	0.1	ND	ND
Isophorone	µg/L	U.S.	100	EPA Lifetime HA	ND	ND	ND	ND	6.3	ND
Menthol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Mercaptobenzothiazole	µg/L	U.S.			10.2	8.8	12.7	41.0	41.8	ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND	ND	ND	ND	6.1	ND
Methyl-4-hydroxybenzoate	µg/L	U.S.			5.1	ND	ND	ND	ND	ND
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
4-Methylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Methylpyrazine	µg/L	U.S.			ND	ND	ND	ND	6.1	ND
1-Methyl-2-pyrrolidinone	µg/L	U.S.			ND	ND	ND	ND	11.4	ND
Methyl sulfone	µg/L	U.S.			ND	ND	ND	ND	0.6	ND
2-Methylthiobenzothiazole	µg/L	U.S.			2.5	2.2	3.2	12.0	48.5	ND
Monomethyl phthalate	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Neomenthol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Nicotine	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Octadecanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L	U.S.			1.0	0.9	0.9	ND	ND	ND
4-t-Octylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Pentacosane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
s-Phenethyl alcohol	µg/L	U.S.			ND	ND	ND	ND	8.4	ND
Phenol	µg/L	U.S.	1/4000	NASA/EPA Lifetime HA	1.2	1.1	0.9	1.0	ND	ND
Phenoxyacetic acid	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Phenoxyethanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
N-Phenyl-2-naphthylamine	µg/L	U.S.			0.2	0.2	ND	6.3	11.7	ND
2-Phenylphenol	µg/L	U.S.			ND	ND	ND	0.2	3.2	ND
2-Phenyl-2-propanol	µg/L	U.S.			ND	ND	ND	ND	30.6	ND
Phenyl sulfone	µg/L	U.S.			ND	ND	ND	0.1	75.1	ND
Phthalide	µg/L	U.S.			ND	ND	ND	ND	2.8	ND
1-alpha-Terpineol	µg/L	U.S.			ND	ND	ND	ND	24.5	ND
1-Tetradecanol	µg/L	U.S.			5.8	2.3	1.8	ND	6.2	ND
Tetramethylsuccinonitrile	µg/L	U.S.			ND	ND	ND	ND	31.7	ND
Tetramethylthiourea	µg/L	U.S.			ND	ND	ND	0.3	24.6	ND
Tetramethylurea	µg/L	U.S.			ND	ND	ND	ND	6	ND
Toluene	µg/L	U.S.	1000	EPA	0.9	1.0	1.0	0.8	1.9	ND
o-Toluic acid	µg/L	U.S.			ND	ND	ND	ND	ND	ND
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Tricosane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Triethyl Phosphate	µg/L	U.S.			ND	ND	ND	ND	4.6	ND
Triethylamine	µg/L	U.S.			ND	ND	ND	ND	11.8	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			0.1	0.1	0.1	0.1	ND	ND
Undecanone Acid	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Undecanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Urethane	µg/L	U.S.			1.4	1.3	1.3	1.9	ND	0.4

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir21 galley-hot regenerated water 3/1/96 96-0401-03	Mir21 galley-hot regenerated water 3/19/96 96-0401-04	Mir21 galley-cold regenerated water 3/19/96 96-0401-05	Mir21 galley-hot regenerated water 3/27/96 96-0408-02	Mir21 galley-cold regenerated water 3/27/96 96-0408-03	Mir21 galley-hot regenerated water 7/15/96 96-0927-03
Alcohols										
Ethanol	µg/L	U.S.			ND	ND	ND	160	ND	2447
Methanol	µg/L	U.S.			ND	ND	ND	ND	ND	489
1-Methoxy-2-propanol	µg/L	U.S.			NA	NA	NA	ND	NA	NA
2-Methyl-2-butanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Propanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Alcohols/Acetone										
Acetone	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Ethanol	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Isoamyl alcohol (3-Pentanol)	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Propyl alcohol	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Glycols										
1,2-Ethanediol	µg/L	U.S.	7000	EPA Lifetime HA	ND	ND	ND	ND	ND	45530
1,2-Ethanediol	µg/L	Russia	7000	EPA Lifetime HA	NA	NA	NA	NA	NA	NA
1,2-Propanediol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Organic Acids										
Acetic acid	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Lactic acid	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Propanoic acid	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Aldehydes										
Formaldehyde	µg/L	U.S.	1000	EPA HA	ND	ND	ND	ND	22.4	63.4
Acetaldehyde	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Carboxylates										
Acetate	mg/L	U.S.			0.215	ND	0.131	1.49	ND	ND
Formate	mg/L	U.S.			ND	ND	ND	ND	ND	ND
Lactate	mg/L	U.S.			ND	ND	ND	ND	ND	ND
Amines										
Methylamine	mg/L	U.S.			ND	ND	ND	ND	ND	ND
Urea	mg/L	U.S.			ND	ND	ND	1.13	ND	ND
Organic Carbon Recovery	percent	U.S.			2.00	0.23	0.94	11.73	12.19	76.25

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir22 Preflight RSC stored water 11/2/95 95-1128-01	Mir21 SVO-ZV stored water 3/27/96 96-0408-04	Mir22 preflight RSC stored water 6/3/96 96-0625-02	Mir21 galley-hot stored water 8/15/96 96-0927-04	Mir22 galley-hot stored water 9/5/96 96-0927-08	Mir22 galley-cold stored water 9/5/96 96-0927-05	Mir22 SVO-ZV stored water 9/5/96 96-0927-06	Mir22 galley-cold stored water 9/23/96 96-0927-07
Conductivity	µS/cm	U.S.			227	219	335	339	380	389	181	175
Conductivity	µS/cm	Russia			NA	NA	NA	350	387	391	188	178
pH	pH units	Russia	5.5-9.0	NASA/RSA	NA	NA	NA	7.7	7.9	8.0	7.1	5.9
pH	pH units	U.S.	5.5-9.0	NASA/RSA	7.68	7.74	7.58	7.68	8.07	8.1	6.96	5.86
Turbidity	NTU	U.S.	1/1.5 mg/L	NASA/RSA	11.14	NA	0.425	4.24	5.47	3.09	5.32	0.61
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	NA	NA	NA	10	10	10	10	10
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	NA	NA	NA	0	0	1	1	0
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	NA	NA	NA	NA	NA	NA	NA	NA
Total Solids	mg/L	Russia	1.5	NASA/RSA	NA	NA	NA	NA	NA	NA	NA	NA
Total Hardness	meq/L	Russia	7	NASA/RSA	NA	NA	NA	3.0	NA	3.4	1.9	1.7
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	NA	NA	NA	53	60	68	80	95
Anions												
Bromide	mg/L	U.S.			ND	ND	ND	NA	NA	NA	NA	NA
Chloride	mg/L	U.S.	200	NASA/RSA	9.14	10.1	13.5	15.3	15.0	17.0	ND	ND
Fluoride	mg/L	U.S.	1.5	NASA/RSA	0.20	2.14	0.1	ND	ND	ND	ND	ND
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	ND	ND	0.6	5.3	0.8	6.1	ND	ND
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Phosphate	mg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Sulfate	mg/L	U.S.	250	NASA/RSA	7.5	9.68	14.2	21.5	18.6	22.8	ND	ND
Cations												
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	3.05	ND	ND	ND	ND	ND	ND	ND
Calcium	mg/L	U.S.	100	NASA/RSA	25.3	34.8	40.5	66.1	75.2	80.0	41.7	36.5
Lithium	mg/L	U.S.			ND	ND	NA	ND	ND	ND	ND	ND
Magnesium	mg/L	U.S.	50	NASA/RSA	6.51	8.32	10.8	16.4	20.0	18.3	6.3	6.7
Potassium	mg/L	U.S.			2.40	1.73	2.23	3.15	3.1	2.7	ND	ND
Sodium	mg/L	U.S.			7.48	5.67	6.63	12.0	13.4	13.2	1.4	1.2
Minerals												
Ammonium (NH4)	mg/L	Russia	2	NASA/RSA	NA	NA	NA	NA	NA	NA	NA	NA
Calcium	mg/L	Russia	100	NASA/RSA	NA	NA	NA	50	NA	54	30	28
Magnesium	mg/L	Russia	50	NASA/RSA	NA	NA	NA	6.0	NA	7.2	4.8	3.6
Metals												
Calcium	µg/L	U.S.	100000	NASA/RSA	30800	NA	NA	NA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	7650	NA	NA	NA	NA	NA	NA	NA
Sodium	µg/L	U.S.			4900	NA	NA	NA	NA	NA	NA	NA
Potassium	µg/L	U.S.			1820	NA	NA	NA	NA	NA	NA	NA
Silver	µg/L	U.S.	500	NASA/RSA	441	889	0.5	244	356	175	309	296
Silver ion	µg/L	Russia	500	NASA/RSA	NA	NA	NA	NA	NA	NA	NA	NA
Aluminum	µg/L	U.S.		NASA	43.1	NA	NA	NA	NA	NA	NA	NA
Arsenic	µg/L	U.S.	10	NASA	3.8	ND	ND	ND	ND	ND	ND	ND
Barium	µg/L	U.S.	1000	NASA	66.0	2.2	32.9	72.0	86.0	76.0	31.5	36.5
Cadmium	µg/L	U.S.	5	NASA	ND	22.0	0.1	0.1	0.1	ND	4.0	ND
Chromium	µg/L	U.S.	100	NASA	0.5	ND	0.4	0.4	ND	0.4	0.4	ND
Cobalt	µg/L	U.S.		NASA	ND	NA	NA	NA	NA	NA	NA	NA
Copper	µg/L	U.S.	1000	NASA	4.8	21.0	2.0	38.9	44.8	27.7	0.5	61.2
Iron	µg/L	U.S.	300	NASA	54.4	290	83.7	24.4	23.2	26.5	4.2	16.6
Mercury	µg/L	U.S.	2	NASA	0.9	NA	ND	NA	NA	NA	NA	NA
Manganese	µg/L	U.S.	50	NASA	21.3	23.7	7.0	6.5	7.2	7.4	0.6	0.4

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 Preflight RSC stored water 11/2/95 95-1128-01	Mir 21 SVO-ZV stored water 3/27/96 96-0408-04	Mir 22 preflight RSC supplied water 6/3/96 96-0625-02	Mir 21 galley-hot stored water 8/15/96 96-0927-04	Mir 22 galley-hot stored water 9/5/96 96-0927-08	Mir 22 galley-cold stored water 9/5/96 96-0927-05	Mir 22 SVO-ZV stored water 9/5/96 96-0927-06	Mir 22 galley-cold stored water 9/23/96 96-0927-07
Metals (contd.)												
Molybdenum	µg/L	U.S.		NASA	1.3	NA	NA	NA	NA	NA	NA	NA
Nickel	µg/L	U.S.	100	NASA	1.5	79.3	1.6	121	54.8	61.3	35.4	62.2
Lead	µg/L	U.S.	50	NASA	0.6	ND	ND	3.9	3.3	2.6	ND	0.6
Selenium	µg/L	U.S.	10	NASA	4.8	ND	ND	ND	ND	ND	ND	ND
Zinc	µg/L	U.S.	5000	NASA	5.0	549	0.5	25	23	19	34	45
Palladium	µg/L	U.S.		NASA	NA	NA	NA	NA	NA	NA	NA	NA
Silicon	µg/L	U.S.		NASA	ND	NA	NA	NA	NA	NA	NA	NA
Total Organic Carbon												
TIC (OI 1010)	mg/L	U.S.			26.7	17.5	NA	20.9	20.5	22.4	3.61	0.568
POC (OI 1010)	mg/L	U.S.			NA	NA	NA	NA	NA	NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.			11.0	9.67	NA	7.79	10.2	6.98	30.5	31.3
TOC (OI 1010)	mg/L	U.S.	0.5/25	NASA/RSA	NA	NA	NA	NA	NA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.			23.4	NA	32.9	36.5	39.2	39.7	6.86	1.50
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	8.72	NA	5.36	7.45	8.11	7.22	27.6	31.2
TOC (Sievers 800)	mg/L	Russia	0.5/25	NASA/RSA	NA	NA	NA	9.9	8.1	10.4	30.2	29.8
Volatile Organics												
Acetaldehyde	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Acetone	µg/L	U.S.			79.7	86.4	ND	ND	ND	ND	13.95	12.13
Bromodichloromethane	µg/L	U.S.	100 (Proposed)	EPA	4.9	ND	7.25	3.48	4.36	6.46	ND	ND
Bromoform	µg/L	U.S.	100 (Proposed)	EPA	ND	ND	ND	ND	ND	ND	ND	ND
2-Butanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	35.37	ND
Carbon disulfide	µg/L	U.S.	1000	EPA	ND	ND	ND	ND	ND	2.01	1.42	ND
Chloroform	µg/L	U.S.	100 (Proposed)	EPA	184.9	56.9	142.84	70.22	68.43	112.4	1.65	ND
Dibromochloromethane	µg/L	U.S.	60 (Proposed Goal)	EPA	ND	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPA Lifetime HA	ND	ND	ND	ND	ND	ND	ND	ND
Diethyl ether	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Iodomethane	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Linolool	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	µg/L	U.S.	5	EPA	ND	3.8	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.			ND	14.8	ND	ND	ND	ND	ND	ND
Toluene	µg/L	U.S.	1000	EPA	ND	ND	ND	ND	ND	ND	11.9	5.33
Trichloroethene	µg/L	U.S.	5	EPA	ND	ND	ND	ND	ND	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND	ND	ND	ND	ND	ND
o-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND	ND	ND	ND	ND	1.06
Extractable Organics												
Acetophenone	µg/L	U.S.			ND	ND	ND	ND	ND	1.2	1.6	ND
2-Aminonaphthalene	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Aniline	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Azobenzene	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Benzaldehyde	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir22 Preflight RSC stored water 11/2/95 95-1128-01	Mir21 SVO-ZV stored water 3/27/96 96-0408-04	Mir22 preflight RSC supplied water 6/3/96 96-0625-02	Mir21 galley-hot stored water 8/15/96 96-0927-04	Mir22 galley-hot stored water 9/5/96 96-0927-08	Mir22 galley-cold stored water 9/5/96 96-0927-05	Mir22 SVO-ZV stored water 9/5/96 96-0927-06	Mir22 galley-cold stored water 9/23/96 96-0927-07
Extractable Organics (contd.)												
Benzoic acid	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Benzothiazole	µg/L	U.S.			ND	ND	0.2	5.2	2.4	4.6	1.9	2.4
Benzyl alcohol	µg/L	U.S.			ND	ND	ND	1.0	ND	ND	62.4	18.9
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	ND	ND	ND	ND	ND	ND	2.6	1.6
2-Butoxyethanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
N-Butylbenzenesulfonamide	µg/L	U.S.			ND	ND	ND	ND	ND	ND	1.6	1.0
3-t-Butylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	0.8	6.4
Caffeine	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Caprolactam	µg/L	U.S.			ND	ND	ND	ND	ND	ND	576.7	87.7
tris-2-Chloroethyl phosphate	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Cyclohexanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Decamethylcyclopentasiloxane	µg/L	U.S.			ND	ND	ND	1.7	0.2	ND	3.2	1.8
1,4 Diacetylbenzene	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	µg/L	U.S.	600	EPA	ND	ND	ND	ND	NA	NA	NA	NA
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND	ND	NA	NA	NA	NA
Di-n-butylamine	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	ND	ND	0.4	0.2	ND	ND	1.1	ND
N,N-Dibutylformamide	µg/L	U.S.			ND	1.6	ND	ND	ND	ND	ND	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
3,5-Di-t-butyl 4-hydroxybenzaldehyde	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2,4-Di-t-butylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
N,N-Diethylformamide	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Diethylene glycol monoethyl ether	µg/L	U.S.			ND	ND	2.1	ND	ND	ND	ND	ND
Diethyl phthalate	µg/L	U.S.	5000	EPA Lifetime HA	ND	4.4	0.2	1.5	ND	1.6	1.2	0.9
N,N-Dimethylacetamide	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
N,N-Dimethylbenzylamine	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Dimethylcarbamyl chloride	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
N,N-Dimethylformamide	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Dimethyl phthalate	µg/L	U.S.			ND	ND	ND	ND	ND	ND	0.8	0.4
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
Dipropylene glycol methyl ether	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Eicosane	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
2-Ethoxyethanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2-Ethylhexanoic acid	µg/L	U.S.			ND	ND	ND	ND	ND	ND	16.6	4.5
2-Ethyl-1-hexanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	4.2	3.2
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	ND	ND	ND	ND	ND	ND	ND	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	700	EPA HA	ND	ND	0.4	0.2	ND	ND	2.0	16.1
4-Ethylmorpholine	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
4-Ethylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
1-Formylpiperidine	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Heneicosane	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
2-Heptanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir22 Preflight RSC stored water 11/2/95 95-1128-01	Mir21 SVO-ZV stored water 3/27/96 96-0408-04	Mir22 preflight RSC supplied water 6/3/96 96-0625-02	Mir21 galley-hot stored water 8/15/96 96-0927-04	Mir22 galley-hot stored water 9/5/96 96-0927-08	Mir22 galley-cold stored water 9/5/96 96-0927-05	Mir22 SVO-ZV stored water 9/5/96 96-0927-06	Mir22 galley-cold stored water 9/23/96 96-0927-07
Extractable Organics (contd.)												
2-Hexanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2-Hydroxybenzothiazole	µg/L	U.S.			ND	ND	ND	2.6	ND	ND	ND	ND
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Indole	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Isophorone	µg/L	U.S.	100	EPA Lifetime HA	ND	ND	ND	ND	ND	ND	ND	ND
Menthol	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
2-Mercaptobenzothiazole	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
Methyl-4-hydroxybenzoate	µg/L	U.S.			ND	ND	ND	1.5	ND	3.7	ND	ND
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
4-Methylphenol	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
2-Methylpyrazine	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
1-Methyl-2-pyrrolidinone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Methyl sulfone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	NA	ND
2-Methylthiobenzothiazole	µg/L	U.S.			0.1	ND	ND	ND	ND	2.4	0.8	1.1
Monomethyl phthalate	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	3.0
Neomenthol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Nicotine	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Octadecanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
4-t-Octylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Pentacosane	µg/L	U.S.			ND	26.7	0.8	ND	ND	ND	ND	ND
s-Phenethyl alcohol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Phenol	µg/L	U.S.	1/4000	NASA/EPA Lifetime HA	ND	ND	ND	1.2	6.0	3.9	24.8	6.2
Phenoxyacetic acid	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2-Phenoxyethanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
N-Phenyl-2-naphthylamine	µg/L	U.S.			ND	ND	ND	ND	ND	ND	2.5	1.8
2-Phenylphenol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	0.3
2-Phenyl-2-propanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	1.2	ND
Phenyl sulfone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Phthalide	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
1-alpha-Terpineol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
1-Tetradecanol	µg/L	U.S.			ND	ND	3.2	ND	ND	ND	ND	ND
Tetramethylsuccinonitrile	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Tetramethylthiourea	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Tetramethylurea	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Toluene	µg/L	U.S.	1000	EPA	ND	ND	2.8	ND	ND	ND	4.7	ND
o-Toluic acid	µg/L	U.S.			ND	ND	ND	ND	NA	NA	NA	NA
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Tricosane	µg/L	U.S.			ND	23.6	ND	ND	ND	ND	ND	ND
Triethyl Phosphate	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Triethylamine	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			0.2	2.3	0.1	ND	ND	ND	ND	ND
Undecanone Acid	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2-Undecanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Urethane	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir22 Preflight RSC stored water 11/2/95 95-1128-01	Mir21 SVO-ZV stored water 3/27/96 96-0408-04	Mir22 preflight RSC supplied water 6/3/96 96-0625-02	Mir21 galley-hot stored water 8/15/96 96-0927-04	Mir22 galley-hot stored water 9/5/96 96-0927-08	Mir22 galley-cold stored water 9/5/96 96-0927-05	Mir22 SVO-ZV stored water 9/5/96 96-0927-06	Mir22 galley-cold stored water 9/23/96 96-0927-07
Alcohols												
Ethanol	µg/L	U.S.			ND	ND	ND	2490	126	ND	22353	18331
Methanol	µg/L	U.S.			ND	ND	ND	502	ND	ND	ND	ND
1-Methoxy-2-propanol	µg/L	U.S.			ND	ND	NA	NA	NA	NA	NA	NA
2-Methyl-2-butanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
2-Propanol	µg/L	U.S.			ND	430	ND	ND	ND	ND	ND	ND
Alcohols/Acetone												
Acetone	µg/L	Russia			NA	NA	NA	NA	NA	NA	NA	NA
Ethanol	µg/L	Russia			NA	NA	NA	NA	NA	NA	NA	NA
Isoamyl alcohol (3-Pentanol)	µg/L	Russia			NA	NA	NA	NA	NA	NA	NA	NA
Propyl alcohol	µg/L	Russia			NA	NA	NA	NA	NA	NA	NA	NA
Glycols												
1,2-Ethanediol	µg/L	U.S.	7000	EPA Lifetime HA	ND	ND	NA	ND	ND	ND	ND	ND
1,2-Ethanediol	µg/L	Russia	7000	EPA Lifetime HA	NA	NA	NA	NA	NA	NA	NA	NA
1,2-Propanediol	µg/L	U.S.			ND	ND	NA	ND	ND	ND	ND	ND
Organic Acids												
Acetic acid	µg/L	U.S.			ND	NA	ND	NA	NA	NA	NA	NA
Lactic acid	µg/L	U.S.			ND	NA	ND	NA	NA	NA	NA	NA
Propanoic acid	µg/L	U.S.			ND	NA	ND	NA	NA	NA	NA	NA
Aldehydes												
Formaldehyde	µg/L	U.S.	1000	EPA HA	ND	12.6	4.4	8.1	6.9	4.7	6.3	6.4
Acetaldehyde	µg/L	U.S.			NA	NA	NA	NA	NA	NA	NA	NA
Acetate	mg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Formate	mg/L	U.S.			ND	ND	ND	ND	ND	ND	73.0	86.8
Lactate	mg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Amines												
Methylamine	mg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Urea	mg/L	U.S.			ND	ND	ND	ND	ND	ND	ND	ND
Organic Carbon Recovery	percent	U.S.			0.79	3.94	0.46	20.22	1.01	0.35	102.35	103.64

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission			Mir21	Mir21	Mir21	Mir21	Mir22	Mir22
Sample Location			CRS	CRS	CRS	CRS	EDV	EDV
Sample Description		Test	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate
Sample Date		Conducted	3/4/96	3/19-22/96	6/22/96	07/23-26/96	9/10-12/96	9/16-18/96
Analysis/Sample ID	Units	by	96-0403-01	96-0403-02	97-0124-21	97-0124-22	96-0928-02	96-0928-03
Conductivity	µS/cm	U.S.	156	134	173	157	506	375
Conductivity	µS/cm	Russia	NA	NA	pending	165	497	383
pH	pH units	Russia	NA	NA	NA	7.40	7.61	7.22
pH	pH units	U.S.	6.65	6.49	6.30	6.40	7.59	7.22
Turbidity	NTU	U.S.	NA	4.19	19.0	19.0	9.39	9.25
Color True	degrees	Russia	10	10	pending	NA	15	15
Odor at 20°C	grade	Russia	3	3	pending	NA	3	3
Taste at 20°C	grade	Russia	NA	NA	pending	NA	NA	NA
Total Solids	mg/L	Russia	NA	NA	NA	NA	NA	NA
Total Hardness	meq/L	Russia	NA	NA	NA	NA	NA	NA
Chemical Oxygen Demand	mg O_2/L	Russia	250	90	pending	200	272	180
Anions								
Bromide	mg/L	U.S.	ND	ND	pending	pending	NA	NA
Chloride	mg/L	U.S.	1.51	0.176	pending	pending	6.2	3.4
Fluoride	mg/L	U.S.	0.241	0.091	pending	pending	ND	ND
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	ND	ND	pending	pending	ND	ND
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.	ND	ND	pending	pending	ND	ND
Phosphate	mg/L	U.S.	ND	ND	pending	pending	ND	ND
Sulfate	mg/L	U.S.	0.361	ND	pending	pending	114	33.0
Cations								
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	15.3	2.72	pending	pending	26.6	27.8
Calcium	mg/L	U.S.	3.33	0.13	pending	pending	ND	ND
Lithium	mg/L	U.S.	ND	ND	pending	pending	4.7	1.4
Magnesium	mg/L	U.S.	0.26	0.10	pending	pending	ND	ND
Potassium	mg/L	U.S.	1.68	ND	pending	pending	8.6	9.8
Sodium	mg/L	U.S.	1.22	0.123	pending	pending	123.4	72.6
Minerals								
Ammonium (NH4)	mg/L	Russia	NA	NA	pending	26	NA	47.5
Calcium	mg/L	Russia	NA	NA	pending	NA	NA	NA
Magnesium	mg/L	Russia	NA	NA	pending	NA	NA	NA
Metals								
Calcium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Sodium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Potassium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Silver	µg/L	U.S.	516	9.1	ND	ND	91.0	74.0
Silver ion	µg/L	Russia	NA	NA	pending	pending	NA	NA
Aluminum	µg/L	U.S.	NA	NA	166	70.2	NA	NA
Arsenic	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Barium	µg/L	U.S.	193	45.7	10.7	11.9	10.8	5.0
Cadmium	µg/L	U.S.	23.7	29.0	240	ND	8.7	8.3
Chromium	µg/L	U.S.	ND	ND	ND	161	1.2	1.5
Cobalt	µg/L	U.S.	NA	NA	ND	ND	NA	NA
Copper	µg/L	U.S.	102	15.5	38.5	ND	8.1	32.8

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission			Mir21	Mir21	Mir21	Mir21	Mir22	Mir22
Sample Location			CRS	CRS	CRS	CRS	EDV	EDV
Sample Description		Test	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate
Sample Date		Conducted	3/4/96	3/19-22/96	6/22/96	07/23-26/96	9/10-12/96	9/16-18/96
Analysis/Sample ID	Units	by	96-0403-01	96-0403-02	97-0124-21	97-0124-22	96-0928-02	96-0928-03
Metals (contd.)								
Iron	µg/L	U.S.	99.6	14.9	475	618	10.2	7.4
Mercury	µg/L	U.S.	NA	ND	ND	ND	NA	NA
Manganese	µg/L	U.S.	8.6	68.6	142	27.6	14.3	41.1
Molybdenum	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Nickel	µg/L	U.S.	475	574	671	106	14700	9150
Lead	µg/L	U.S.	51.0	68.7	311	139	33.2	17.0
Selenium	µg/L	U.S.	ND	ND	ND	ND	ND	4.2
Zinc	µg/L	U.S.	3.5	608	728	5334	45.0	56
Palladium	µg/L	U.S.	NA	NA	NA	NA	11.5	12.6
Silicon	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Total Organic Carbon								
TIC (OI 1010)	mg/L	U.S.	14.5	12.7	NA	NA	19.5	6.30
POC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.	51.6	39.6	NA	NA	33.6	34.7
TOC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.	NA	NA	26.0	24.6	31.9	4.9
TOC (Sievers 800)	mg/L	U.S.	NA	NA	33.9	78.1	34.0	36.9
TOC (Sievers 800)	mg/L	Russia	NA	NA	pending	75	NA	NA
Volatile Organics								
Acetaldehyde	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Acetone	µg/L	U.S.	79.2	114	44.16	70.06	18.53	19.82
Bromodichloromethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Bromoform	µg/L	U.S.	ND	ND	ND	ND	ND	ND
2-Butanone	µg/L	U.S.	ND	ND	ND	35.18	ND	ND
Carbon disulfide	µg/L	U.S.	71.2	11.0	13.56	1425.20	7.46	7.08
Chloroform	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Dibromochloromethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Diethyl ether	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Iodomethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Linolool	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Methylene chloride	µg/L	U.S.	ND	ND	5.32	4.56	2.57	1.77
4-Methyl-2-pentanone	µg/L	U.S.	ND	ND	ND	ND	2.17	ND
alpha-Methyl styrene	µg/L	U.S.	ND	ND	ND	ND	1.03	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.	ND	ND	30.38	27.94	ND	ND
Toluene	µg/L	U.S.	ND	ND	ND	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
m&p-Xylene	µg/L	U.S.	ND	ND	ND	ND	ND	ND
o-Xylene	µg/L	U.S.	ND	ND	ND	3.76	ND	ND

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission			Mir21	Mir21	Mir21	Mir21	Mir22	Mir22
Sample Location			CRS	CRS	CRS	CRS	EDV	EDV
Sample Description		Test	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate
Sample Date		Conducted	3/4/96	3/19-22/96	6/22/96	07/23-26/96	9/10-12/96	9/16-18/96
Analysis/Sample ID	Units	by	96-0403-01	96-0403-02	97-0124-21	97-0124-22	96-0928-02	96-0928-03
Extractable Organics								
Acetophenone	µg/L	U.S.	19.7	8.1	6.5	76.4	38.7	28.8
2-Aminonaphthalene	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Aniline	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Azobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Benzaldehyde	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Benzoic acid	µg/L	U.S.	108.6	ND	ND	ND	ND	ND
Benzothiazole	µg/L	U.S.	72.8	28.7	129.5	159.0	57.6	41.9
Benzyl alcohol	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Benzyl butyl phthlate	µg/L	U.S.	ND	ND	ND	ND	ND	ND
2-Butoxyethanol	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.	ND	ND	7.5	12.4	9.6	7.0
N-Butylbenzenesulfonamide	µg/L	U.S.	ND	ND	3.2	ND	ND	ND
3-t-Butylphenol	µg/L	U.S.	98.0	128.6	867.6	342.0	377.5	265.9
Caffeine	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Caprolactam	µg/L	U.S.	ND	23.1	129.0	3572.6	ND	ND
tris-2-Chloroethyl phosphate	µg/L	U.S.	ND	5.8	ND	ND	ND	ND
Cyclohexanone	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Decamethylcyclopentasiloxane	µg/L	U.S.	ND	5.6	ND	ND	4.0	1.5
1,4 Diacetylbenzene	µg/L	U.S.	ND	2.9	20.0	18.9	10.8	7.5
1,3- Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	NA
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	NA
Di-n-butylamine	µg/L	U.S.	ND	ND	6.4	ND	ND	ND
Di-n-butyl phthalate	µg/L	U.S.	ND	1.2	1.7	34.7	46.1	30.8
N,N-Dibutylformamide	µg/L	U.S.	ND	6.5	ND	ND	2.8	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.	ND	ND	ND	26.4	6.6	4.9
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.	ND	ND	ND	13.8	ND	ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.	ND	16.0	ND	ND	ND	ND
2,4-Di-t-butylphenol	µg/L	U.S.	ND	ND	ND	ND	ND	ND
N,N-Diethylformamide	µg/L	U.S.	34.3	48.3	108.3	109.9	134.5	89.8
N,N-Diethyl-m-toluamide	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Diethylene glycol monoethyl ether	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Diethyl phthalate	µg/L	U.S.	3.0	5.1	ND	ND	4.6	ND
N,N-Dimethylacetamide	µg/L	U.S.	253.7	207.0	ND	664.7	695.7	471.8
N,N-Dimethylbenzylamine	µg/L	U.S.	ND	ND	11.2	11.7	ND	ND
Dimethylcarbamyl chloride	µg/L	U.S.	ND	ND	ND	127.1	ND	ND
N,N-Dimethylformamide	µg/L	U.S.	430.1	1134.7	ND	2284.0	3098.5	2153.2
Dimethyl phthalate	µg/L	U.S.	ND	ND	ND	8.2	ND	ND
Dimethylthiocarbamoyl chloride	µg/L	U.S.	ND	ND	ND	ND	NA	NA
Dipropylene glycol methyl ether	µg/L	U.S.	91.1	ND	60.6	59.5	146.3	88.1
Dodecamethylcyclohexasiloxane	µg/L	U.S.	ND	0.6	8.7	9.8	ND	ND
Eicosane	µg/L	U.S.	ND	ND	ND	ND	NA	NA
2-Ethoxyethanol	µg/L	U.S.	ND	45.5	ND	214.2	180.3	171.7
2-Ethylhexanoic acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission			Mir21	Mir21	Mir21	Mir21	Mir22	Mir22
Sample Location			CRS	CRS	CRS	CRS	EDV	EDV
Sample Description		Test	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate
Sample Date		Conducted	3/4/96	3/19-22/96	6/22/96	07/23-26/96	9/10-12/96	9/16-18/96
Analysis/Sample ID	Units	by	96-0403-01	96-0403-02	97-0124-21	97-0124-22	96-0928-02	96-0928-03
Extractable Organics (contd.)								
2-Ethyl-1-hexanol	µg/L	U.S.	ND	ND	ND	ND	14.8	ND
bis-2-Ethylhexyl adipate	µg/L	U.S.	ND	ND	ND	ND	ND	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	42.0	29.3	30.9	9.7	ND	ND
4-Ethylmorpholine	µg/L	U.S.	57.2	18.3	368.4	393.0	ND	5.1
4-Ethylphenol	µg/L	U.S.	ND	3.0	ND	4.9	ND	ND
1-Formylpiperidine	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Heneicosane	µg/L	U.S.	ND	ND	ND	ND	NA	NA
2-Heptanone	µg/L	U.S.	ND	ND	ND	ND	ND	ND
2-Hexanol	µg/L	U.S.	ND	ND	ND	ND	ND	ND
2-Hydroxybenzothiazole	µg/L	U.S.	67.1	94.4	16.5	102.0	7.8	5.3
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.	38.7	24.7	39.2	93.7	204.4	136.6
Indole	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Isophorone	µg/L	U.S.	ND	4.9	ND	5.4	11.0	7.3
Menthol	µg/L	U.S.	ND	ND	ND	ND	NA	NA
2-Mercaptobenzothiazole	µg/L	U.S.	ND	40.6	ND	ND	ND	ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.	5.0	1.4	ND	ND	NA	NA
Methyl-4-hydroxybenzoate	µg/L	U.S.	ND	ND	ND	ND	7.0	ND
2-Methyl-2,4-pentanediol	µg/L	U.S.	ND	ND	ND	31.5	ND	ND
4-Methylphenol	µg/L	U.S.	ND	ND	ND	ND	NA	NA
2-Methylpyrazine	µg/L	U.S.	ND	6.6	ND	ND	NA	NA
1-Methyl-2-pyrrolidinone	µg/L	U.S.	61.4	33.0	185.6	198.9	122.4	78.9
Methyl sulfone	µg/L	U.S.	5.5	4.7	4.3	50.6	21.4	ND
2-Methylthiobenzothiazole	µg/L	U.S.	25.9	10.6	16.4	78.6	22.1	15.7
Monomethyl phthalate	µg/L	U.S.	ND	7.7	ND	ND	ND	ND
Neomenthol	µg/L	U.S.	11.4	ND	ND	17.3	74.6	46.3
Nicotine	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Octadecanol	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
4-t-Octylphenol	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Pentacosane	µg/L	U.S.	ND	ND	ND	2.3	ND	ND
s-Phenethyl alcohol	µg/L	U.S.	14.2	6.3	3.3	19.5	35.1	24.1
Phenol	µg/L	U.S.	ND	6.6	ND	ND	5.7	ND
Phenoxyacetic acid	µg/L	U.S.	ND	48.2	ND	ND	122.7	ND
2-Phenoxyethanol	µg/L	U.S.	ND	ND	ND	ND	ND	10.9
N-Phenyl-2-naphthylamine	µg/L	U.S.	15.3	4.8	15.3	55.5	29.3	18.7
2-Phenylphenol	µg/L	U.S.	4.3	1.6	ND	5.0	2.5	1.9
2-Phenyl-2-propanol	µg/L	U.S.	32.6	12.7	99.5	91.0	85.8	57.8
Phenyl sulfone	µg/L	U.S.	10.7	15.1	63.0	28.6	93.3	63.8
Phthalide	µg/L	U.S.	2.7	7.3	ND	ND	NA	NA
1-alpha-Terpineol	µg/L	U.S.	18.5	7.7	44.8	27.0	30.3	20.1
1-Tetradecanol	µg/L	U.S.	ND	ND	ND	ND	ND	7.3
Tetramethylsuccinonitrile	µg/L	U.S.	22.4	4.9	72.3	59.5	146.4	100.7
Tetramethylthiourea	µg/L	U.S.	26.6	9.1	338.4	1291.4	19.1	15.1

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission			Mir21	Mir21	Mir21	Mir21	Mir22	Mir22
Sample Location			CRS	CRS	CRS	CRS	EDV	EDV
Sample Description		Test	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate	humidity condensate
Sample Date		Conducted	3/4/96	3/19-22/96	6/22/96	07/23-26/96	9/10-12/96	9/16-18/96
Analysis/Sample ID	Units	by	96-0403-01	96-0403-02	97-0124-21	97-0124-22	96-0928-02	96-0928-03
Extractable Organics (contd.)								
Tetramethylurea	µg/L	U.S.	23.5	11.7	134.4	226.1	66.8	42.2
Toluene	µg/L	U.S.	ND	1.9	ND	ND	ND	ND
o-Toluic acid	µg/L	U.S.	ND	80.5	ND	ND	NA	NA
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.	7.0	ND	12.5	13.4	8.4	6.8
Tricosane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Triethyl Phosphate	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Triethylamine	µg/L	U.S.	ND	ND	ND	ND	ND	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.	8.6	ND	ND	ND	ND	ND
Undecanone Acid	µg/L	U.S.	ND	ND	ND	ND	ND	22.9
2-Undecanone	µg/L	U.S.	ND	ND	ND	7.1	ND	ND
Urethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Alcohols								
Ethanol	µg/L	U.S.	ND	ND	ND	ND	ND	ND
Methanol	µg/L	U.S.	ND	ND	116	ND	ND	ND
2-Methyl-2-butanol	µg/L	U.S.	ND	ND	ND	ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.	ND	ND	224	220	147	128
2-Propanol	µg/L	U.S.	ND	ND	ND	109	ND	ND
Alcohols/Acetone								
Acetone	µg/L	Russia	NA	NA	pending	ND	NA	NA
Ethanol	µg/L	Russia	NA	NA	pending	ND	NA	NA
Isoamyl alcohol (3-Pentanol)	µg/L	Russia	NA	NA	pending	ND	NA	NA
Propyl alcohol	µg/L	Russia	NA	NA	pending	600	NA	NA
Glycols								
1,2-Ethanediol	µg/L	U.S.	ND	62000	ND	41547	12410	20580
1,2-Ethanediol	µg/L	Russia	NA	NA	pending	7800	NA	NA
1,2-Propanediol	µg/L	U.S.	ND	1430	ND	527	1400	1690
Organic Acids								
Acetic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Lactic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Propanoic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Aldehydes								
Formaldehyde	µg/L	U.S.	27.0	27.3	26.9	32.7	17.7	10.1
Acetaldehyde	µg/L	U.S.	NA	NA	153.1	pending	NA	NA
Carboxylates								
Acetate	mg/L	U.S.	ND	ND	ND	pending	ND	ND
Formate	mg/L	U.S.	ND	ND	ND	pending	ND	ND
Lactate	mg/L	U.S.	ND	ND	ND	pending	ND	ND
Amines								
Methylamine	mg/L	U.S.	0.524	0.293	pending	pending	ND	ND
Urea	mg/L	U.S.	ND	ND	ND	6.78	ND	ND
Organic Carbon Recovery	percent	U.S.	3.82	67.15	pending	pending	26.25	30.19

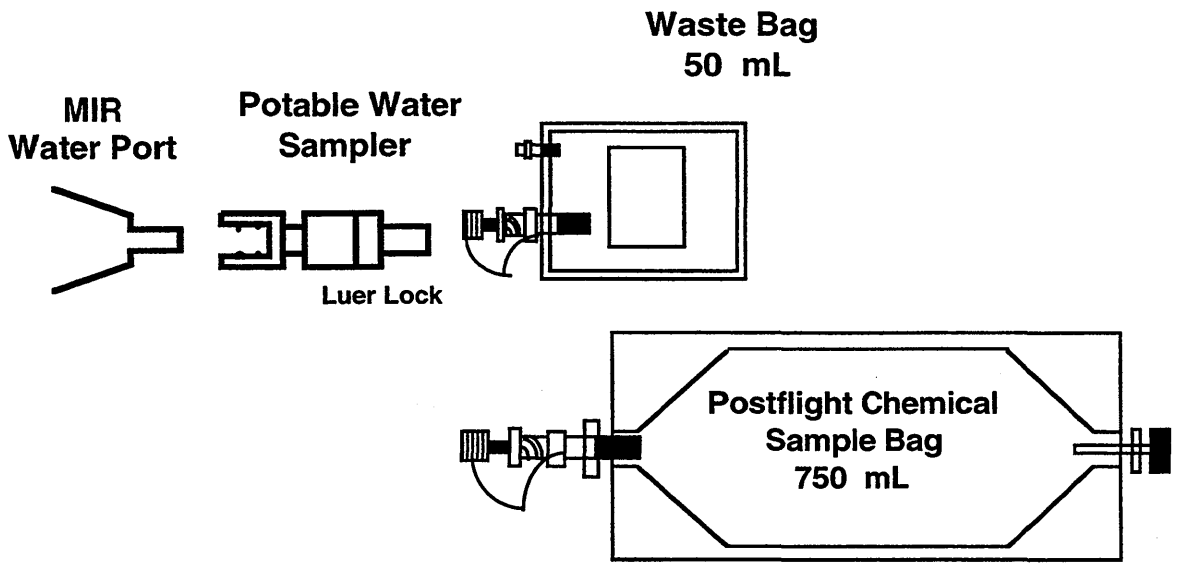

Figure 1. Sample Collection Methodology

Collecting Mir Source and Reclaimed Water for Postflight Analysis

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Russian Principal Investigator: **YURI SINYAK, PH.D.,** Institute of Biomedical Problems
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(NASA 3 Operational Accomplishment Report)

INTRODUCTION

Approximately fifty percent of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water transferred from the Shuttle. This experiment is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain the concentrations of potentially harmful contaminants at acceptably safe levels.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Previous Mission Experiments

This experiment has flown during the Mir 18/NASA 1, Mir 19, Mir 20/STS-74, and Mir 21/NASA2/STS-79 missions.

RESEARCH OPERATIONS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

On 9/8/96, it was reported that the condensate recovery system, which produces regenerated potable water from humidity condensate, was turned off. The crewmembers relied on Russian and American ground supplied water for drinking until the system could be repaired. In addition, there were also reports of at least two incidents of thermal coolant loop leaks on 10/14/96 and 11/25/96 which also necessitated the use of ground supplied water, instead of regenerated water. Therefore Mir 22/NASA 3 crewmembers were not using regenerated water from the condensate recovery system for their primary source of water until 12/14/96. Because of this, the water source (Progress supplied Kaliningrad water or Shuttle transfered water) of water collected from the SVO-ZV on 11/6/96 is not known. These water samples may be a result of the use of Russian or American ground supplied water that was connected to the condensate recovery system or actual regenerated water from the processing of humidity condensate, or a combination of both.

One additional session for water collection was performed on 12/4/96. This session was completed before the changeout of the condensate recovery system multifiltration beds. Water samples were also collected after the multifiltration beds were changed (12/14/96). Data from the analysis of these samples are critical in

determining the operational efficiency of the condensate recovery system with the replacement of the multifiltration beds and the installation of the catalytic oxidation system.

Postflight Anomalies

Two humidity condensate samples collected during Mir 21/NASA 2/STS-79 were found and returned on STS-81.

Completeness/Quality of Data

Data for this experiment are derived from analysis of water samples returned from the mission. Sample analyses are in progress. Refer to Table 2 for a list of samples received from the return of STS-81.

DISCUSSION

Status of Data Analysis

Chemical analyses of the potable water and humidity condensate samples are in progress. Analyses completed to date include conductivity, pH, turbidity, total organic carbon (TOC), trace metals, urea, volatile organics, semivolatile organics, formaldehyde, ethylene glycol, and propylene glycol. Analyses yet to be completed include color, taste, odor, total hardness, total solids, chemical oxygen demand (COD), anions, cations, alcohols, carboxylates, and the identification of unknown compounds,

Preliminary Research Findings

Preliminary results show that potable water samples collected on 11/6/96, 12/4/96, 12/14/96, and 1/18/97 exceeded the U.S. maximum contaminant level of 0.5 mg/L for total organic carbon (TOC). A sample of SVO-ZV water sample collected on 11/6/96 also exceeded the Russian specification for TOC which is 25 mg/L. The TOC levels in these samples ranged from 1.06 mg/L - 54.8 mg/L. It is noted that samples collected after the changeout of the condensate recovery system multifiltration beds (i.e 12/14/96, 1/18/97) had less total organic carbon as compared to those samples collected before changeout of the beds (11/6/96, 12/4/96). Some of these potable water samples also exceeded the U.S. maximum contaminant level of 1.0 NTU for turbidity. The turbidity levels in these samples ranged from 0.7 - 6.58 NTU.

One SVO-ZV water sample collected on 1/18/97 had high levels of chloroform and manganese. This sample had 243.59 µg/L of chloroform; the U.S. Environmental Protection Agency maximum contaminant level for chloroform is 100 µg/L. The manganese level for this sample was 62.7 µg/L, whereas, the Joint U.S/Russian potable water specification for this element is 50 µg/L. Another sample (potable water collected on 12/4/96) also had high levels of chloroform. This sample has 177.2 µg/L of chloroform.

A variety of compounds have been identified in the humidity condensate samples collected. These samples had TOC levels of 3.37 - 27.0 mg/L. Some of the compounds identified to date in the humidity condensate samples include manganese, zinc, mercury, carbon disulfide, tetrahydrofuran, n,n-dimethylacetamide, 3-t-butylphenol, tetramethylthiourea, acetaldehyde, caprolactam, and 4-ethylmorpholine. No ethylene glycol or propylene glycol, which are components of the thermal coolant that leaked on board Mir were detected in the condensate samples analyzed to date.

Conclusions

Initial findings from the analysis of the potable water samples show that the water met all requirements of the Joint U.S./Russian spacecraft water quality standards. It is noted, however, that the NASA requirements for TOC and turbidity were exceeded in these samples. Although the exceeding of these specifications is a concern, the regenerated water is considered potable. The ground supplied water is also considered potable, although it exceeded the NASA requirements for TOC, manganese, and turbidity, and the U.S. EPA maximum contaminant levels for chloroform. As noted, selected parameters were exceeded, but not to a degree which would adversely affect the potability of the water.

TABLE 1. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH1	5.5-9.0 pH units	5.5-9.0 pH units
Color2	15 Pt-Co units	20 degrees
Taste2	3 TTN	2 points
Odor2	3 TON	2 points
Total Dissolved Solids3	100-1,000 mg/L	100-1,000 mg/L
Turbidity2	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20oC	5% volume @1 ATM, 20oC
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	250 mg/L	250 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual4	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria2	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 µg/L	200 µg/L
Total Phenols	1 µg/L	1 µg/L
Total Organic Carbon (TOC)	500 µg/L	25,000 µg/L
Uncharacterized TOC	100 µg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

TABLE 2. WATER SAMPLES COLLECTED DURING MIR 22/NASA 3/STS-81

Sample Date	Description	Location	Volume (mL)
6 Nov 96	Regenerated Water	Galley-Hot	695
6 Nov 96	Stored Water	SVO-ZV	908
6 Nov 96	Regenerated Water	Galley-Cold	769
4 Dec 96	Recovered Condensate	EDV1	788
4 Dec 96	Regenerated Water	Galley-Hot	754
14 Dec 96	Regenerated Water	Galley-Hot	748
14 Dec 96	Regenerated Water	Galley-Cold	778
18 Jan 97	Regenerated Water	Galley-Hot	613
18 Jan 97	Stored Water	SVO-ZV	505
8-15 Oct 96	Condensate	CRS2	72
1-4 Dec 96	Condensate	CRS3	88
22 Jun 96	Condensate	CRS4	80
23-26 Jul 96	Condensate	CRS5	73

[1]EDV - Russian 22 liter hard tank
[2]CRS - condensate recovery system

Collecting Mir Source and Reclaimed Water for Postflight Analysis

U.S. Principal Investigator: **RICHARD L. SAUER, P.E.,** NASA/Johnson Space Center

Russian Principal Investigator: **YURI SINYAK, PH.D.,** Institute of Biomedical Problems

Co-Investigator: John Schultz, Ph.D.

Co-Author: Lizanna M. Pierre

(NASA 3 Preliminary Research Report)

INTRODUCTION

A portion of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. Additional supplies come from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water transferred from the Shuttle. Because of off-nominal conditions, stored water supplies have been the predominant source of potable water used on board Mir since Mir 21 which began in February, 1996. This project is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain the concentrations of potentially harmful contaminants at acceptably safe levels.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Background/History

Historically, water provided for crew consumption during U.S. space missions has either been launched from the ground or produced as a byproduct of fuel cell operation. Reclamation and purification of spacecraft wastewaters as practiced on the Russian Space Station Mir, will be required for supplying crewmembers of the International Space Station with potable and hygiene water.

This experiment has flown during the Mir 18/NASA 1/STS-71, Mir 19, Mir 20/STS-74, and Mir 21/NASA2/STS-79 missions.

METHODS/RESEARCH OPERATIONS

Functional Objectives

FO1. Preflight collection of ground-supplied water at RSC Energiya, Korolyov, Russia

FO2. Water Sampling Hardware Setup

FO3. Inflight collection of hot, cold, and SVO-ZV (ground-supplied) water

FO4. Inflight collection of humidity condensate

FO5. Postflight analysis of samples

Hardware Items

Major hardware items used in flight for this experiment:

HW1. Water Experiment Kit - NASA provided

HW2. Disinfectant/Antiseptic Wipes - NASA provided

HW3. Potable Water Samplers (with Mir port adapter interfaces) - NASA provided

HW4. Waste bags and Postflight Chemical Sample Bags - NASA provided

HW5. Self Sealing Storage Bags - NASA provided

HW6. Atmospheric Condensate Sampler - RSA provided

Major hardware items used postflight for this experiment:

HW7. HP 5890 Gas Chromatograph (GC) with HP5971A Mass Spectrometer (MS) - NASA provided

HW8. Waters Quanta 4000 Capillary Electrophoresis System - NASA provided

HW9. OI 700 Carbon Analyzer - NASA provided

HW10. Sievers Model 800 Total Organic Carbon Analyzer - NASA provided

HW11. HP 7694 Headspace sampler with a HP 5890 GC and 5972 Mass Selective Detector - NASA provided

HW12. HP 5989 Mass Spectrometer (MS) with a 1090 Liquid Chromatograph with Particle beam & Thermospray interfaces - NASA provided

HW13. pH meter - RSA and NASA provided

HW14. Conductivity meter - RSA provided

Method/Protocol

During inflight water sampling sessions on board Mir, the water experiment kit was unstowed from its storage location. The water experiment kit contained the disinfectant wipes, potable water samplers, waste bags, chemical archive sample bags, and storage bags needed for water sampling. A prepackaged disinfectant wipe containing 1 ml of benzalkonium chloride in 250 ml of water, was retrieved from the kit and used to disinfect the Mir galley-hot, galley-cold, or SVO-ZV water port. Next, a potable water sampler was connected to the port. A waste bag was then connected to the potable water sampler. Using the waste bag, 50 ml of water was collected and discarded. Next, 750 ml of water was collected into the chemical archive sample bag. The chemical archive sample bag was placed in a self sealing storage bag and stowed for return on the Shuttle. These procedures were used to collect galley-hot, galley-cold, and SVO-ZV (ground-supplied) water for postflight chemical analysis for this experiment. Following the collection of the chemical samples, microbiological samples were obtained for a separate experiment. The procedures used for microbiological sample collection, analysis, and preliminary results are reported elsewhere in "Microbiological Investigations of the Mir Station and Flight Crew" [4].

Postflight chemical analysis of samples occurred at Johnson Space Center (JSC) and the Institute for Biomedical Problems (IBMP). Following recovery of the samples on the ground, the samples were allocated (See Table 2) for distribution to the water analysis laboratories at JSC and IBMP. Parameters tested at JSC included total carbon (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, nonvolatiles, formaldehyde), and silver. Parameters tested by IBMP included conductivity, pH, color, chemical oxygen demand, total solids, calcium, magnesium, total hardness, and silver.

RESULTS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

On 9/8/96, it was reported that the condensate recovery system, which produces regenerated potable water from humidity condensate, was turned off. The crewmembers relied on Russian ground supplied and American stored water for drinking until the system could be repaired. In addition, there were reports of at least two incidents of thermal coolant loop leaks on 10/14/96 and 11/25/96 which also necessitated the use of stored water instead of regenerated water. Therefore Mir 22/NASA 3 crewmembers were not using regenerated water from the condensate recovery system for their primary source of water until 12/14/96. Because of this, the source of water collected from the SVO-ZV on 11/6/96 is not known. This water sample may be a result of the use of Russian ground supplied water or American stored water, or a combination of both.

One additional session for water collection was performed on 12/4/96. This session was completed before the changeout of the condensate recovery system multifiltration beds and the installation of the ambient temperature catalytic oxidation system (filter reactor). Water samples were also collected after the multifiltration beds were changed (12/14/96). Data from the analysis of these samples are critical in determining the operational efficiency of the condensate recovery system with the replacement of the multifiltration beds and the installation of the catalytic oxidation system.

Although not requested, three additional water samples were collected during this mission. They include one cold and one SVO-ZV collected on 11/6/96. Also, one sample of partially processed condensate (recovered condensate) stored in a Russian EDV container was collected on 12/4/96.

Postflight Anomalies

Two humidity condensate samples collected previously during Mir 21/NASA 2/STS-79 were found and returned on STS-81.

Completeness/Quality of Data

Data for this experiment are derived from analysis of water samples returned from the mission. Sample analyses are in progress.

DISCUSSION

Status of Data Analysis

Chemical analyses of the potable water and humidity condensate samples are in progress. Analyses completed to date include conductivity, pH, turbidity, total organic carbon (TOC), trace metals, urea, volatile organics, formaldehyde, alcohols, carboxylates, and glycols. Analyses yet to be completed include color, taste, odor, total hardness, total solids, chemical oxygen demand (COD), anions, cations, amines, semivolatile organics, and the identification of unknown compounds.

Preliminary Research Findings

Eleven samples were collected during the Mir-22 mission and returned on STS-81 in January, 1997 (Table 1). During this mission, leaks from the thermal control system in the Mir core, the Kvant, and the Kvant II modules required shutting down the condensate recovery system (CRS), which reclaims potable water from humidity condensate [5,6,7], because of possible contamination of the potable water by the thermal coolant, 1,2-ethanediol (ethylene glycol). The first thermal-coolant leak aboard Mir was reported during the Mir-20 mission in November 1995, when 1.8 L of 1,2-ethanediol leaked in the Kvant module [2]. In addition, several problems with CRS hardware such as line blockage and pump failures were also reported. Crewmembers relied on stored water, either Russian ground-supplied water or U.S.-supplied fuel-cell water, when the CRS was inoperable.

Regenerated Water Results

Preliminary results of potable water samples collected on 11/6/96, 12/4/96, 12/14/96, and 1/18/97 show that the regenerated water continues to meet the Russian potable water specification of 25 mg/L of Total Organic Carbon (TOC), however not meeting the U.S. maximum contaminant level (MCL) of 0.5 mg/L for TOC. Also, turbidity exceeded the U.S. MCL of 1 NTU. The TOC levels in these samples ranged from 1.06 mg/L - 7.25 mg/L, as compared to the range of 1.3 -25.1 mg/L for thirteen samples collected from Mir 18-Mir 21. It is noted that samples collected after the changeout of the condensate recovery system (CRS) multifiltration beds (i.e 12/14/96, 1/18/97) had less total organic carbon as compared to those samples collected before changeout of the beds (11/6/96, 12/4/96). Turbidity levels in the regenerated water samples returned on STS-81 ranged from 0.7 - 6.58 NTU; samples collected from Mir 18 - Mir 21 had turbidity levels ranging from 0.95 - 5.50 NTU.

In addition, one sample of hot water collected on 12/4/96 slightly exceeded the Joint U.S./Russian potable water specification (Table 3) for manganese and total phenols. This sample had 51.7 μg/L of manganese; the U.S./Russian specification for manganese is 50 μg/L. Manganese was not analyzed in samples received from Mir 18-Mir 20, but samples collected during Mir 21 did not exceed this specification. Values for Mir 21 samples ranged from 1.6-4.8 μg/L. Total phenols in this sample included the presence of phenol only at 1.3 μg/L. The U.S./Russian specification for total phenols is 1.0 μg/L. No other phenolic compounds were detected in the other Mir 22 samples returned on STS-81. However, phenol was detected at concentrations ranging from nondetectable - 6.0 μg/L in Mir 18-Mir 21 samples.

This hot water sample also had 177.2 μg/L of chloroform; the U.S. Environmental Protection Agency (EPA) maximum contaminant level for chloroform is 100 μg/L. Levels of chloroform previously seen in Mir 18 - Mir 21 samples range from nondetectable - 31.79 μg/L. Levels of chloroform in the other Mir 22 samples returned on STS-81 ranged from nondetectable - 26.39 μg/L.

Stored Water Results

Two stored water samples were returned on STS-81. Results from the analysis of these samples reveal that the stored water samples did not meet U.S. standards for turbidity and total phenols and the joint U.S./Russian standards for TOC and manganese. U.S. EPA standards were also exceeded for chloroform. Turbidity levels in the two stored water samples returned on STS-81 were 6.43 NTU and 6.58 NTU. Stored water samples collected during Mir 21 were analyzed for turbidity and their values were 7.74 NTU and 7.68 NTU, respectively. Stored water samples continue to exceed the U.S. specification of 0.5 mg/L of TOC. One sample, collected on 11/6/97, which contained 54.8 mg/L of TOC exceeded both the U.S. standard and the Russian standard of 25 mg/L for TOC. Because of the presence of formate (40.5 mg/L) and ethanol (86.6 mg/L) in this sample, it is believed that this water originated as fuel cell water supplied by the U.S. Shuttle since preflight servicing and mineralization of the U.S. water prior to transfer to Mir adds formate and ethanol to the water. The other sample, collected on

1/18/97 measured 7.14 mg/L of TOC, which exceeded the U.S. standard only.

The manganese levels in the two samples were nondetectable for the 11/6/96 sample and 62.7 µg/L for the 1/18/97 sample which exceeds the joint U.S./Russian specification of 50 µg/L. Other stored water samples had manganese levels which ranged from 5.5-23.7 µg/L in five samples tested, three of which were collected prior to launch of the water on a Progress resupply spacecraft, and two collected during the Mir 21 mission. The joint U.S./Russian potable water specification for total phenols (1 µg/L) was also exceeded in one of the stored water samples. This sample, collected on 11/6/97 contained 16.6 µg/L of phenol. No data are available yet for the 1/18/97 sample. Only one sample collected during Mir 21 showed detectable levels of phenol. This sample, collected on 8/15/96 has 1.2 µg/L of phenol.

The only EPA standard exceeded in the stored water samples was for chloroform, whose MCL is 100 µg/L. The stored water sample collected on 1/18/97 has 243.59 µg/L of chloroform. Chloroform levels have been exceeded in the past in both samples collected prior to Progress launch and in samples collected during a mission. Previous levels of chloroform ranged from non-detectable - 205.5 µg/L.

Humidity Condensate Results

Three humidity condensate samples were collected during this mission. Of these, one sample had been incompletely processed through the CRS; this sample is known as recovered condensate. Analytical results on these condensate samples have identified a variety of compounds. Some of the compounds identified to date in the humidity condensate samples include manganese, zinc, mercury, carbon disulfide, tetrahydrofuran, n,n-dimethylacetamide, 3-t-butylphenol, tetramethylthiourea, acetaldehyde, caprolactam, and 4-ethylmorpholine. No ethylene glycol or propylene glycol, which are components of the thermal coolant that leaked on board Mir were detected in these samples. These samples had TOC levels of 3.37 - 27.0 mg/L.

Conclusions

Preliminary findings from the analysis of the reclaimed and stored water samples show that the Mir water generally met all requirements of the Joint U.S./Russian spacecraft water quality standards. It is noted, however, that the NASA requirements for TOC and turbidity were exceeded in these samples. Other parameters in the reclaimed and stored water that exceeded the joint U.S./Russian standards included total phenols and manganese, in addition to the EPA standard for chloroform. The exceeding of these specifications is not a concern, since EPA long term health advisories for phenol and chloroform have not be exceeded. These health advisories define the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects up to approximately 7 years in an individual's lifetime of exposure [11]. The EPA long term health advisory for phenol is 20 mg/L and the long term health advisory for chloroform is 400 µg/L.

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TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

Session Name	FO#	HW#	Scheduled Day	Actual Day	Samples/ Parameters
Mir 22					
humidity condensate collection	4,5	6,7,8,9,10, 11,12,13,14	MD 53-60	MD 53-60 8-15 Oct 96	72 ml of condensate Split: 50 ml US, 22 ml RSA
galley-hot water collection	2,3,5	2,3,4,5, 7,8,9,10, 11,12,13,14	MD82	MD82 6 Nov 96	695 ml of water Split: 495 ml US, 200 ml RSA
galley-cold water collection	2,3,5	2,3,4,5, 7,8,9,10, 11,12,13,14	not scheduled	MD82 6 Nov 96	769 ml of water Split: 569 ml US, 200 ml RSA
SVO-ZV (ground supplied) water collection	2,3,5	2,3,4,5, 7,8,9,10, 11,12,13,14	not scheduled	MD82 6 Nov 96	908 ml of water Split: 658 ml US, 250 ml RSA
humidity condensate collection	4,5	6,7,8,9,10, 11,12,13,14	MD 107-110	MD 107-110 1-4 Dec 96	88 ml of condensate Split: 60 ml US, 28 ml RSA
humidity condensate collection	4,5	6,7,8,9,10, 11,12,13,14	not scheduled	MD110 4 Dec 96	788 ml of condensate Split: 559 ml US, 229 ml RSA
galley-hot water collection	2,3,5	2,3,4,5, 7,8,9,10, 11,12,13,14	MD110	MD110 4 Dec 96	754 ml of water Split: 559 ml US, 195 ml RSA
galley-hot water collection	2,3,5	2,3,4,5, 7,8,9,10, 11,12,13,14	MD120	MD120 14 Dec 96	748 ml of water Split: 546 ml US, 202 ml RSA
galley-cold water collection	2,3,5	2,3,4,5, 7,8,9,10, 11,12,13,14	MD120	MD120 14 Dec 96	778 ml of water Split: 559 ml US, 219 ml RSA
galley-hot water collection	2,3,5	2,3,4,5, 7,8,9,10, 11,12,13,14	MD154	MD155 18 Jan 97	607 ml of water Split: 415 ml US, 192 ml RSA
SVO-ZV (ground supplied) water collection	2,3,5	2,3,4,5, 7,8,9,10, 11,12,13,14	MD154	MD155 18 Jan 97	509 ml of water Split: 365 ml US, 144 ml RSA

TABLE 2. SAMPLE ALLOCATION TABLE

Mission	Mir 22	Mir 22	Mir 22	Mir 22	Mir 22	Mir 22	Mir 22	Mir 22
Sample Description	Condensate	Reclaimed Water	Reclaimed Water	Stored Water	Condensate	Reclaimed Water	Condensate*	Reclaimed Water
Sample Location	CRS	Galley-Hot	Galley-Cold	SVO-ZV	CRS	Galley-Hot	EDV	Galley-Hot
Sample Date	10/8-15/96	11/6/96	11/6/96	11/6/96	12/1-4/96	12/4/96	12/4/96	12/14/96
WAFAL ID	97-0124-19	97-0124-10	97-0124-12	97-0124-11	97-0124-20	97-0124-14	97-0124-13	97-0124-15
Analysis/Aliquot		mL	mL	mL		mL	mL	mL
pH, conductivity, Turbidity	BNA Split	70	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split
Alcohols	2	15	15	15	2	15	15	15
Formaldehyde	2	20	20	20	2	20	20	20
Glycols/Nonvolatiles	2	15	15	15	2	15	15	15
Acids, Amines, Anions, Cations	5	5	4	4	5	4	4	4
Semivolatiles (BNA)	25	250	250	250	30	250	250	237
Metals	5	30	50	53	10	40	40	40
TOC	3	pH split	125	125	3	125	125	125
Volatiles	6	90	90	90	6	90	90	90
Archive	0	0	0	86	0	0	0	0
U.S. Total	50	495	569	658	60	559	559	546
Russian Total for chemical analysis	18	200	200	250	24	195	229	202
Russian Total for microbiological analysis	4	0	0	0	4	0	0	0
Russian Total	22	200	200	250	28	195	229	202
Total (mL)	72	695	769	908	88	754	788	748

Mission	Mir 22	Mir 22	Mir 22	Mir 22	Mir 22	Mir 22	Mir 22	Mir 22
Sample Description	Reclaimed Water	Reclaimed Water	Stored Water	Condensate*	Reclaimed Water	Reclaimed Water	Reclaimed Water	Stored Water
Sample Location	Galley-Cold	Galley-Hot	SVO-ZV	EDV	Galley-Hot	Galley-Cold	Galley-Hot	SVO-ZV
Sample Date	12/14/96	1/18/97	1/18/97	12/4/96	12/14/96	12/14/96	1/18/97	1/18/97
WAFAL ID	97-0124-16	97-0124-17	97-0124-18	97-0124-13	97-0124-15	97-0124-16	97-0124-17	97-0124-18
Analysis/Aliquot	mL			mL	mL	mL		
pH, conductivity, Turbidity	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split	BNA Split
Alcohols	15	5	5	15	15	15	5	5
Formaldehyde	20	5	5	20	20	20	5	5
Glycols/Nonvolatiles	15	5	5	15	15	15	5	5
Acids, Amines, Anions, Cations	4	5	5	4	4	4	5	5
Semivolatiles (BNA)	250	250	200	250	237	250	250	200
Metals	40	50	50	40	40	40	50	50
TOC	125	60	60	125	125	125	60	60
Volatiles	90	45	45	90	90	90	45	45
Archive	0	0	0	0	0	0	0	0
U.S. Total	559	415	365	559	546	559	415	365
Russian Total for chemical analysis	219	188	140	229	202	219	188	140
Russian Total for microbiological analysis	0	4**	4**	0	0	0	4**	4**
Russian Total	219	192	144	229	202	219	192	144
Total (mL)	778	607	509	788	748	778	607	509

TABLE 3. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH1	5.5-9.0 pH units	5.5-9.0 pH units
Color2	15 Pt-Co units	20 degrees
Taste2	3 TTN	2 points
Odor2	3 TON	2 points
Total Dissolved Solids3	100-1,000 mg/L	100-1,000 mg/L
Turbidity2	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20oC	5% volume @1 ATM, 20oC
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	250 mg/L	250 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual4	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria2	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 µg/L	200 µg/L
Total Phenols	1 µg/L	1 µg/L
Total Organic Carbon (TOC)	500 µg/L	25,000 µg/L
Uncharacterized TOC	100 µg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 galley-hot regenerated water 11/6/96 97-0124-10	Mir 22 galley-cold regenerated water 11/6/96 97-0124-12	Mir 22 galley-hot regenerated water 12/4/96 97-0124-14	Mir 22 galley-hot regenerated water 12/14/96 97-0124-15	Mir 22 galley-cold regenerated water 12/14/96 97-0124-16	Mir 22 galley-hot regenerated water 1/18/97 97-0124-17
Conductivity	µS/cm	U.S.			14.3	14.9	225	87.2	90.0	59.8
pH	pH units	U.S.	5.5-9.0	NASA/RSA	6.18	6.65	7.45	7.17	7.25	6.96
Turbidity	NTU	U.S.	1/1.5 mg/L	NASA/RSA	2.78	2.42	3.14	0.70	0.93	4.86
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	pending	pending	pending	pending	pending	pending
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	pending	pending	pending	pending	pending	pending
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	pending	pending	pending	pending	pending	pending
Total Solids	mg/L	Russia	1.5	NASA/RSA	pending	pending	pending	pending	pending	pending
Total Hardness	meq/L	Russia	7	NASA/RSA	pending	pending	pending	pending	pending	pending
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	pending	pending	pending	pending	pending	pending
Anions										
Bromide	mg/L	U.S.			pending	pending	pending	pending	pending	pending
Chloride	mg/L	U.S.	200	NASA/RSA	pending	pending	pending	pending	pending	pending
Fluoride	mg/L	U.S.	1.5	NASA/RSA	pending	pending	pending	pending	pending	pending
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	pending	pending	pending	pending	pending	pending
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			pending	pending	pending	pending	pending	pending
Phosphate	mg/L	U.S.			pending	pending	pending	pending	pending	pending
Sulfate	mg/L	U.S.	250	NASA/RSA	pending	pending	pending	pending	pending	pending
Cations										
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	pending	pending	pending	pending	pending	pending
Calcium	mg/L	U.S.	100	NASA/RSA	pending	pending	pending	pending	pending	pending
Lithium	mg/L	U.S.			pending	pending	pending	pending	pending	pending
Magnesium	mg/L	U.S.	50	NASA/RSA	pending	pending	pending	pending	pending	pending
Potassium	mg/L	U.S.			pending	pending	pending	pending	pending	pending
Sodium	mg/L	U.S.			pending	pending	pending	pending	pending	pending
Metals										
Calcium	µg/L	U.S.	100000	NASA/RSA	NA	NA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA	NA	NA	NA	NA	NA
Sodium	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Potassium	µg/L	U.S.			NA	NA	NA	NA	NA	NA
Silver	µg/L	U.S.	500	NASA/RSA	16.8	17.3	108	15.4	19.2	90.8
Aluminum	µg/L	U.S.		NASA	6.0	6.0	16.9	4.7	10.9	4.4
Arsenic	µg/L	U.S.	10	NASA	ND	ND	ND	ND	ND	ND
Barium	µg/L	U.S.	1000	NASA	ND	ND	36.5	5.5	6.3	4.4
Cadmium	µg/L	U.S.	5	NASA	ND	ND	ND	ND	ND	ND
Chromium	µg/L	U.S.	100	NASA	ND	ND	ND	ND	ND	ND
Cobalt	µg/L	U.S.		NASA	ND	ND	ND	ND	ND	ND
Copper	µg/L	U.S.	1000	NASA	13.7	13.2	30.3	18.1	15.2	16.3
Iron	µg/L	U.S.	300	NASA	45.8	37.6	87.5	32.4	39.2	32.5
Mercury	µg/L	U.S.	2	NASA	ND	ND	ND	ND	ND	ND
Manganese	µg/L	U.S.	50	NASA	1.3	1.2	51.7	9.7	10.8	8.6
Molybdenum	µg/L	U.S.		NASA	ND	ND	ND	ND	ND	ND
Nickel	µg/L	U.S.	100	NASA	9.5	10.4	54.0	17.0	17.8	45.2
Lead	µg/L	U.S.	50	NASA	2.1	1.8	3.2	ND	ND	1.5
Selenium	µg/L	U.S.	10	NASA	ND	ND	ND	ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 galley-hot regenerated water 11/6/96 97-0124-10	Mir 22 galley-cold regenerated water 11/6/96 97-0124-12	Mir 22 galley-hot regenerated water 12/4/96 97-0124-14	Mir 22 galley-hot regenerated water 12/14/96 97-0124-15	Mir 22 galley-cold regenerated water 12/14/96 97-0124-16	Mir 22 galley-hot regenerated water 1/18/97 97-0124-17
Metals (contd.)										
Zinc	µg/L	U.S.	5000	NASA	24.6	20.3	15.6	23.7	26.1	24.5
Palladium	µg/L	U.S.		NASA	NA	NA	NA	NA	NA	NA
Silicon	µg/L	U.S.		NASA	NA	NA	NA	NA	NA	NA
Total Organic Carbon										
TIC (Sievers 800)	mg/L	U.S.			1.82	3.53	21.8	10.4	11.1	7.13
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	2.12	1.43	7.25	1.06	1.24	2.49
Volatile Organics										
Acetaldehyde	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Acetone	µg/L	U.S.			22.17	11.84	13.95	16.75	19.73	17.67
Acryloniltrile	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Bromodichloromethane	µg/L	U.S.	100	EPA	ND	ND	5.75	ND	ND	ND
Bromoform	µg/L	U.S.	100	EPA	ND	ND	ND	ND	ND	ND
2-Butanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Carbon disulfide	µg/L	U.S.			3.65	2.46	ND	1.24	1.10	3.36
Chloroform	µg/L	U.S.	100	EPA	ND	ND	177.20	20.55	26.39	24.67
Dibromochloromethane	µg/L	U.S.	100	EPA	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPALifetime HA	ND	ND	ND	ND	ND	ND
Diethyl ether	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Iodomethane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Linolool	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Methylene chloride	µg/L	U.S.	5	EPA	2.66	1.41	1.29	1.72	ND	1.28
4-Methyl-2-pentanone	µg/L	U.S.			ND	ND	ND	ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Toluene	µg/L	U.S.	1000	EPA	ND	ND	ND	ND	ND	ND
Trichloroethene	µg/L	U.S.	5	EPA	ND	ND	ND	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.			ND	ND	ND	ND	ND	ND
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND	ND	ND	ND
o-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND	ND	ND	ND
Extractable Organics										
Acetophenone	µg/L	U.S.			1.0	0.7	1.1	pending	pending	pending
2-Aminonaphthalene	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Aniline	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Azobenzene	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Benzaldehyde	µg/L	U.S.			ND	ND	1.0	pending	pending	pending
Benzoic acid	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Benzothiazole	µg/L	U.S.			1.9	1.8	3.7	pending	pending	pending
Benzyl alcohol	µg/L	U.S.			ND	1.3	5.5	pending	pending	pending
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	ND	3.8	3.6	pending	pending	pending

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 galley-hot regenerated water 11/6/96 97-0124-10	Mir 22 galley-cold regenerated water 11/6/96 97-0124-12	Mir 22 galley-hot regenerated water 12/4/96 97-0124-14	Mir 22 galley-hot regenerated water 12/14/96 97-0124-15	Mir 22 galley-cold regenerated water 12/14/96 97-0124-16	Mir 22 galley-hot regenerated water 1/18/97 97-0124-17
Extractable Organics (contd.)										
2-Butoxyethanol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-(2-Butoxyethoxy) Ethanol	µg/L	U.S.			ND	ND	0.5	pending	pending	pending
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND	ND	ND	pending	pending	pending
N-Butylbenzenesulfonamide	µg/L	U.S.			ND	ND	2.2	pending	pending	pending
3-t-Butylphenol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Caffeine	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Caprolactam	µg/L	U.S.			ND	ND	1.8	pending	pending	pending
tris-2-Chloroethyl phosphate	µg/L	U.S.			ND	1.2	1.3	pending	pending	pending
Cyclododecane	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Cyclohexanone	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Decamethylcyclopentasiloxane	µg/L	U.S.			ND	ND	ND	pending	pending	pending
1,4 Diacetylbenzene	µg/L	U.S.			ND	ND	ND	pending	pending	pending
1,3- Dichlorobenzene	µg/L	U.S.	600	EPA	NA	NA	NA	pending	pending	pending
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	NA	NA	NA	pending	pending	pending
Di-n-butylamine	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	0.7	0.2	0.4	pending	pending	pending
N,N-Dibutylformamide	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			ND	ND	ND	pending	pending	pending
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2,4-Di-t-butylphenol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
N,N-Diethylformamide	µg/L	U.S.			ND	ND	ND	pending	pending	pending
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Diethylene glycol monoethyl ether	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Diethyl phthalate	µg/L	U.S.	5000	EPA Lifetime HA	0.4	ND	0.1	pending	pending	pending
Diisopropyl Adipate	µg/L	U.S.			ND	0.9	0.9	pending	pending	pending
N,N-Dimethylacetamide	µg/L	U.S.			ND	ND	ND	pending	pending	pending
N,N-Dimethylbenzylamine	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Dimethylcarbamyl chloride	µg/L	U.S.			ND	ND	ND	pending	pending	pending
N,N-Dimethylformamide	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Dimethyl phthalate	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Dipropylene glycol methyl ether	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND	ND	0.4	pending	pending	pending
Eicosane	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Ethoxyethanol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Ethylhexanoic acid	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Ethyl-1-hexanol	µg/L	U.S.			ND	ND	0.8	pending	pending	pending
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	ND	ND	ND	pending	pending	pending
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	6	EPA HA	0.4	1.0	0.9	pending	pending	pending
4-Ethylmorpholine	µg/L	U.S.			ND	ND	ND	pending	pending	pending
4-Ethylphenol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
1-Formylpiperidine	µg/L	U.S.			ND	ND	ND	pending	pending	pending

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 galley-hot regenerated water 11/6/96 97-0124-10	Mir 22 galley-cold regenerated water 11/6/96 97-0124-12	Mir 22 galley-hot regenerated water 12/4/96 97-0124-14	Mir 22 galley-hot regenerated water 12/14/96 97-0124-15	Mir 22 galley-cold regenerated water 12/14/96 97-0124-16	Mir 22 galley-hot regenerated water 1/18/97 97-0124-17
Extractable Organics (contd.)										
Heneicosane	µg/L	U.S.			ND	NA	ND	pending	pending	pending
2-Heptanone	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Hexanol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Hydroxybenzothiazole	µg/L	U.S.			ND	1.5	2.9	pending	pending	pending
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND	ND	0.2	pending	pending	pending
Indole	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Isophorone	µg/L	U.S.	100	EPA Lifetime HA	ND	ND	ND	pending	pending	pending
Menthol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Mercaptobenzothiazole	µg/L	U.S.			ND	ND	ND	pending	pending	pending
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Methyl-4-hydroxybenzoate	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
4-Methylphenol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Methylpyrazine	µg/L	U.S.			ND	ND	ND	pending	pending	pending
1-Methyl-2-pyrrolidinone	µg/L	U.S.			ND	1.0	1.1	pending	pending	pending
Methyl sulfone	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Methylthiobenzothiazole	µg/L	U.S.			1.6	3.2	2.9	pending	pending	pending
Monomethyl phthalate	µg/L	U.S.			ND	ND	5.0	pending	pending	pending
Neomenthol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Nicotine	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Octadecanol	µg/L	U.S.			ND	8.8	ND	pending	pending	pending
Octamethylcyclotetrasiloxane	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Octanoic Acid	µg/L	U.S.			ND	ND	2.6	pending	pending	pending
4-t-Octylphenol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Oxindole	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Pentacosane	µg/L	U.S.			ND	3.7	2.9	pending	pending	pending
s-Phenethyl alcohol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Phenol	µg/L	U.S.	1/4000	NASA/EPA Lifetime HA	ND	ND	1.3	pending	pending	pending
Phenoxyacetic acid	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2-Phenoxyethanol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
N-Phenyl-2-naphthylamine	µg/L	U.S.			1.4	ND	1.4	pending	pending	pending
2-Phenylacetic Acid	µg/L	U.S.			ND	7.6	ND	pending	pending	pending
2-Phenylphenol	µg/L	U.S.			ND	ND	0.3	pending	pending	pending
2-Phenyl-2-propanol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Phenyl sulfone	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Phthalide	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Squalene	µg/L	U.S.			ND	1.2	ND	pending	pending	pending
1-alpha-Terpineol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
1-Tetradecanol	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Tetramethylsuccinonitrile	µg/L	U.S.			ND	0.3	ND	pending	pending	pending
Tetramethylthiourea	µg/L	U.S.			0.9	ND	ND	pending	pending	pending
Tetramethylurea	µg/L	U.S.			ND	ND	ND	pending	pending	pending

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 galley-hot regenerated water 11/6/96 97-0124-10	Mir 22 galley-cold regenerated water 11/6/96 97-0124-12	Mir 22 galley-hot regenerated water 12/4/96 97-0124-14	Mir 22 galley-hot regenerated water 12/14/96 97-0124-15	Mir 22 galley-cold regenerated water 12/14/96 97-0124-16	Mir 22 galley-hot regenerated water 1/18/97 97-0124-17
Extractable Organics (contd.)										
Toluene	µg/L	U.S.	1000	EPA	0.2	ND	ND	pending	pending	pending
o-Toluic acid	µg/L	U.S.			ND	ND	ND	pending	pending	pending
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Tricosane	µg/L	U.S.			ND	0.5	0.1	pending	pending	pending
Triethyl Phosphate	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Triethylamine	µg/L	U.S.			ND	ND	ND	pending	pending	pending
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			ND	ND	ND	pending	pending	pending
Undecanoic Acid	µg/L	U.S.			5.8	ND	ND	pending	pending	pending
2-Undecanone	µg/L	U.S.			ND	0.4	ND	pending	pending	pending
Urethane	µg/L	U.S.			0.1	ND	ND	pending	pending	pending
Vanillin	µg/L	U.S.			ND	ND	2.3	pending	pending	pending
Alcohols										
Ethanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Methanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
1-Methoxy-2-propanol	µg/L	U.S.			ND	NA	ND	ND	NA	NA
2-Methyl-2-butanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
2-Propanol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Glycols										
1,2-Ethanediol	µg/L	U.S.	7000	EPA Lifetime HA	ND	ND	ND	ND	ND	ND
1,2-Propanediol	µg/L	U.S.			ND	ND	ND	ND	ND	ND
Organic Acids										
Acetic acid	µg/L	U.S.			NA	pending	NA	pending	pending	pending
Lactic acid	µg/L	U.S.			NA	pending	NA	pending	pending	pending
Propanoic acid	µg/L	U.S.			NA	pending	NA	pending	pending	pending
Aldehydes										
Formaldehyde	µg/L	U.S.	1000	EPA Lifetime HA	2.2	2.2	6.5	3.4	2	ND
Acetaldehyde	µg/L	U.S.			NA	NA	NA	NA	NA	ND
Carboxylates										
Acetate	mg/L	U.S.			ND	ND	ND	ND	ND	ND
Formate	mg/L	U.S.			ND	ND	0.74	ND	ND	ND
Lactate	mg/L	U.S.			ND	ND	ND	ND	ND	ND
Amines										
Methylamine	mg/L	U.S.			pending	pending	pending	pending	pending	pending
Urea	mg/L	U.S.			ND	ND	ND	ND	ND	ND
Organic Carbon Recovery	percent	U.S.			pending	pending	pending	pending	pending	pending

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 SVO-ZV stored water 11/6/96 97-0124-11	Mir 22 SVO-ZV stored water 1/18/97 97-0124-18
Conductivity	µS/cm	U.S.			177	259
pH	pH units	U.S.	5.5-9.0	NASA/RSA	7.10	7.56
Turbidity	NTU	U.S.	1/1.5 mg/L	NASA/RSA	6.43	6.58
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	pending	pending
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	pending	pending
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	pending	pending
Total Solids	mg/L	Russia	1.5	NASA/RSA	pending	pending
Total Hardness	meq/L	Russia	7	NASA/RSA	pending	pending
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	pending	pending
Anions						
Bromide	mg/L	U.S.			pending	pending
Chloride	mg/L	U.S.	200	NASA/RSA	pending	pending
Fluoride	mg/L	U.S.	1.5	NASA/RSA	pending	pending
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	pending	pending
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			pending	pending
Phosphate	mg/L	U.S.			pending	pending
Sulfate	mg/L	U.S.	250	NASA/RSA	pending	pending
Cations						
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	pending	pending
Calcium	mg/L	U.S.	100	NASA/RSA	pending	pending
Lithium	mg/L	U.S.			pending	pending
Magnesium	mg/L	U.S.	50	NASA/RSA	pending	pending
Potassium	mg/L	U.S.			pending	pending
Sodium	mg/L	U.S.			pending	pending
Metals						
Calcium	µg/L	U.S.	100000	NASA/RSA	NA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA	NA
Sodium	µg/L	U.S.			NA	NA
Potassium	µg/L	U.S.			NA	NA
Silver	µg/L	U.S.	500	NASA/RSA	172	369
Aluminum	µg/L	U.S.		NASA	4.9	25.0
Arsenic	µg/L	U.S.	10	NASA	ND	1.1
Barium	µg/L	U.S.	1000	NASA	7.1	41.2

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 SVO-ZV stored water 11/6/96 97-0124-11	Mir 22 SVO-ZV stored water 1/18/97 97-0124-18
Metals (contd.)						
Cadmium	µg/L	U.S.	5	NASA	5.3	43.6
Chromium	µg/L	U.S.	100	NASA	ND	ND
Cobalt	µg/L	U.S.		NASA	ND	ND
Copper	µg/L	U.S.	1000	NASA	1.1	3.6
Iron	µg/L	U.S.	300	NASA	68.0	101
Mercury	µg/L	U.S.	2	NASA	ND	ND
Manganese	µg/L	U.S.	50	NASA	ND	62.7
Molybdenum	µg/L	U.S.		NASA	ND	ND
Nickel	µg/L	U.S.	100	NASA	32.2	34.4
Lead	µg/L	U.S.	50	NASA	ND	ND
Selenium	µg/L	U.S.	10	NASA	ND	ND
Zinc	µg/L	U.S.	5000	NASA	56.7	52.3
Palladium	µg/L	U.S.		NASA	NA	NA
Silicon	µg/L	U.S.		NASA	NA	NA
Total Organic Carbon						
TIC (Sievers 800)	mg/L	U.S.			11.2	24.5
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	54.8	7.14
Volatile Organics						
Acetaldehyde	µg/L	U.S.			ND	ND
Acetone	µg/L	U.S.			95.86	18.47
Acryloniltrile	µg/L	U.S.			ND	ND
Bromodichloromethane	µg/L	U.S.	100	EPA	ND	8.98
Bromoform	µg/L	U.S.	100	EPA	ND	ND
2-Butanone	µg/L	U.S.			ND	ND
Carbon disulfide	µg/L	U.S.			ND	ND
Chloroform	µg/L	U.S.	100	EPA	ND	243.59
Dibromochloromethane	µg/L	U.S.	100	EPA	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPALifetime HA	ND	ND
Diethyl ether	µg/L	U.S.			ND	ND
Iodomethane	µg/L	U.S.			ND	ND
Linolool	µg/L	U.S.			ND	ND

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 SVO-ZV stored water 11/6/96 97-0124-11	Mir 22 SVO-ZV stored water 1/18/97 97-0124-18
Volatile Organics (contd.)						
Methylene chloride	µg/L	U.S.	5	EPA	ND	1.66
4-Methyl-2-pentanone	µg/L	U.S.			ND	ND
alpha-Methyl styrene	µg/L	U.S.			ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND	ND
Tetrahydrofuran	µg/L	U.S.			ND	ND
Toluene	µg/L	U.S.	1000	EPA	9.88	ND
Trichloroethene	µg/L	U.S.	5	EPA	ND	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.			ND	ND
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND
o-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND
Extractable Organics						
Acetophenone	µg/L	U.S.			ND	pending
2-Aminonaphthalene	µg/L	U.S.			ND	pending
Aniline	µg/L	U.S.			ND	pending
Azobenzene	µg/L	U.S.			ND	pending
Benzaldehyde	µg/L	U.S.			ND	pending
Benzoic acid	µg/L	U.S.			ND	pending
Benzothiazole	µg/L	U.S.			1.3	pending
Benzyl alcohol	µg/L	U.S.			ND	pending
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	4.7	pending
2-Butoxyethanol	µg/L	U.S.			ND	pending
2-(2-Butoxyethoxy) Ethanol	µg/L	U.S.			1.9	pending
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND	pending
N-Butylbenzenesulfonamide	µg/L	U.S.			2.2	pending
3-t-Butylphenol	µg/L	U.S.			ND	pending
Caffeine	µg/L	U.S.			ND	pending
Caprolactam	µg/L	U.S.			164.7	pending
tris-2-Chloroethyl phosphate	µg/L	U.S.			ND	pending
Cyclododecane	µg/L	U.S.			ND	pending
Cyclohexanone	µg/L	U.S.			ND	pending
Decamethylcyclopentasiloxane	µg/L	U.S.			ND	pending
1,4 Diacetylbenzene	µg/L	U.S.			ND	pending

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 SVO-ZV stored water 11/6/96 97-0124-11	Mir 22 SVO-ZV stored water 1/18/97 97-0124-18
Extractable Organics (contd.)						
1,3-Dichlorobenzene	µg/L	U.S.	600	EPA	NA	pending
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	NA	pending
Di-n-butylamine	µg/L	U.S.			ND	pending
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	1.8	pending
N,N-Dibutylformamide	µg/L	U.S.			ND	pending
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			ND	pending
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			ND	pending
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			ND	pending
2,4-Di-t-butylphenol	µg/L	U.S.			ND	pending
N,N-Diethylformamide	µg/L	U.S.			ND	pending
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND	pending
Diethylene glycol monoethyl ether	µg/L	U.S.			ND	pending
Diethyl phthalate	µg/L	U.S.	5000	EPA Lifetime HA	1.2	pending
Diisopropyl Adipate	µg/L	U.S.				pending
N,N-Dimethylacetamide	µg/L	U.S.			5.9	pending
N,N-Dimethylbenzylamine	µg/L	U.S.			ND	pending
Dimethylcarbamyl chloride	µg/L	U.S.			ND	pending
N,N-Dimethylformamide	µg/L	U.S.			ND	pending
Dimethyl phthalate	µg/L	U.S.			0.6	pending
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND	pending
Dipropylene glycol methyl ether	µg/L	U.S.			ND	pending
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND	pending
Eicosane	µg/L	U.S.			ND	pending
2-Ethoxyethanol	µg/L	U.S.			ND	pending
2-Ethylhexanoic acid	µg/L	U.S.			ND	pending
2-Ethyl-1-hexanol	µg/L	U.S.			0.5	pending
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	0.4	pending
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	6	EPA HA	0.6	pending
4-Ethylmorpholine	µg/L	U.S.			ND	pending
4-Ethylphenol	µg/L	U.S.			ND	pending
1-Formylpiperidine	µg/L	U.S.			ND	pending
Heneicosane	µg/L	U.S.			NA	pending

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 SVO-ZV stored water 11/6/96 97-0124-11	Mir 22 SVO-ZV stored water 1/18/97 97-0124-18
Extractable Organics (contd.)						
2-Heptanone	µg/L	U.S.			ND	pending
2-Hexanol	µg/L	U.S.			ND	pending
2-Hydroxybenzothiazole	µg/L	U.S.			ND	pending
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND	pending
Indole	µg/L	U.S.			ND	pending
Isophorone	µg/L	U.S.	100	EPA Lifetime HA	ND	pending
Menthol	µg/L	U.S.			ND	pending
2-Mercaptobenzothiazole	µg/L	U.S.			ND	pending
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND	pending
Methyl-4-hydroxybenzoate	µg/L	U.S.			ND	pending
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND	pending
4-Methylphenol	µg/L	U.S.			ND	pending
2-Methylpyrazine	µg/L	U.S.			ND	pending
1-Methyl-2-pyrrolidinone	µg/L	U.S.			3.0	pending
Methyl sulfone	µg/L	U.S.			ND	pending
2-Methylthiobenzothiazole	µg/L	U.S.			ND	pending
Monomethyl phthalate	µg/L	U.S.			5.7	pending
Neomenthol	µg/L	U.S.			ND	pending
Nicotine	µg/L	U.S.			ND	pending
Octadecanol	µg/L	U.S.			ND	pending
Octamethylcyclotetrasiloxane	µg/L	U.S.			ND	pending
Octanoic Acid	µg/L	U.S.			ND	pending
4-t-Octylphenol	µg/L	U.S.			ND	pending
Oxindole	µg/L	U.S.			ND	pending
Pentacosane	µg/L	U.S.			0.2	pending
s-Phenethyl alcohol	µg/L	U.S.			ND	pending
Phenol	µg/L	U.S.	1/4000	NASA/EPA	16.6	pending
Phenoxyacetic acid	µg/L	U.S.			ND	pending
2-Phenoxyethanol	µg/L	U.S.			ND	pending
N-Phenyl-2-naphthylamine	µg/L	U.S.			ND	pending
2-Phenylacetic Acid	µg/L	U.S.			ND	pending
2-Phenylphenol	µg/L	U.S.			ND	pending

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 SVO-ZV stored water 11/6/96 97-0124-11	Mir 22 SVO-ZV stored water 1/18/97 97-0124-18
Extractable Organics (contd.)						
2-Phenyl-2-propanol	µg/L	U.S.			1.0	pending
Phenyl sulfone	µg/L	U.S.			ND	pending
Phthalide	µg/L	U.S.			ND	pending
Squalene	µg/L	U.S.			ND	pending
1-alpha-Terpineol	µg/L	U.S.			ND	pending
1-Tetradecanol	µg/L	U.S.			ND	pending
Tetramethylsuccinonitrile	µg/L	U.S.			ND	pending
Tetramethylthiourea	µg/L	U.S.			ND	pending
Tetramethylurea	µg/L	U.S.			ND	pending
Toluene	µg/L	U.S.	1000	EPA	1.3	pending
o-Toluic acid	µg/L	U.S.			ND	pending
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-	µg/L	U.S.			ND	pending
Tricosane	µg/L	U.S.			ND	pending
Triethyl Phosphate	µg/L	U.S.			ND	pending
Triethylamine	µg/L	U.S.			ND	pending
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			ND	pending
Undecanoic Acid	µg/L	U.S.			ND	pending
2-Undecanone	µg/L	U.S.			ND	pending
Urethane	µg/L	U.S.			ND	pending
Vanillin	µg/L	U.S.			ND	pending
Alcohols						
Ethanol	µg/L	U.S.			86642	ND
Methanol	µg/L	U.S.			ND	ND
1-Methoxy-2-propanol	µg/L	U.S.			NA	NA
2-Methyl-2-butanol	µg/L	U.S.			ND	ND
2-Methyl-2-propanol	µg/L	U.S.			ND	ND
2-Propanol	µg/L	U.S.			ND	ND
Glycols						
1,2-Ethanediol	µg/L	U.S.	7000	EPA Lifetime HA	ND	ND
1,2-Propanediol	µg/L	U.S.			ND	ND

TABLE 5. GROUND SUPPLIED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 22 SVO-ZV stored water 11/6/96 97-0124-11	Mir 22 SVO-ZV stored water 1/18/97 97-0124-18
Organic Acids						
Acetic acid	µg/L	U.S.			NA	NA
Lactic acid	µg/L	U.S.			NA	NA
Propanoic acid	µg/L	U.S.			NA	NA
Aldehydes						
Formaldehyde	µg/L	U.S.	1000	EPA Lifetime HA	3.6	ND
Acetaldehyde	µg/L	U.S.			NA	71.6
Carboxylates						
Acetate	mg/L	U.S.			ND	ND
Formate	mg/L	U.S.			40.5	ND
Lactate	mg/L	U.S.			ND	ND
Amines						
Methylamine	mg/L	U.S.			pending	pending
Urea	mg/L	U.S.			ND	ND
Organic Carbon Recovery	percent	U.S.			pending	pending

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission			Mir22	Mir22	Mir22
Sample Location			CRS	CRS	EDV
Sample Description			condensate	condensate	condensate
Sample Date		Conducted	10/8-15/96	12/1-4/96	12/4/96
Analysis/Sample ID	Units	by	97-0124-19	97-0124-20	97-0124-13
Conductivity	µS/cm	U.S.	184	204	2.11
pH	pH units	U.S.	6.83	6.78	5.27
Turbidity	NTU	U.S.	14.5	9.5	6.74
Color True	degrees	Russia	pending	pending	pending
Odor at 20°C	grade	Russia	pending	pending	pending
Taste at 20°C	grade	Russia	pending	pending	pending
Total Solids	mg/L	Russia	pending	pending	pending
Total Hardness	meq/L	Russia	pending	pending	pending
Chemical Oxygen Demand	mg O_2/L	Russia	pending	pending	pending
Anions					
Bromide	mg/L	U.S.	pending	pending	pending
Chloride	mg/L	U.S.	pending	pending	pending
Fluoride	mg/L	U.S.	pending	pending	pending
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	pending	pending	pending
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.	pending	pending	pending
Phosphate	mg/L	U.S.	pending	pending	pending
Sulfate	mg/L	U.S.	pending	pending	pending
Cations					
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	pending	pending	pending
Calcium	mg/L	U.S.	pending	pending	pending
Lithium	mg/L	U.S.	pending	pending	pending
Magnesium	mg/L	U.S.	pending	pending	pending
Potassium	mg/L	U.S.	pending	pending	pending
Sodium	mg/L	U.S.	pending	pending	pending
Metals					
Calcium	µg/L	U.S.	NA	NA	NA
Magnesium	µg/L	U.S.	NA	NA	NA
Sodium	µg/L	U.S.	NA	NA	NA
Potassium	µg/L	U.S.	NA	NA	NA
Silver	µg/L	U.S.	ND	ND	118
Aluminum	µg/L	U.S.	55.2	19.4	12.4
Arsenic	µg/L	U.S.	ND	ND	ND
Barium	µg/L	U.S.	14.8	26.8	ND
Cadmium	µg/L	U.S.	13.5	ND	1.2
Chromium	µg/L	U.S.	ND	ND	ND
Cobalt	µg/L	U.S.	ND	ND	ND
Copper	µg/L	U.S.	ND	ND	2.4
Iron	µg/L	U.S.	56.5	ND	9.9
Mercury	µg/L	U.S.	ND	83.7	ND
Manganese	µg/L	U.S.	97.2	80.3	ND
Molybdenum	µg/L	U.S.	ND	ND	ND
Nickel	µg/L	U.S.	55.6	50.1	85.4
Lead	µg/L	U.S.	121	69.4	11.4
Selenium	µg/L	U.S.	ND	ND	ND
Zinc	µg/L	U.S.	2940	2520	12.3
Palladium	µg/L	U.S.	NA	NA	NA
Silicon	µg/L	U.S.	NA	NA	NA

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Conducted by	Mir22 CRS condensate 10/8-15/96 97-0124-19	Mir22 CRS condensate 12/1-4/96 97-0124-20	Mir22 EDV condensate 12/4/96 97-0124-13
Total Organic Carbon					
TIC (Sievers 800)	mg/L	U.S.	27.9	20.2	5.89
TOC (Sievers 800)	mg/L	U.S.	26.8	27.0	3.37
Volatile Organics					
Acetaldehyde	µg/L	U.S.	ND	ND	ND
Acetone	µg/L	U.S.	15.94	79.50	17.70
Acryloniltrile	µg/L	U.S.	ND	22.04	ND
Bromodichloromethane	µg/L	U.S.	ND	ND	ND
Bromoform	µg/L	U.S.	ND	ND	ND
2-Butanone	µg/L	U.S.	ND	19.40	ND
Carbon disulfide	µg/L	U.S.	1538.40	842.40	3.29
Chloroform	µg/L	U.S.	ND	ND	ND
Dibromochloromethane	µg/L	U.S.	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	ND	ND	ND
Diethyl ether	µg/L	U.S.	ND	ND	ND
Iodomethane	µg/L	U.S.	ND	ND	ND
Linolool	µg/L	U.S.	ND	ND	ND
Methylene chloride	µg/L	U.S.	6.12	3.60	1.41
4-Methyl-2-pentanone	µg/L	U.S.	ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.	212.70	164.90	ND
Toluene	µg/L	U.S.	ND	ND	ND
Trichloroethene	µg/L	U.S.	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.	ND	ND	ND
m&p-Xylene	µg/L	U.S.	ND	ND	ND
o-Xylene	µg/L	U.S.	ND	ND	ND
Extractable Organics					
Acetophenone	µg/L	U.S.	70.5	71.6	pending
2-Aminonaphthalene	µg/L	U.S.	ND	ND	pending
Aniline	µg/L	U.S.	ND	ND	pending
Azobenzene	µg/L	U.S.	ND	ND	pending
Benzaldehyde	µg/L	U.S.	ND	ND	pending
Benzoic acid	µg/L	U.S.	ND	ND	pending
Benzothiazole	µg/L	U.S.	87.7	184.5	pending
Benzyl alcohol	µg/L	U.S.	ND	ND	pending
Benzyl butyl phthlate	µg/L	U.S.	ND	ND	pending
2-Butoxyethanol	µg/L	U.S.	ND	ND	pending
2-(2-Butoxyethoxy) Ethanol	µg/L	U.S.	ND	ND	pending
Butylated hydroxyanisole (BHA)	µg/L	U.S.	9.3	13.5	pending
N-Butylbenzenesulfonamide	µg/L	U.S.	ND	ND	pending
3-t-Butylphenol	µg/L	U.S.	281.5	831.3	pending
Caffeine	µg/L	U.S.	ND	ND	pending
Caprolactam	µg/L	U.S.	271.0	322.1	pending
tris-2-Chloroethyl phosphate	µg/L	U.S.	ND	ND	pending
Cyclododecane	µg/L	U.S.	7.5	ND	pending
Cyclohexanone	µg/L	U.S.	ND	ND	pending

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Conducted by	Mir22 CRS condensate 10/8-15/96 97-0124-19	Mir22 CRS condensate 12/1-4/96 97-0124-20	Mir22 EDV condensate 12/4/96 97-0124-13
Extractable Organics (contd.)					
Decamethylcyclopentasiloxane	µg/L	U.S.	ND	ND	pending
1,4 Diacetylbenzene	µg/L	U.S.	15.8	20.5	pending
1,3- Dichlorobenzene	µg/L	U.S.	ND	ND	pending
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	pending
Di-n-butylamine	µg/L	U.S.	ND	ND	pending
Di-n-butyl phthalate	µg/L	U.S.	27.9	30.3	pending
N,N-Dibutylformamide	µg/L	U.S.	ND	5.9	pending
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.	11.4	14.8	pending
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.	10.6	20.3	pending
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.	ND	ND	pending
2,4-Di-t-butylphenol	µg/L	U.S.	ND	ND	pending
N,N-Diethylformamide	µg/L	U.S.	37.8	61.5	pending
N,N-Diethyl-m-toluamide	µg/L	U.S.	ND	ND	pending
Diethylene glycol monoethyl ether	µg/L	U.S.	ND	ND	pending
Diethyl phthalate	µg/L	U.S.	ND	ND	pending
Diisopropyl Adipate	µg/L	U.S.			pending
N,N-Dimethylacetamide	µg/L	U.S.	231.5	387.2	pending
N,N-Dimethylbenzylamine	µg/L	U.S.	ND	8.3	pending
Dimethylcarbamyl chloride	µg/L	U.S.	103.6	78.6	pending
N,N-Dimethylformamide	µg/L	U.S.	141.8	171.7	pending
Dimethyl phthalate	µg/L	U.S.	3.0	6.3	pending
Dimethylthiocarbamoyl chloride	µg/L	U.S.	ND	ND	pending
Dipropylene glycol methyl ether	µg/L	U.S.	23.1	32.7	pending
Dodecamethylcyclohexasiloxane	µg/L	U.S.	9.0	6.5	pending
Eicosane	µg/L	U.S.	ND	ND	pending
2-Ethoxyethanol	µg/L	U.S.	ND	ND	pending
2-Ethylhexanoic acid	µg/L	U.S.	ND	ND	pending
2-Ethyl-1-hexanol	µg/L	U.S.	ND	ND	pending
bis-2-Ethylhexyl adipate	µg/L	U.S.	ND	ND	pending
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	53.4	17.7	pending
4-Ethylmorpholine	µg/L	U.S.	114.6	546.3	pending
4-Ethylphenol	µg/L	U.S.	ND	ND	pending
1-Formylpiperidine	µg/L	U.S.	ND	ND	pending
Heneicosane	µg/L	U.S.	ND	ND	pending
2-Heptanone	µg/L	U.S.	ND	ND	pending
2-Hexanol	µg/L	U.S.	ND	ND	pending
2-Hydroxybenzothiazole	µg/L	U.S.	83.5	276.1	pending
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.	61.9	81.3	pending
Indole	µg/L	U.S.	ND	ND	pending
Isophorone	µg/L	U.S.	4.1	6.8	pending
Menthol	µg/L	U.S.	ND	ND	pending
2-Mercaptobenzothiazole	µg/L	U.S.	ND	155.7	pending
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.	ND	ND	pending
Methyl-4-hydroxybenzoate	µg/L	U.S.	ND	ND	pending
2-Methyl-2,4-pentanediol	µg/L	U.S.	20.0	21.2	pending
4-Methylphenol	µg/L	U.S.	ND	ND	pending
2-Methylpyrazine	µg/L	U.S.	ND	ND	pending

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Conducted by	Mir22 CRS condensate 10/8-15/96 97-0124-19	Mir22 CRS condensate 12/1-4/96 97-0124-20	Mir22 EDV condensate 12/4/96 97-0124-13
Extractable Organics (contd.)					
1-Methyl-2-pyrrolidinone	µg/L	U.S.	80.7	151.3	pending
Methyl sulfone	µg/L	U.S.	3.1	17.2	pending
2-Methylthiobenzothiazole	µg/L	U.S.	36.9	46.6	pending
Monomethyl phthalate	µg/L	U.S.	35.1	ND	pending
Neomenthol	µg/L	U.S.	ND	ND	pending
Nicotine	µg/L	U.S.	ND	ND	pending
Octadecanol	µg/L	U.S.	ND	ND	pending
Octamethylcyclotetrasiloxane	µg/L	U.S.	ND	ND	pending
Octanoic Acid	µg/L	U.S.	ND	ND	pending
4-t-Octylphenol	µg/L	U.S.	ND	ND	pending
Oxindole	µg/L	U.S.	ND	5.2	pending
Pentacosane	µg/L	U.S.	2.4	3.0	pending
s-Phenethyl alcohol	µg/L	U.S.	4.4	6.9	pending
Phenol	µg/L	U.S.	ND	ND	pending
Phenoxyacetic acid	µg/L	U.S.	ND	ND	pending
2-Phenoxyethanol	µg/L	U.S.	ND	ND	pending
N-Phenyl-2-naphthylamine	µg/L	U.S.	40.1	50.8	pending
2-Phenylacetic Acid	µg/L	U.S.	ND	ND	pending
2-Phenylphenol	µg/L	U.S.	ND	ND	pending
2-Phenyl-2-propanol	µg/L	U.S.	67.7	122.9	pending
Phenyl sulfone	µg/L	U.S.	28.7	19.8	pending
Phthalide	µg/L	U.S.	ND	ND	pending
Squalene	µg/L	U.S.	ND	ND	pending
1-alpha-Terpineol	µg/L	U.S.	15.5	ND	pending
1-Tetradecanol	µg/L	U.S.	ND	ND	pending
Tetramethylsuccinonitrile	µg/L	U.S.	42.5	81.2	pending
Tetramethylthiourea	µg/L	U.S.	351.2	719.6	pending
Tetramethylurea	µg/L	U.S.	53.1	122.1	pending
Toluene	µg/L	U.S.	ND	ND	pending
o-Toluic acid	µg/L	U.S.	ND	ND	pending
1,3,5-Triallyl-1,3,5-triazine-	µg/L	U.S.	3.5	7.7	pending
Tricosane	µg/L	U.S.	ND	ND	pending
Triethyl Phosphate	µg/L	U.S.	ND	ND	pending
Triethylamine	µg/L	U.S.	ND	ND	pending
2,2,4-Trimethyl-1,3-pentanediol	µg/L	U.S.	ND	ND	pending
Undecanoic Acid	µg/L	U.S.	ND	ND	pending
2-Undecanone	µg/L	U.S.	ND	4.0	pending
Urethane	µg/L	U.S.	ND	ND	pending
Vanillin	µg/L	U.S.	ND	ND	pending
Alcohols					
Ethanol	µg/L	U.S.	ND	ND	ND
Methanol	µg/L	U.S.	ND	105	ND
1-Methoxy-2-propanol	µg/L	U.S.	NA	NA	NA
2-Methyl-2-butanol	µg/L	U.S.	ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.	132	170	ND
2-Propanol	µg/L	U.S.	1158	496	ND

TABLE 6. HUMIDITY CONDENSATE RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Conducted by	Mir22 CRS condensate 10/8-15/96 97-0124-19	Mir22 CRS condensate 12/1-4/96 97-0124-20	Mir22 EDV condensate 12/4/96 97-0124-13
Glycols					
1,2-Ethanediol	µg/L	U.S.	ND	ND	ND
1,2-Propanediol	µg/L	U.S.	ND	ND	ND
Organic Acids					
Acetic acid	µg/L	U.S.	pending	pending	pending
Lactic acid	µg/L	U.S.	pending	pending	pending
Propanoic acid	µg/L	U.S.	pending	pending	pending
Aldehydes					
Formaldehyde	µg/L	U.S.	12	31.4	2.2
Acetaldehyde	µg/L	U.S.	236	524.1	NA
Carboxylates					
Acetate	mg/L	U.S.	ND	ND	ND
Formate	mg/L	U.S.	ND	ND	ND
Lactate	mg/L	U.S.	ND	ND	ND
Amines					
Methylamine	mg/L	U.S.	pending	pending	pending
Urea	mg/L	U.S.	ND	384	ND
Organic Carbon Recovery	percent	U.S.	pending	pending	pending

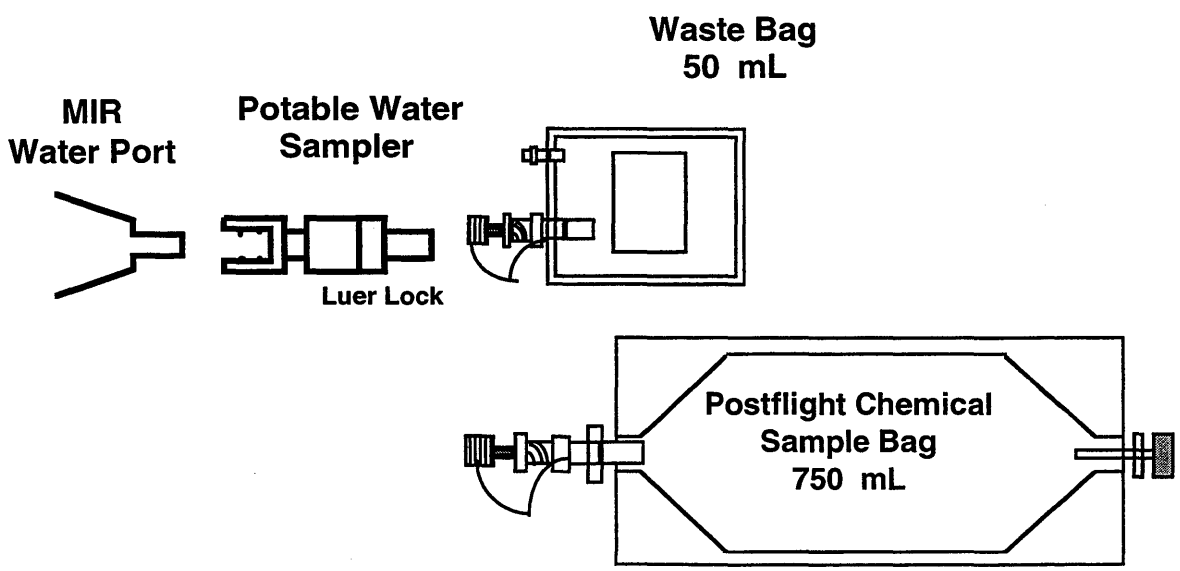

Figure 1. Sample Collection Methodology

Analysis of Mir Archival Water Samples

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(NASA 4 Operational Accomplishments Report)

INTRODUCTION

Approximately fifty percent of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water transferred from the Shuttle. This experiment is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain water of potable quality.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Previous Mission Experience

This experiment has flown under the Human Life Sciences Discipline during the Mir 18/NASA 1, the Mir 19, the Mir 20/STS-74, the Mir 21/NASA 2/STS-79, and the Mir 22/NASA 3/STS-81 missions.

RESEARCH OPERATIONS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

The condensate recovery system (CRS), which produces regenerated potable water from humidity condensate, was turned off because of operational problems with the system. The crewmembers relied on Russian and American stored water for drinking. In addition, there were also reports of thermal coolant loop leaks which also necessitated the use of stored water, instead of regenerated water. Therefore, Mir 23/NASA 4 crewmembers did not use regenerated water from the condensate recovery system as their primary source of drinking water. Because of this, no regenerated water samples were collected during this mission. Instead, samples of Shuttle supplied water that was processed through the CRS and Russian supplied water (SVO-ZV) were collected.

A small fire occurred on board Mir on February 23, 1997 which necessitated the collection of 2 additional humidity condensate samples. One sample was returned on Soyuz on March 2, 1997, and the other sample was returned on STS-84 on May 24, 1997.

During STS-84 docking to the Mir, two wastewater samples were collected from EDVs (Russian water storage

tanks). These EDVs contained accumulated free standing condensate and wastewater collected throughout the Mir Space Station, as a result of humidity control and urine processor operational problems. These samples were taken in preparation to dispose of this water through the Shuttle Wastewater System.

Postflight Anomalies

The sample identification labels on four samples returned on STS-84 were not filled out. Therefore, the sample location, sample type, sample date, and time for these samples could not be verified. The sample information was deduced based on sample collection hardware used and reports /timelines of the anticipated collection dates.

Completeness/Quality of Data

Sample analyses are in progress. Refer to Table 2 for a list of samples received from the return of STS-84.

DISCUSSION

Status of Data Analysis

Chemical analyses of the potable water and humidity condensate samples are in progress. Analyses completed to date include conductivity, pH, turbidity, total organic carbon (TOC), glycols, formaldehyde, volatile organics, and trace metals. Analyses yet to be completed include color, taste, odor, total hardness, total solids, chemical oxygen demand (COD), anions, cations, alcohols, carboxylates, semivolatile organics, and the identification of unknown compounds.

Preliminary Research Findings

Preliminary results show that the SVO-ZV water sample collected on May 19, 1997 exceeded the U.S. maximum contaminant level of 0.5 mg/L for total organic carbon (TOC) (See Table 1). This sample contained 8.61 mg/L of TOC. No other potable water samples collected during this mission exceeded the U.S. or Russian TOC standard. It is noted that none of the potable water samples collected during this mission were regenerated from humidity condensate. Instead, U.S. supplied water in Contingency Water Containers (CWCs) were processed through the condensate recovery system.

The SVO-ZV water sample collected on May 19, 1997 also exceeded the U.S. maximum contaminant level for turbidity and the Joint U.S./Russian Potable Water Specifications for cadmium. The turbidity level for this sample was 5.69 NTU as compared to the U.S. standard of 1.0 NTU. This sample had 19.4 μg/L of cadmium; the maximum contaminant level for this compound is 5 μg/L.

A variety of compounds have been identified in the humidity condensate samples collected. Samples collected during this mission had TOC levels of 54.8-155 mg/L. Ethylene glycol, a component of the thermal coolant that leaked on board Mir, was detected in the condensate samples at levels ranging from 1.10-334 mg/L. The range of ethylene glycol found in the condensates from Mir 19 to 22 was not detected to 153 mg/L. In addition, propylene glycol levels in the condensate samples ranged from 0.63 - 6.97 mg/L. Other organic compounds identified to date in the humidity condensate samples include carbon disulfide, tetrahydrofuran, n,n-dimethylacetamide, 3-t-butylphenol, tetramethylthiourea, acetaldehyde, caprolactam, and 4-ethylmorpholine. The metals analyses of the condensate samples indicate the presence of manganese, zinc, and a trace of mercury. There was insufficient sample volume to confirm the positive mercury result by a different analytical method.

Two wastewater/condensate samples collected from EDVs showed high concentrations of urea (32.6 mg/L and 28.3 mg/L) and chromium (24.8 mg/L and 24.5 mg/L), indicating the presence of about 3% of urine in the containers (EDV) where the samples were collected. These samples were taken because of a Russian request to dispose of this water using the Shuttle Wastewater System.

Conclusions

Initial findings from the analysis of the potable water samples show that the water met all requirements of the Joint U.S./Russian spacecraft water quality standards. It is noted, however, that the NASA requirements for TOC and turbidity and the joint U.S./Russian specification for cadmium were exceeded in the SVO-ZV sample. Although the exceedance of these specifications is a concern, the water is considered potable.

Two condensate samples collected from May 13-19, 1997 had high levels of ethylene glycol, 334 mg/L and 314 mg/L, respectively.

In addition, unusually high concentrations of urea and chromium were found in two wastewater/condensate samples collected from EDVs on May 21, 1997. It is suspected that urine was also collected in these bags.

TABLE 1. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH1	5.5-9.0 pH units	5.5-9.0 pH units
Color2	15 Pt-Co units	20 degrees
Taste2	3 TTN	2 points
Odor2	3 TON	2 points
Total Dissolved Solids3	100-1,000 mg/L	100-1,000 mg/L
Turbidity2	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20oC	5% volume @1 ATM, 20oC
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	250 mg/L	250 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual4	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria2	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 µg/L	200 µg/L
Total Phenols	1 µg/L	1 µg/L
Total Organic Carbon (TOC)	500 µg/L	25,000 µg/L
Uncharacterized TOC	100 µg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

TABLE 2. WATER SAMPLES COLLECTED DURING MIR 23/NASA 4/STS-84

Sample Date	Sample Description	Sample Location	Volume (ml)
19 May 97	1 CWC Regenerated Water (Stored)	Galley-Cold	741
19 May 97	Stored Water	SVO-ZV	750
19 May 97	CWC Regenerated Water (Stored)	Galley-Hot	755
13-19 May 97	Condensate	CRS2	58
13-19 May 97	Condensate	CRS2	81
21 May 97	Condensate/Wastewater	EDV3	683
21 May 97	Condensate/Wastewater	EDV3	694
1 Mar 97	Postfire Condensate	CRS2	787
8 May 97	CWC Regenerated Water (Stored)	Galley-Hot	719

[1]CWC - Contingency Water Container

(Shuttle transferred water that was processed through the CRS)

[2]CRS - Condensate Recovery System

[3]EDV - Russian 22 Liter hard tank

Analysis of Mir Archival Water Samples

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(NASA 4 Preliminary Research Report)

INTRODUCTION

A portion of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. Additional supplies come from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water transferred from the Shuttle. Because of the inability to operate the Condensate Recovery System (CRS) at its normal rate, stored water supplies have been the predominant source of potable water used on board Mir since Mir 21 which began in February 1996. This project is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain the concentrations of potentially harmful contaminants at acceptably safe levels.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Background/History

Historically, water provided for crew consumption during U.S. space missions has either been launched from the ground or produced as a byproduct of fuel cell operation. Reclamation and purification of spacecraft wastewaters as practiced on the Russian Space Station Mir will be required for supplying crewmembers of the International Space Station with potable and hygiene water.

This experiment has flown under the Human Life Sciences Discipline during the Mir 18/NASA 1, the Mir 19, the Mir 20/STS-74, and the Mir 21/NASA 2/STS-79 missions. In addition, this activity was performed under the Space Medicine Program during the Mir 22/NASA 3/STS-81 mission.

METHODS/RESEARCH OPERATIONS

Functional Objectives

FO1. Preflight collection of ground-supplied water at RSC Energia, Korolov, Russia

FO2. Water Sampling Hardware Setup

FO3. Inflight collection of hot, cold, and SVO-ZV (ground-supplied) water

FO4. Inflight collection of humidity condensate

FO5. Postflight analysis of samples

Hardware Items

Major hardware items used inflight for this experiment:

HW1. Water Experiment Kit - NASA provided

HW2. Disinfectant/Antiseptic Wipes - NASA provided

HW3. Potable Water Samplers (with Mir port adapter interfaces) - NASA provided

HW4. Waste bags and Chemical Sample, Postflight Analysis Bags - NASA provided

HW5. Self Sealing Storage Bags - NASA provided

HW6. Atmospheric Condensate Sampler - RSA provided

Major hardware items used postflight for this experiment:

HW7. HP 5890 Gas Chromatograph (GC) with HP5971A Mass Spectrometer (MS) - NASA provided

HW8. Waters Quanta 4000 Capillary Electrophoresis System - NASA provided

HW9. OI 700 Carbon Analyzer - NASA provided

HW10. Sievers Model 800 Total Organic Carbon Analyzer - NASA provided

HW11. HP 7694 Headspace sampler with a HP 5890 GC and 5972 Mass Selective Detector - NASA provided

HW12. HP 5989 Mass Spectrometer (MS) with a 1090 Liquid Chromatograph with Particle beam & Thermospray interfaces - NASA provided

HW13. pH meter - RSA and NASA provided

HW14. Conductivity meter - RSA provided

Method/Protocol

During inflight water sampling sessions on board Mir, the water experiment kit was unstowed from its storage location. The water experiment kit contained the disinfectant wipes, potable water samplers, waste bags, chemical archive sample bags, and storage bags needed for water sampling. A prepackaged disinfectant wipe containing 1 ml of benzalkonium chloride in 250 ml of water, was retrieved from the kit and used to disinfect the Mir galley-hot, galley-cold, or SVO-ZV water port. Next, a potable water sampler was connected to the port. A waste bag was then connected to the potable water sampler. Using the waste bag, 50 ml of water was collected and discarded. Next, 750 ml of water was collected into the chemical archive sample bag. The chemical archive sample bag was placed in a self sealing storage bag and stowed for return on the Shuttle. These procedures were used to collect galley-hot, galley-cold, and SVO-ZV (ground-supplied) water for postflight chemical analysis for this experiment. Following the collection of the chemical samples, microbiological samples were obtained for a separate experiment. The procedures used for microbiological sample collection, analysis, and preliminary results are reported elsewhere in "Microbiological Investigations of the Mir Station and Flight Crew" [4].

Postflight chemical analysis of samples occurred at Johnson Space Center (JSC) and the Institute for Biomedical Problems (IBMP). Following recovery of the samples on the ground, the samples were allocated (see Table 2) for distribution to the water analysis laboratories at Johnson Space Center, Houston, TX (JSC) and the Institute for Biomedical Problems, Russia (IBMP). Parameters tested at JSC included total carbon (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, nonvolatiles, formaldehyde), and silver. Parameters tested by IBMP included conductivity, pH, color, chemical oxygen demand, total solids, calcium, magnesium, total hardness, and silver.

RESULTS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

The condensate recovery system (CRS), which produces regenerated potable water from humidity condensate, was turned off because of operational problems with the system. The crewmembers relied on Russian and American stored water for drinking. In addition, there were also thermal coolant loop leaks that would have contaminated the humidity condensate with 1,2 ethanediol (ethylene glycol). This also necessitated the use of stored water, instead of regenerated water. Therefore, Mir 23/NASA 4 crewmembers did not use regenerated water from the condensate recovery system as their primary source of drinking water. Because of this, no regenerated water samples were collected during this mission. Instead, samples of Shuttle supplied water that was processed through the CRS and Russian supplied water were collected.

A fire occurred on board Mir on February 23, 1997, which necessitated the collection of 2 additional humidity condensate samples. One sample was returned on Soyuz in March 1997, and the other sample was returned on STS-84 in May 1997.

During STS-84 docking to the Mir, two wastewater samples were collected from EDVs (Russian water storage tanks). These EDVs contained accumulated free standing condensate and wastewater collected throughout the Mir Space Station, as a result of humidity control and urine processor operational problems. These samples were taken based on a request by the Russians to dispose of this water through the Shuttle Wastewater System, which did not occur. Also, one additional sample was collected from the galley-hot port, which had not been planned.

Postflight Anomalies

The sample identification labels on four condensate samples returned on STS-84 were not filled out. Therefore, the sample location, sample type, sample date, and time for these samples could not be verified. The sample information was deduced based on sample collection hardware used and reports/timelines of the anticipated collection dates.

Completeness/Quality of Data

Sample analyses are in progress. Refer to Table 2 for is a list of samples received from the return of STS-84.

DISCUSSION

Status of Data Analysis

Chemical analyses of the potable water and humidity condensate samples are in progress. Analyses completed to date include conductivity, pH, turbidity, total organic carbon (TOC), glycols, formaldehyde, volatile organics, alcohols, and trace metals,. Analyses yet to be completed by JSC include anions, cations, carboxylates, semivolatile organics, and the identification of unknown compounds. In addition, results from IMBP for the analysis of color, taste, odor, total hardness, total solids, and chemical oxygen demand (COD) have not been received.

Preliminary Research Findings

Stored Water

Preliminary results show that the SVO-ZV water sample collected on May 19, 1997, exceeded the U.S. maximum contaminant level of 0.5 mg/L for total organic carbon (TOC), but met the Russian requirement of 25 mg/L. This sample contained 8.61 mg/L of TOC. No other potable water samples collected during this mission exceeded the U.S. or Russian TOC standard. It is noted that none of potable water samples collected during this mission were regenerated from humidity condensate. Instead, U.S. supplied water in Contingency Water Containers (CWCs) were processed through the condensate recovery system.

The SVO-ZV water sample collected on May 19, 1997, also exceeded the U.S. maximum contaminant level for turbidity and the Joint U.S./Russian Potable Water Specifications for cadmium. The turbidity level for this sample was 5.69 NTU as compared to the U.S. standard of 1.0 NTU. This sample had 19.4 μg/L of cadmium; the maximum contaminant level for this compound is 5 μg/L.

Condensate

A variety of compounds have been identified in the humidity condensate samples collected. Samples collected during this mission had TOC levels of 54.8-155 mg/L. Ethylene glycol, a component of the thermal coolant that leaked on board Mir, was detected in the condensate samples at levels ranging from 1.10-334 mg/L. The range of ethylene glycol found in the condensate from Mir 19 to 22 was not detected to 153 mg/L. In addition, propylene glycol levels in the condensate samples ranged from 0.63 - 6.97 mg/L. Other organic compounds identified to date in the humidity condensate samples include carbon disulfide, tetrahydrofuran, n,n-dimethylacetamide, 3-t-butylphenol, tetramethylthiourea, acetaldehyde, caprolactam, and 4-ethylmorpholine. The metals analyses of the condensate samples indicate the presence of manganese, zinc, and a trace of mercury. There was insufficient sample volume to confirm the positive mercury result by a different analytical method.

Two wastewater/condensate samples collected from EDVs showed high concentrations of urea (32.6 mg/L and 28.3 mg/L) and chromium (24.8 mg/L and 24.5 mg/L), indicating the presence of about 3% of urine in the containers (EDV) where the samples were collected. These samples were taken because of a Russian request to dispose of this water using the Shuttle Wastewater System.

Conclusions

Initial findings from the analysis of the potable water samples show that the water met all requirements of the Joint U.S./Russian spacecraft water quality standards. It is noted, however, that the NASA requirements for TOC and turbidity and the joint U.S./Russian specification for cadmium were exceeded in the SVO-ZV sample. Although the exceedance of these specifications is a concern, the water is considered potable since the US Environmental Protection Agency (EPA) Health Advisory of 20 μg/L for long term consumption was not exceeded.

Two condensate samples collected from May 13-19, 1997, had high levels of ethylene glycol, 334 mg/L and 314 mg/L, respectively.

In addition, unusually high concentrations of urea and chromium were found in two wastewater/condensate samples collected from EDVs on May 21, 1997. It is suspected that urine was also collected in these bags.

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TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

Session Name	FO#	HW#	Scheduled Day	Actual Day	Samples/ Parameters
Mir22/Mir23					
humidity condensate collection	4,5	6-14	not scheduled	MD197/MD19 1 Mar97	787 ml of condensate Split: 537 ml US, 250 ml RSA
Mir23					
galley-hot water collection	2,3,5	2-5, 7-14	MD88	MD88 8 May97	719 ml of water Split: 519 ml US, 200 ml RSA
galley-hot water collection	2,3,5	2-5, 7-14	not scheduled	MD99 19 May97	755 ml of water Split: 522 ml US, 233 ml RSA
galley-cold water collection	2,3,5	2-5, 7-14	MD99	MD99 19 May97	741 ml of water Split: 522 ml US, 219 ml RSA
SVO-ZV (ground supplied) water collection	2,3,5	2-5, 7-14	MD99	MD99 19 May97	750 ml of water Split: 522 ml US, 228 ml RSA
humidity condensate collection	4,5	6-14	MD93-96	MD93-96 13-16 May97	58 ml of condensate Split: 46 ml US, 12 ml RSA
humidity condensate collection	4,5	6-14	MD96-99	MD96-99 16-19 May97	81 ml of condensate Split: 62 ml US, 19 ml RSA
surface condensate/ wastewater collection	4,5	6-14	not scheduled	MD101 21 May97	683 ml of condensate Split: 483 ml US, 200 ml RSA
surface condensate/ wastewater collection	4,5	6-14	not scheduled	MD101 21 May97	694 ml of condensate Split: 494 ml US, 200 ml RSA

TABLE 2. SAMPLE ALLOCATION TABLE

Mission	Mir 22/Mir 23	Mir 23	Mir 23	Mir 23	Mir 23	Mir 23	Mir 23	Mir 23	Mir 23
Sample Description	Condensate	Stored Water	Stored Water	Stored Water	Stored Water	Condensate	Condensate	Condensate/ Wastewater	Condensate/ Wastewater
Sample Location	CRS	Galley-Hot	Galley-Cold	SVO-ZV	Galley-Hot	CRS	CRS	EDV	EDV
Sample Date	3/1/97	5/8/97	5/19/97	5/19/97	5/19/97	5/13-16/97	5/16-19/97	5/21/97	5/21/97
Sample ID	97-0527-19	97-0527-20	97-0527-12	97-0527-13	97-0527-14	97-0527-15	97-0527-16	97-0527-17	97-0527-18
Analysis/Aliquot	ml	ml	ml	ml	ml	ml	ml	ml	ml
pH, conductivity, Turbidity	BNA split	BNA split	BNA split	BNA split	BNA split	BNA split	BNA split	BNA split	BNA split
Alcohols	16	16	16	16	16	1	2	16	16
Formaldehyde	16	16	16	16	16	5	5	16	16
Glycols/Nonvolatiles	16	16	16	16	16	2	2	16	16
Acids, Amines, Anions, Cations	4	4	4	4	4	4	4	4	4
Semivolatiles (BNA)	250	247	250	250	250	20	30	211	222
Metals	50	50	50	50	50	5	10	50	50
TOC	125	125	125	125	125	3	3	125	125
Volatiles	45	45	45	45	45	6	6	45	45
Archive	15	0	0	0	0	0	0	0	0
NASA Total	537	519	522	522	522	46	62	483	494
RSA Chemical	250	200	219	228	233	12	19	200	200
RSA TOTAL	250	200	219	228	233	12	19	200	200
Total (mL)	787	719	741	750	755	58	81	683	694

TABLE 3. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH[1]	5.5-9.0 pH units	5.5-9.0 pH units
Color[2]	15 Pt-Co units	20 degrees
Taste[2]	3 TTN	2 grade
Odor[2]	3 TON	2 grade
Total Dissolved Solids[3]	100-1,000 mg/L	100-1,000 mg/L
Turbidity[2]	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20°C	5% volume @1 ATM, 20°C
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual[4]	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria[2]	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 μg/L	200 μg/L
Total Phenols	1 μg/L	1 μg/L
Total Organic Carbon (TOC)	500 μg/L	25,000 μg/L
Uncharacterized TOC	100 μg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1] pH range applies only before iodination

[2] Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3] The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L.

[4] Range of required level if iodine is used as a biocide

TABLE 4. STORED WATER RESULTS

Mission					Mir 23	Mir 23	Mir 23	Mir 23
Sample Location			Maximum	Maximum	galley-hot	galley-hot	galley-cold	SVO-ZV
Sample Description		Test	Contaminant	Contaminant	stored water	stored water	stored water	stored water
Sample Date		Conducted	Level	Level	5/8/97	5/19/97	5/19/97	5/19/97
Analysis/Sample ID	Units	by	(MCL)	Source	97-0527-20	97-0527-14	97-0527-12	97-0527-13
Conductivity	µS/cm	U.S.			14.5	5.82	5.8	314
Conductivity	µS/cm	Russia			pending	pending	pending	pending
pH	pH units	U.S.	5.5-9.0	NASA/RSA	6.23	5.93	5.71	7.35
pH	pH units	Russia	5.5-9.0	NASA/RSA	pending	pending	pending	pending
Turbidity	NTU	U.S.	1/1.5 mg/L	NASA/RSA	0.18	0.06	0.06	5.69
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	pending	pending	pending	pending
Odor at 20°C	grade	Russia	3TON/2	NASA/RSA	pending	pending	pending	pending
Taste at 20°C	grade	Russia	3TTN/2	NASA/RSA	pending	pending	pending	pending
Total Solids	mg/L	Russia	1.5	NASA/RSA	pending	pending	pending	pending
Total Hardness	meq/L	Russia	7	NASA/RSA	pending	pending	pending	pending
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	pending	pending	pending	pending
Anions (CE/IC)								
Bromide	mg/L	U.S.			ND	ND	ND	ND
Chloride	mg/L	U.S.	200	NASA/RSA	0.06	0.02	0.02	12.2
Fluoride	mg/L	U.S.	1.5	NASA/RSA	ND	ND	ND	0.19
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	ND	0.03	ND	0.44
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			ND	ND	ND	ND
Phosphate	mg/L	U.S.			ND	ND	ND	0.11
Sulfate	mg/L	U.S.	250	NASA/RSA	0.11	ND	0.10	16.4
Cations (CE/IC)								
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	0.044	0.01	0.008	ND
Calcium	mg/L	U.S.	100	NASA/RSA	2.33	0.757	0.772	38.5
Lithium	mg/L	U.S.			ND	ND	ND	ND
Magnesium	mg/L	U.S.	50	NASA/RSA	0.088	0.046	0.042	9.76
Potassium	mg/L	U.S.			ND	0.004	0.009	1.93
Sodium	mg/L	U.S.			0.009	0.026	0.039	7.53
Minerals								
Ammonium (NH4)	mg/L	Russia	2	NASA/RSA	pending	pending	pending	pending
Calcium	mg/L	Russia	100	NASA/RSA	pending	pending	pending	pending
Magnesium	mg/L	Russia	50	NASA/RSA	pending	pending	pending	pending
Metals								
Calcium	µg/L	U.S.	100000	NASA/RSA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA	NA	NA	NA
Sodium	µg/L	U.S.			NA	NA	NA	NA
Potassium	µg/L	U.S.			NA	NA	NA	NA
Silver	µg/L	U.S.	500	NASA/RSA	4.10	6.9	2.3	378
Silver ion	µg/L	Russia			pending	pending	pending	pending
Aluminum	µg/L	U.S.		NASA	2.2	ND	ND	33.7
Arsenic	µg/L	U.S.	10	NASA	ND	ND	ND	1.0
Barium	µg/L	U.S.	1000	NASA	ND	ND	ND	38.3
Cadmium	µg/L	U.S.	5	NASA	ND	ND	ND	19.4
Chromium	µg/L	U.S.	100	NASA	ND	ND	ND	ND
Cobalt	µg/L	U.S.		NASA	ND	ND	ND	ND
Copper	µg/L	U.S.	1000	NASA	21.3	15.2	13.1	5.2
Iron	µg/L	U.S.	300	NASA	14.0	9.6	12.0	265.0
Mercury	µg/L	U.S.	2	NASA	ND	ND	ND	ND

TABLE 4. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 23 galley-hot stored water 5/8/97 97-0527-20	Mir 23 galley-hot stored water 5/19/97 97-0527-14	Mir 23 galley-cold stored water 5/19/97 97-0527-12	Mir 23 SVO-ZV stored water 5/19/97 97-0527-13
Metals contd.								
Manganese	µg/L	U.S.	50	NASA	1.2	ND	ND	4.0
Molybdenum	µg/L	U.S.		NASA	ND	ND	ND	ND
Nickel	µg/L	U.S.	100	NASA	21.1	11.8	10.9	77.8
Lead	µg/L	U.S.	50	NASA	1.5	1.6	1.6	1.1
Selenium	µg/L	U.S.	10	NASA	ND	ND	ND	ND
Zinc	µg/L	U.S.	5000	NASA	20.8	17.9	23.7	45.0
Palladium	µg/L	U.S.		NASA	NA	NA	NA	NA
Silicon	µg/L	U.S.		NASA	NA	NA	NA	NA
Total Organic Carbon								
TIC (OI 1010)	mg/L	U.S.			NA	NA	NA	30.0
POC (OI 1010)	mg/L	U.S.			NA	NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.			NA	NA	NA	8.50
TOC (OI 1010)	mg/L	U.S.	0.5/25	NASA/RSA	NA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.			2.62	1.17	1.2	31.8
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	0.197	0.168	0.107	8.61
Total Organic Carbon								
TOC (Sievers 800)	mg/L	Russia	0.5/25	NASA/RSA	pending	pending	pending	pending
Volatile Organics								
Acetaldehyde	µg/L	U.S.			ND	ND	ND	ND
Acetone	µg/L	U.S.			ND	ND	ND	ND
Acryloniltrile	µg/L	U.S.			ND	ND	ND	ND
Benzene	µg/L	U.S.	5.0	EPA	ND	ND	ND	ND
Bromodichloromethane	µg/L	U.S.	100	EPA	ND	ND	ND	6.54
Bromoform	µg/L	U.S.	100	EPA	ND	ND	ND	ND
2-Butanone	µg/L	U.S.			ND	ND	ND	ND
Carbon disulfide	µg/L	U.S.			ND	ND	ND	ND
Chloroform	µg/L	U.S.	100	EPA	ND	ND	ND	99.73
Dibromochloromethane	µg/L	U.S.	100	EPA	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPALifetime HA	ND	ND	ND	ND
1,1-Dichloroethene	µg/L	U.S.			ND	ND	ND	ND
cis1,2-dichloroethene	µg/L	U.S.			ND	ND	ND	ND
trans-1,2-dichloroethene	µg/L	U.S.			ND	ND	ND	ND
Diethyl ether	µg/L	U.S.			ND	ND	ND	ND
Iodomethane	µg/L	U.S.			ND	ND	ND	ND
Linolool	µg/L	U.S.			ND	ND	ND	ND
Methylene chloride	µg/L	U.S.	5	EPA	ND	ND	ND	ND
4-Methyl-2-pentanone	µg/L	U.S.			ND	ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.			ND	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.			ND	ND	ND	ND
Toluene	µg/L	U.S.	1000	EPA	ND	ND	ND	ND
Trichloroethene	µg/L	U.S.	5	EPA	ND	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.			ND	ND	ND	ND
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND	ND

TABLE 4. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 23 galley-hot stored water 5/8/97 97-0527-20	Mir 23 galley-hot stored water 5/19/97 97-0527-14	Mir 23 galley-cold stored water 5/19/97 97-0527-12	Mir 23 SVO-ZV stored water 5/19/97 97-0527-13
Volatile Organics contd.								
o-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND	ND
Extractable Organics								
Acetophenone	µg/L	U.S.			pending	pending	pending	pending
2-Aminonaphthalene	µg/L	U.S.			pending	pending	pending	pending
Aniline	µg/L	U.S.			pending	pending	pending	pending
Azobenzene	µg/L	U.S.			pending	pending	pending	pending
Benzaldehyde	µg/L	U.S.			pending	pending	pending	pending
Benzoic acid	µg/L	U.S.			pending	pending	pending	pending
Benzothiazole	µg/L	U.S.			pending	pending	pending	pending
Benzyl alcohol	µg/L	U.S.			pending	pending	pending	pending
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	pending	pending	pending	pending
2-Butoxyethanol	µg/L	U.S.			pending	pending	pending	pending
2-(2-Butoxyethoxy) Ethanol	µg/L	U.S.			pending	pending	pending	pending
Butylated hydroxyanisole (BHA)	µg/L	U.S.			pending	pending	pending	pending
N-Butylbenzenesulfonamide	µg/L	U.S.			pending	pending	pending	pending
3-t-Butylphenol	µg/L	U.S.			pending	pending	pending	pending
Caffeine	µg/L	U.S.			pending	pending	pending	pending
Caprolactam	µg/L	U.S.			pending	pending	pending	pending
tris-2-Chloroethyl phosphate	µg/L	U.S.			pending	pending	pending	pending
Cyclododecane	µg/L	U.S.			pending	pending	pending	pending
Cyclohexanone	µg/L	U.S.			pending	pending	pending	pending
Decamethylcyclopentasiloxane	µg/L	U.S.			pending	pending	pending	pending
1,4 Diacetylbenzene	µg/L	U.S.			pending	pending	pending	pending
1,3-Dichlorobenzene	µg/L	U.S.	600	EPA	pending	pending	pending	pending
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	pending	pending	pending	pending
Di-n-butylamine	µg/L	U.S.			pending	pending	pending	pending
Diallyl Phthalate	µg/L	U.S.			pending	pending	pending	pending
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	pending	pending	pending	pending
N,N-Dibutylformamide	µg/L	U.S.			pending	pending	pending	pending
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			pending	pending	pending	pending
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			pending	pending	pending	pending
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			pending	pending	pending	pending
2,4-Di-t-butylphenol	µg/L	U.S.			pending	pending	pending	pending
N,N-Diethylformamide	µg/L	U.S.			pending	pending	pending	pending
N,N-Diethyl-m-toluamide	µg/L	U.S.			pending	pending	pending	pending
Diethylene glycol monoethyl ether	µg/L	U.S.			pending	pending	pending	pending
Diethyl phthalate	µg/L	U.S.	5000	EPA Lifetime HA	pending	pending	pending	pending
Diisopropyl Adipate	µg/L	U.S.			pending	pending	pending	pending
N,N-Dimethylacetamide	µg/L	U.S.			pending	pending	pending	pending
N,N-Dimethylbenzylamine	µg/L	U.S.			pending	pending	pending	pending
Dimethylcarbamyl chloride	µg/L	U.S.			pending	pending	pending	pending
N,N-Dimethylformamide	µg/L	U.S.			pending	pending	pending	pending
Dimethyl phthalate	µg/L	U.S.			pending	pending	pending	pending
Dimethylthiocarbamoyl chloride	µg/L	U.S.			pending	pending	pending	pending
Dipropylene glycol methyl ether	µg/L	U.S.			pending	pending	pending	pending

TABLE 4. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir23 galley-hot stored water 5/8/97 97-0527-20	Mir23 galley-hot stored water 5/19/97 97-0527-14	Mir23 galley-cold stored water 5/19/97 97-0527-12	Mir23 SVO-ZV stored water 5/19/97 97-0527-13
Extractable Organics contd.								
Dodecamethylcyclohexasiloxane	µg/L	U.S.			pending	pending	pending	pending
Eicosane	µg/L	U.S.			pending	pending	pending	pending
2-Ethoxyethanol	µg/L	U.S.			pending	pending	pending	pending
2-Ethylhexanoic acid	µg/L	U.S.			pending	pending	pending	pending
2-Ethyl-1-hexanol	µg/L	U.S.			pending	pending	pending	pending
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	pending	pending	pending	pending
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	6	EPA HA	pending	pending	pending	pending
4-Ethylmorpholine	µg/L	U.S.			pending	pending	pending	pending
4-Ethylphenol	µg/L	U.S.			pending	pending	pending	pending
1-Formylpiperidine	µg/L	U.S.			pending	pending	pending	pending
Heneicosane	µg/L	U.S.			pending	pending	pending	pending
2-Heptanone	µg/L	U.S.			pending	pending	pending	pending
2-Hexanol	µg/L	U.S.			pending	pending	pending	pending
2-Hydroxybenzothiazole	µg/L	U.S.			pending	pending	pending	pending
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			pending	pending	pending	pending
Indole	µg/L	U.S.			pending	pending	pending	pending
Isophorone	µg/L	U.S.	100	EPA Lifetime HA	pending	pending	pending	pending
Limonene	µg/L	U.S.			pending	pending	pending	pending
Menthol	µg/L	U.S.			pending	pending	pending	pending
Menthone	µg/L	U.S.			pending	pending	pending	pending
2-Mercaptobenzothiazole	µg/L	U.S.			pending	pending	pending	pending
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			pending	pending	pending	pending
Methyl-4-hydroxybenzoate	µg/L	U.S.			pending	pending	pending	pending
3-Methylindole	µg/L	U.S.			pending	pending	pending	pending
2-Methyl-2,4-pentanediol	µg/L	U.S.			pending	pending	pending	pending
4-Methylphenol	µg/L	U.S.			pending	pending	pending	pending
2-Methylpyrazine	µg/L	U.S.			pending	pending	pending	pending
1-Methyl-2-pyrrolidinone	µg/L	U.S.			pending	pending	pending	pending
Methyl sulfone	µg/L	U.S.			pending	pending	pending	pending
2-Methylthiobenzothiazole	µg/L	U.S.			pending	pending	pending	pending
Monomethyl phthalate	µg/L	U.S.			pending	pending	pending	pending
Neomenthol	µg/L	U.S.			pending	pending	pending	pending
Nicotine	µg/L	U.S.			pending	pending	pending	pending
Octadecanol	µg/L	U.S.			pending	pending	pending	pending
Octamethylcyclotetrasiloxane	µg/L	U.S.			pending	pending	pending	pending
Octanoic Acid	µg/L	U.S.			pending	pending	pending	pending
4-t-Octylphenol	µg/L	U.S.			pending	pending	pending	pending
Oxindole	µg/L	U.S.			pending	pending	pending	pending
Pentacosane	µg/L	U.S.			pending	pending	pending	pending
s-Phenethyl alcohol	µg/L	U.S.			pending	pending	pending	pending
Phenol	µg/L	U.S.	1/4000	NASA/EPA Lifetime HA	pending	pending	pending	pending
Phenoxyacetic acid	µg/L	U.S.			pending	pending	pending	pending
2-Phenoxyethanol	µg/L	U.S.			pending	pending	pending	pending
N-Phenyl-2-naphthylamine	µg/L	U.S.			pending	pending	pending	pending
2-Phenylacetic Acid	µg/L	U.S.			pending	pending	pending	pending

TABLE 4. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 23 galley-hot stored water 5/8/97 97-0527-20	Mir 23 galley-hot stored water 5/19/97 97-0527-14	Mir 23 galley-cold stored water 5/19/97 97-0527-12	Mir 23 SVO-ZV stored water 5/19/97 97-0527-13
Extractable Organics contd.								
2-Phenylphenol	µg/L	U.S.			pending	pending	pending	pending
2-Phenyl-2-propanol	µg/L	U.S.			pending	pending	pending	pending
Phenyl sulfone	µg/L	U.S.			pending	pending	pending	pending
Phthalide	µg/L	U.S.			pending	pending	pending	pending
Squalene	µg/L	U.S.			pending	pending	pending	pending
1-alpha-Terpineol	µg/L	U.S.			pending	pending	pending	pending
1-Tetradecanol	µg/L	U.S.			pending	pending	pending	pending
Tetramethylsuccinonitrile	µg/L	U.S.			pending	pending	pending	pending
Tetramethylthiourea	µg/L	U.S.			pending	pending	pending	pending
Tetramethylurea	µg/L	U.S.			pending	pending	pending	pending
Thymol	µg/L	U.S.			pending	pending	pending	pending
o-Toluic acid	µg/L	U.S.			pending	pending	pending	pending
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.			pending	pending	pending	pending
Tricosane	µg/L	U.S.			pending	pending	pending	pending
Tributyl Phosphate	µg/L	U.S.			pending	pending	pending	pending
Triethyl Phosphate	µg/L	U.S.			pending	pending	pending	pending
Triethylamine	µg/L	U.S.			pending	pending	pending	pending
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			pending	pending	pending	pending
Undecanoic Acid	µg/L	U.S.			pending	pending	pending	pending
2-Undecanone	µg/L	U.S.			pending	pending	pending	pending
Urethane	µg/L	U.S.			pending	pending	pending	pending
Vanillin	µg/L	U.S.			pending	pending	pending	pending
Alcohols (DAI/GC/MS)								
Ethanol	µg/L	U.S.			ND	ND	ND	ND
Methanol	µg/L	U.S.			ND	ND	ND	ND
1-Methoxy-2-propanol	µg/L	U.S.			ND	ND	ND	ND
2-Methyl-2-butanol	µg/L	U.S.			ND	ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.			ND	ND	ND	ND
2-Propanol	µg/L	U.S.			ND	ND	ND	ND
Alcohols/Acetone								
Acetone	µg/L	Russia			pending	pending	pending	pending
Ethanol	µg/L	Russia			pending	pending	pending	pending
Isoamyl alcohol (3-Pentanol)	µg/L	Russia			pending	pending	pending	pending
Propyl alcohol	µg/L	Russia			pending	pending	pending	pending
Glycols (DAI/GC/MS)								
1,2-Ethanediol	µg/L	U.S.	7000	EPA Lifetime HA	ND	ND	ND	ND
1,2-Propanediol	µg/L	U.S.			ND	ND	ND	ND
Glycols								
1,2-Ethanediol	µg/L	Russia	7000	EPA Lifetime HA	pending	pending	pending	pending
1,2-Propanediol	µg/L	Russia			pending	pending	pending	pending
Organic Acids (SPE/GC/MS)								
Acetic acid	µg/L	U.S.			NA	NA	NA	NA
Acetic acid	µg/L	Russia			pending	pending	pending	pending
Lactic acid	µg/L	U.S.			NA	NA	NA	NA
Propanoic acid	µg/L	U.S.			NA	NA	NA	NA

TABLE 4. STORED WATER RESULTS

Mission					Mir 23	Mir 23	Mir 23	Mir 23
Sample Location			Maximum	Maximum	galley-hot	galley-hot	galley-cold	SVO-ZV
Sample Description		Test	Contaminant	Contaminant	stored water	stored water	stored water	stored water
Sample Date		Conducted	Level	Level	5/8/97	5/19/97	5/19/97	5/19/97
Analysis/Sample ID	Units	by	(MCL)	Source	97-0527-20	97-0527-14	97-0527-12	97-0527-13
Aldehydes								
Formaldehyde	µg/L	U.S.	1000	EPA Lifetime HA	ND	ND	ND	ND
Acetaldehyde	µg/L	U.S.			NA	NA	NA	NA
Carboxylates (CE)								
Acetate	mg/L	U.S.			pending	pending	pending	pending
Formate	mg/L	U.S.			pending	pending	pending	pending
Lactate	mg/L	U.S.			pending	pending	pending	pending
Amines (CE)								
Methylamine	mg/L	U.S.			pending	ND	0.79	pending
Urea	mg/L	U.S.			ND	ND	ND	pending
Organic Carbon Recovery	percent	U.S.			pending	pending	pending	pending

TABLE 5. CONDENSATE RESULTS

Mission			Mir 22/Mir 23	Mir 23	Mir 23	Mir 23	Mir 23
Sample Location			CRS	CRS	CRS	EDV	EDV
Sample Description		Test	condensate	condensate	condensate	surface condensate /wastewater	surface condensate /wastewater
Sample Date		Conducted	3/1/97	5/13-16/97?	5/16-19/97?	5/21/97	5/21/97
Analysis/Sample ID	Units	by	97-0527-19	97-0527-15	97-0527-16	97-0527-17	97-0527-18
Conductivity	µS/cm	U.S.	201	280	323	1130	1110
Conductivity	µS/cm	Russia	NA	pending	pending	pending	pending
pH	pH units	U.S.	7.02	7.41	7.09	6.29	6.42
pH	pH units	Russia	NA	pending	pending	pending	pending
Turbidity	NTU	U.S.	11.2	4.04	4.44	95.9	95.8
Color True	degrees	Russia	NA	pending	pending	pending	pending
Odor at 20°C	grade	Russia	NA	pending	pending	pending	pending
Taste at 20°C	grade	Russia	NA	pending	pending	pending	pending
Total Solids	mg/L	Russia	NA	pending	pending	pending	pending
Total Hardness	meq/L	Russia	NA	pending	pending	pending	pending
Chemical Oxygen Demand	mg O_2/L	Russia	NA	pending	pending	pending	pending
Anions (CE/IC)							
Bromide	mg/L	U.S.	ND	pending	pending	ND	ND
Chloride	mg/L	U.S.	0.65	pending	pending	88.1	85.5
Fluoride	mg/L	U.S.	0.36	pending	pending	ND	0.68
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	ND	pending	pending	ND	1.72
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.	ND	pending	pending	ND	ND
Phosphate	mg/L	U.S.	ND	pending	pending	8.12	8.35
Sulfate	mg/L	U.S.	0.35	pending	pending	271	262
Cations (CE/IC)							
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	26.1	pending	pending	85.4	82.9
Calcium	mg/L	U.S.	1.02	pending	pending	2.07	2.67
Lithium	mg/L	U.S.	ND	pending	pending	ND	ND
Magnesium	mg/L	U.S.	0.484	pending	pending	4.47	4.73
Potassium	mg/L	U.S.	ND	pending	pending	49.9	47.0
Sodium	mg/L	U.S.	1.38	pending	pending	59.8	58.7
Minerals							
Ammonium (NH4)	mg/L	Russia	NA	pending	pending	pending	pending
Calcium	mg/L	Russia	NA	pending	pending	pending	pending
Magnesium	mg/L	Russia	NA	pending	pending	pending	pending
Metals							
Calcium	µg/L	U.S.	NA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	NA	NA	NA	NA	NA
Sodium	µg/L	U.S.	NA	NA	NA	NA	NA
Potassium	µg/L	U.S.	NA	NA	NA	NA	NA
Silver	µg/L	U.S.	165.0	ND	ND	35.3	34.1
Silver ion	µg/L	Russia	NA	pending	pending	pending	pending
Aluminum	µg/L	U.S.	12.5	30.5	30.2	168	201
Arsenic	µg/L	U.S.	ND	ND	ND	ND	ND
Barium	µg/L	U.S.	4.8	16.9	18.2	10.8	9.9
Cadmium	µg/L	U.S.	8.1	31.3	29.9	215.0	437.0
Chromium	µg/L	U.S.	5.3	ND	ND	24800.0	24500.0
Cobalt	µg/L	U.S.	ND	ND	ND	ND	ND
Copper	µg/L	U.S.	6.9	10.2	2.1	46.1	39.8
Iron	µg/L	U.S.	16.9	35.3	9.6	944	903
Mercury	µg/L	U.S.	ND	2.4	ND	ND	ND

TABLE 5. CONDENSATE RESULTS

Mission			Mir22/Mir23	Mir23	Mir23	Mir23	Mir23
Sample Location			CRS	CRS	CRS	EDV	EDV
Sample Description		Test	condensate	condensate	condensate	surface condensate/wastewater	surface condensate/wastewater
Sample Date		Conducted	3/1/97	5/13-16/97?	5/16-19/97?	5/21/97	5/21/97
Analysis/Sample ID	Units	by	97-0527-19	97-0527-15	97-0527-16	97-0527-17	97-0527-18
Metals contd.							
Manganese	µg/L	U.S.	28.0	5.6	6.0	138.0	139.0
Molybdenum	µg/L	U.S.	2.4	ND	2.4	695.0	659.0
Nickel	µg/L	U.S.	2390	127	17.0	2060	1890
Lead	µg/L	U.S.	16.1	ND	5.2	17.9	16.7
Selenium	µg/L	U.S.	ND	ND	ND	ND	ND
Zinc	µg/L	U.S.	156	536	711	770	1210
Palladium	µg/L	U.S.	NA	NA	NA	NA	NA
Silicon	µg/L	U.S.	NA	NA	NA	NA	NA
Total Organic Carbon							
TIC (OI1010)	mg/L	U.S.	21.9	NA	NA	15.8	20.9
POC (OI1010)	mg/L	U.S.	NA	NA	NA	NA	NA
NPOC (OI1010)	mg/L	U.S.	43.1	NA	NA	130	125
TOC (OI1010)	mg/L	U.S.	NA	NA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.	27.7	33.4	36.1	18.5	24.6
TOC (Sievers 800)	mg/L	U.S.	54.8	155.0	152.0	150.0	144.0
Total Organic Carbon							
TOC (Sievers 800)	mg/L	Russia	NA	pending	pending	pending	pending
Volatile Organics							
Acetaldehyde	µg/L	U.S.	ND	ND	ND	ND	ND
Acetone	µg/L	U.S.	31.18	10145	ND	33.33	ND
Acryloniltrile	µg/L	U.S.	ND	ND	ND	ND	ND
Benzene	µg/L	U.S.	ND	ND	5.35	ND	ND
Bromodichloromethane	µg/L	U.S.	ND	ND	ND	ND	ND
Bromoform	µg/L	U.S.	ND	ND	ND	ND	ND
2-Butanone	µg/L	U.S.	ND	ND	ND	ND	ND
Carbon disulfide	µg/L	U.S.	ND	28.4	63.5	1.8	2.78
Chloroform	µg/L	U.S.	ND	ND	ND	ND	ND
Dibromochloromethane	µg/L	U.S.	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	ND	ND	ND	ND	ND
1,1-Dichloroethene	µg/L	U.S.	ND	ND	ND	ND	ND
cis1,2-dichloroethene	µg/L	U.S.	ND	ND	ND	ND	ND
trans-1,2-dichloroethene	µg/L	U.S.	ND	ND	ND	ND	ND
Diethyl ether	µg/L	U.S.	ND	ND	ND	1.88	2.12
Iodomethane	µg/L	U.S.	ND	ND	ND	ND	ND
Linolool	µg/L	U.S.	ND	ND	ND	ND	ND
Methylene chloride	µg/L	U.S.	1.46	ND	ND	1.47	1.53
4-Methyl-2-pentanone	µg/L	U.S.	ND	ND	ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.	ND	ND	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.	ND	ND	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.	8.69	ND	ND	96.4	87.33
Toluene	µg/L	U.S.	ND	ND	ND	ND	ND
Trichloroethene	µg/L	U.S.	ND	ND	ND	ND	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.	ND	ND	ND	ND	ND
m&p-Xylene	µg/L	U.S.	ND	ND	ND	ND	ND

TABLE 5. CONDENSATE RESULTS

Mission			Mir22/Mir23	Mir23	Mir23	Mir23	Mir23
Sample Location			CRS	CRS	CRS	EDV	EDV
Sample Description		Test	condensate	condensate	condensate	surface condensate /wastewater	surface condensate /wastewater
Sample Date		Conducted	3/1/97	5/13-16/97?	5/16-19/97?	5/21/97	5/21/97
Analysis/Sample ID	Units	by	97-0527-19	97-0527-15	97-0527-16	97-0527-17	97-0527-18
Volatile Organics contd.							
o-Xylene	µg/L	U.S.	ND	ND	ND	ND	ND
Extractable Organics							
Acetophenone	µg/L	U.S.	pending	40.0	25.4	pending	pending
2-Aminonaphthalene	µg/L	U.S.	pending	ND	ND	pending	pending
Aniline	µg/L	U.S.	pending	ND	ND	pending	pending
Azobenzene	µg/L	U.S.	pending	ND	ND	pending	pending
Benzaldehyde	µg/L	U.S.	pending	ND	ND	pending	pending
Benzoic acid	µg/L	U.S.	pending	ND	ND	pending	pending
Benzothiazole	µg/L	U.S.	pending	ND	72.9	pending	pending
Benzyl alcohol	µg/L	U.S.	pending	78.6	ND	pending	pending
Benzyl butyl phthlate	µg/L	U.S.	pending	ND	ND	pending	pending
2-Butoxyethanol	µg/L	U.S.	pending	ND	ND	pending	pending
2-(2-Butoxyethoxy) Ethanol	µg/L	U.S.	pending	ND	ND	pending	pending
Butylated hydroxyanisole (BHA)	µg/L	U.S.	pending	10.7	10.1	pending	pending
N-Butylbenzenesulfonamide	µg/L	U.S.	pending	ND	ND	pending	pending
3-t-Butylphenol	µg/L	U.S.	pending	493.8	451.0	pending	pending
Caffeine	µg/L	U.S.	pending	ND	ND	pending	pending
Caprolactam	µg/L	U.S.	pending	ND	193.0	pending	pending
tris-2-Chloroethyl phosphate	µg/L	U.S.	pending	ND	ND	pending	pending
Cyclododecane	µg/L	U.S.	pending	ND	ND	pending	pending
Cyclohexanone	µg/L	U.S.	pending	ND	ND	pending	pending
Decamethylcyclopentasiloxane	µg/L	U.S.	pending	ND	ND	pending	pending
1,4 Diacetylbenzene	µg/L	U.S.	pending	ND	21.9	pending	pending
1,3- Dichlorobenzene	µg/L	U.S.	pending	ND	ND	pending	pending
1,4-Dichlorobenzene	µg/L	U.S.	pending	ND	ND	pending	pending
Di-n-butylamine	µg/L	U.S.	pending	28.0	ND	pending	pending
Diallyl Phthalate	µg/L	U.S.	pending	ND	ND	pending	pending
Di-n-butyl phthalate	µg/L	U.S.	pending	ND	ND	pending	pending
N,N-Dibutylformamide	µg/L	U.S.	pending	ND	ND	pending	pending
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.	pending	ND	ND	pending	pending
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.	pending	ND	ND	pending	pending
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.	pending	ND	ND	pending	pending
2,4-Di-t-butylphenol	µg/L	U.S.	pending	ND	ND	pending	pending
N,N-Diethylformamide	µg/L	U.S.	pending	80.3	77.9	pending	pending
N,N-Diethyl-m-toluamide	µg/L	U.S.	pending	ND	ND	pending	pending
Diethylene glycol monoethyl ether	µg/L	U.S.	pending	81.1	53.8	pending	pending
Diethyl phthalate	µg/L	U.S.	pending	ND	ND	pending	pending
Diisopropyl Adipate	µg/L	U.S.	pending	ND	ND	pending	pending
N,N-Dimethylacetamide	µg/L	U.S.	pending	526.6	552.4	pending	pending
N,N-Dimethylbenzylamine	µg/L	U.S.	pending	11.7	ND	pending	pending
Dimethylcarbamyl chloride	µg/L	U.S.	pending	ND	42.7	pending	pending
N,N-Dimethylformamide	µg/L	U.S.	pending	854.2	700.7	pending	pending
Dimethyl phthalate	µg/L	U.S.	pending	ND	ND	pending	pending
Dimethylthiocarbamoyl chloride	µg/L	U.S.	pending	ND	ND	pending	pending
Dipropylene glycol methyl ether	µg/L	U.S.	pending	40.4	36.5	pending	pending

TABLE 5. CONDENSATE RESULTS

Mission			Mir22/Mir23	Mir23	Mir23	Mir23	Mir23
Sample Location			CRS	CRS	CRS	EDV	EDV
Sample Description		Test	condensate	condensate	condensate	surface condensate/wastewater	surface condensate/wastewater
Sample Date		Conducted	3/1/97	5/13-16/97?	5/16-19/97?	5/21/97	5/21/97
Analysis/Sample ID	Units	by	97-0527-19	97-0527-15	97-0527-16	97-0527-17	97-0527-18
Extractable Organics contd.							
Dodecamethylcyclohexasiloxane	µg/L	U.S.	pending	7.1	13.3	pending	pending
Eicosane	µg/L	U.S.	pending	ND	ND	pending	pending
2-Ethoxyethanol	µg/L	U.S.	pending	120.6	ND	pending	pending
2-Ethylhexanoic acid	µg/L	U.S.	pending	ND	117	pending	pending
2-Ethyl-1-hexanol	µg/L	U.S.	pending	ND	ND	pending	pending
bis-2-Ethylhexyl adipate	µg/L	U.S.	pending	ND	ND	pending	pending
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	pending	21.5	17.3	pending	pending
4-Ethylmorpholine	µg/L	U.S.	pending	303.8	19.4	pending	pending
4-Ethylphenol	µg/L	U.S.	pending	ND	ND	pending	pending
1-Formylpiperidine	µg/L	U.S.	pending	ND	ND	pending	pending
Heneicosane	µg/L	U.S.	pending	ND	ND	pending	pending
2-Heptanone	µg/L	U.S.	pending	ND	ND	pending	pending
2-Hexanol	µg/L	U.S.	pending	ND	ND	pending	pending
2-Hydroxybenzothiazole	µg/L	U.S.	pending	66.6	46.3	pending	pending
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.	pending	141.6	152.6	pending	pending
Indole	µg/L	U.S.	pending	ND	ND	pending	pending
Isophorone	µg/L	U.S.	pending	5.3	4.9	pending	pending
Limonene	µg/L	U.S.	pending	ND	ND	pending	pending
Menthol	µg/L	U.S.	pending	ND	ND	pending	pending
Menthone	µg/L	U.S.	pending	ND	ND	pending	pending
2-Mercaptobenzothiazole	µg/L	U.S.	pending	ND	ND	pending	pending
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.	pending	ND	ND	pending	pending
Methyl-4-hydroxybenzoate	µg/L	U.S.	pending	ND	ND	pending	pending
3-Methylindole	µg/L	U.S.	pending	ND	ND	pending	pending
2-Methyl-2,4-pentanediol	µg/L	U.S.	pending	ND	ND	pending	pending
4-Methylphenol	µg/L	U.S.	pending	ND	ND	pending	pending
2-Methylpyrazine	µg/L	U.S.	pending	ND	ND	pending	pending
1-Methyl-2-pyrrolidinone	µg/L	U.S.	pending	156.2	174.1	pending	pending
Methyl sulfone	µg/L	U.S.	pending	8.4	13.4	pending	pending
2-Methylthiobenzothiazole	µg/L	U.S.	pending	51.9	55.1	pending	pending
Monomethyl phthalate	µg/L	U.S.	pending	ND	ND	pending	pending
Neomenthol	µg/L	U.S.	pending	ND	ND	pending	pending
Nicotine	µg/L	U.S.	pending	ND	ND	pending	pending
Octadecanol	µg/L	U.S.	pending	ND	ND	pending	pending
Octamethylcyclotetrasiloxane	µg/L	U.S.	pending	ND	ND	pending	pending
Octanoic Acid	µg/L	U.S.	pending	ND	ND	pending	pending
4,t-Octylphenol	µg/L	U.S.	pending	ND	ND	pending	pending
Oxindole	µg/L	U.S.	pending	ND	ND	pending	pending
Pentacosane	µg/L	U.S.	pending	ND	ND	pending	pending
s-Phenethyl alcohol	µg/L	U.S.	pending	10.3	8.8	pending	pending
Phenol	µg/L	U.S.	pending	ND	ND	pending	pending
Phenoxyacetic acid	µg/L	U.S.	pending	ND	ND	pending	pending
2-Phenoxyethanol	µg/L	U.S.	pending	ND	ND	pending	pending
N-Phenyl-2-naphthylamine	µg/L	U.S.	pending	ND	19.9	pending	pending
2-Phenylacetic Acid	µg/L	U.S.	pending	ND	ND	pending	pending

TABLE 5. CONDENSATE RESULTS

Mission			Mir22/Mir23	Mir23	Mir23	Mir23	Mir23
Sample Location			CRS	CRS	CRS	EDV	EDV
Sample Description		Test	condensate	condensate	condensate	surface condensate /wastewater	surface condensate /wastewater
Sample Date		Conducted	3/1/97	5/13-16/97?	5/16-19/97?	5/21/97	5/21/97
Analysis/Sample ID	Units	by	97-0527-19	97-0527-15	97-0527-16	97-0527-17	97-0527-18
Extractable Organics contd.							
2-Phenylphenol	µg/L	U.S.	pending	9.9	3	pending	pending
2-Phenyl-2-propanol	µg/L	U.S.	pending	84.3	91.8	pending	pending
Phenyl sulfone	µg/L	U.S.	pending	23.4	28.4	pending	pending
Phthalide	µg/L	U.S.	pending	ND	ND	pending	pending
Squalene	µg/L	U.S.	pending	ND	ND	pending	pending
1-alpha-Terpineol	µg/L	U.S.	pending	17.8	18.1	pending	pending
1-Tetradecanol	µg/L	U.S.	pending	ND	ND	pending	pending
Tetramethylsuccinonitrile	µg/L	U.S.	pending	21.5	20.0	pending	pending
Tetramethylthiourea	µg/L	U.S.	pending	64.1	125.5	pending	pending
Tetramethylurea	µg/L	U.S.	pending	44.3	56.3	pending	pending
Thymol	µg/L	U.S.	pending	ND	ND	pending	pending
o-Toluic acid	µg/L	U.S.	pending	ND	ND	pending	pending
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.	pending	10.3	ND	pending	pending
Tricosane	µg/L	U.S.	pending	ND	ND	pending	pending
Tributyl Phosphate	µg/L	U.S.	pending	ND	ND	pending	pending
Triethyl Phosphate	µg/L	U.S.	pending	ND	ND	pending	pending
Triethylamine	µg/L	U.S.	pending	ND	ND	pending	pending
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.	pending	ND	ND	pending	pending
Undecanoic Acid	µg/L	U.S.	pending	ND	ND	pending	pending
2-Undecanone	µg/L	U.S.	pending	ND	ND	pending	pending
Urethane	µg/L	U.S.	pending	ND	ND	pending	pending
Vanillin	µg/L	U.S.	pending	ND	ND	pending	pending
Alcohols (DAI/GC/MS)							
Ethanol	µg/L	U.S.	ND	ND	ND	ND	ND
Methanol	µg/L	U.S.	ND	ND	ND	ND	ND
1-Methoxy-2-propanol	µg/L	U.S.	ND	ND	ND	ND	ND
2-Methyl-2-butanol	µg/L	U.S.	ND	ND	ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.	ND	ND	ND	116	ND
2-Propanol	µg/L	U.S.	153	2203	704	510	478
Alcohols/Acetone							
Acetone	µg/L	Russia	NA	pending	pending	pending	pending
Ethanol	µg/L	Russia	NA	pending	pending	pending	pending
Isoamyl alcohol (3-Pentanol)	µg/L	Russia	NA	pending	pending	pending	pending
Propyl alcohol	µg/L	Russia	NA	pending	pending	pending	pending
Glycols (DAI/GC/MS)							
1,2-Ethanediol	µg/L	U.S.	9465	333950	314140	ND	1097
1,2-Propanediol	µg/L	U.S.	632	6599	6969	ND	ND
Glycols							
1,2-Ethanediol	µg/L	Russia	NA	pending	pending	pending	pending
1,2-Propanediol	µg/L	Russia	NA	pending	pending	pending	pending
Organic Acids (SPE/GC/MS)							
Acetic acid	µg/L	U.S.	NA	NA	NA	NA	NA
Acetic acid	µg/L	Russia	pending	pending	pending	pending	pending
Lactic acid	µg/L	U.S.	NA	NA	NA	NA	NA
Propanoic acid	µg/L	U.S.	NA	NA	NA	NA	NA

TABLE 5. CONDENSATE RESULTS

Mission			Mir 22/Mir 23	Mir 23	Mir 23	Mir 23	Mir 23
Sample Location			CRS	CRS	CRS	EDV	EDV
Sample Description		Test	condensate	condensate	condensate	surface condensate /wastewater	surface condensate /wastewater
Sample Date		Conducted	3/1/97	5/13-16/97?	5/16-19/97?	5/21/97	5/21/97
Analysis/Sample ID	Units	by	97-0527-19	97-0527-15	97-0527-16	97-0527-17	97-0527-18
Aldehydes							
Formaldehyde	µg/L	U.S.	10	19	22	37	25
Acetaldehyde	µg/L	U.S.	NA	NA	NA	NA	NA
Carboxylates (CE)							
Acetate	mg/L	U.S.	pending	pending	pending	pending	pending
Formate	mg/L	U.S.	pending	pending	pending	pending	pending
Lactate	mg/L	U.S.	pending	pending	pending	pending	pending
Amines (CE)							
Methylamine	mg/L	U.S.	pending	pending	pending	pending	pending
Urea	mg/L	U.S.	ND	pending	pending	326000	283200
Organic Carbon Recovery	percent	U.S.	pending	pending	pending	pending	pending

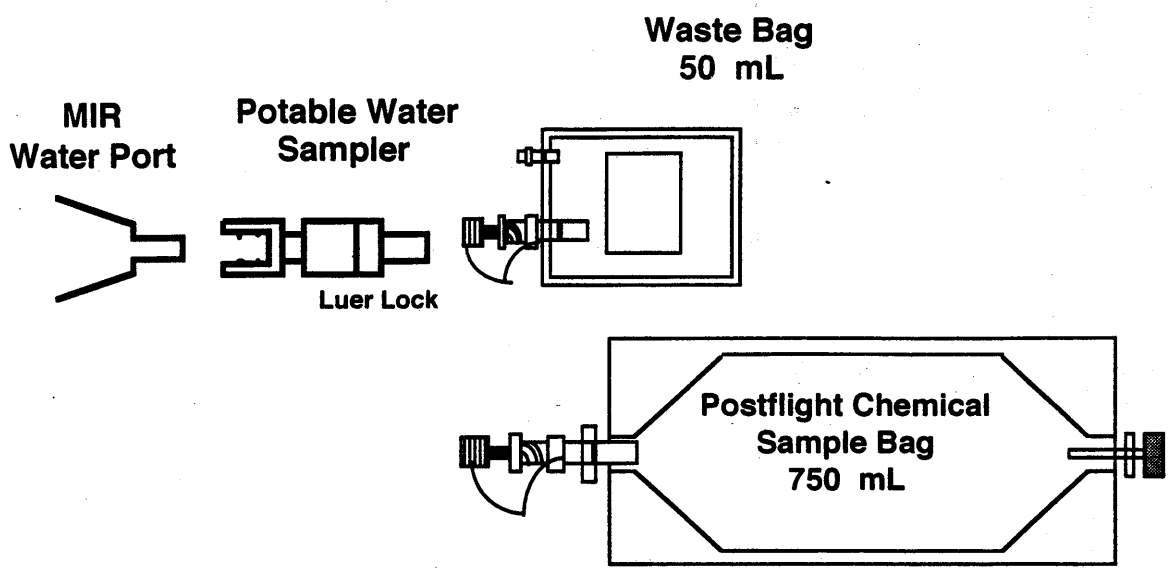

Figure 1. Sample Collection Methodology

Analysis of Mir Archival Water Samples

U.S. Principal Investigator: **RICHARD L. SAUER, P.E.,** NASA/Johnson Space Center
Russian Principal Investigator: **YURI SINYAK, PH.D.,** Institute of Biomedical Problems
Co-Investigator: John Schultz, Ph.D.
Co-Author: Lizanna M. Pierre

(NASA 5 Operational Accomplishments Report)

INTRODUCTION

A portion of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. Additional supplies come from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water transferred from the Shuttle. This project is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain water of potable quality.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Previous Mission Experience

This experiment has flown under the Human Life Sciences Discipline during the Mir 18/NASA 1, the Mir 19, the Mir 20/STS-74, and the Mir 21/NASA2/STS-79 missions. In addition, this activity was performed under the Space Medicine Program during the Mir 22/NASA3/STS-81 and the Mir 23/NASA4/STS-84 missions.

RESEARCH OPERATIONS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

An accident aboard the Mir occurred on June 25, 1997 where a Progress resupply spacecraft collided with the Spektr module of the Mir Space Station. This module contained the necessary hardware for this project. Because of depressurization of the module, the hardware could not be retrieved. Therefore, no recycled or stored water samples were collected during this mission. However, one sample of recycled water was collected during the docking of STS-86 when new supplies were carried to the Mir. In addition, hardware for condensate sampling was delivered by a Soyuz vehicle. There were reports that one condensate sample was collected using this hardware.

Postflight Anomalies

Although one condensate sample was reported to have been collected inflight, the sample could not be found upon return of the Shuttle to Earth.

Completeness/Quality of Data

Sample analyses are in progress.

DISCUSSION

Status of Data Analysis

Chemical analyses of the recycled water sample is in progress. Analyses completed to date include conductivity, pH, turbidity, total organic carbon (TOC), trace metals, anions, cations, carboxylates, amines, volatile and semivolatile organics, glycols, urea, and alcohols. Analyses yet to be completed include color, taste, odor, total hardness, total solids, chemical oxygen demand (COD), formaldehyde, and the identification of unknown compounds.

Preliminary Research Findings

Preliminary results show that the reclaimed water sample collected on 10/01/97 met the Russian requirement of 25 mg/L, but exceeded the U.S. maximum contaminant level of 0.5 mg/L for total organic carbon (TOC) (See Table 1). The TOC for this sample was 1.15 mg/L. This sample had no detectable levels of glycols and had a silver concentration of 89.6 μg/L. No other parameters analyzed exceeded the U.S. EPA or the Joint U.S./Russian specifications. Overall, the results indicate the water is of potable quality, meeting both U.S. EPA and Russian water quality standards.

Conclusions

Initial findings from the analysis of the potable water samples show that the water met all requirements of the Joint U.S./Russian spacecraft water quality standards. It is noted, however, that the NASA requirement for TOC was exceeded in the sample. However, the water is of potable quality.

REFERENCES

None

TABLE 1. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH[1]	5.5-9.0 pH units	5.5-9.0 pH units
Color[2]	15 Pt-Co units	20 degrees
Taste[2]	3 TTN	2 grade
Odor[2]	3 TON	2 grade
Total Dissolved Solids[3]	100-1,000 mg/L	100-1,000 mg/L
Turbidity[2]	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20°C	5% volume @1 ATM, 20°C
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual[4]	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria[2]	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 μg/L	200 μg/L
Total Phenols	1 μg/L	1 μg/L
Total Organic Carbon (TOC)	500 μg/L	25,000 μg/L
Uncharacterized TOC	100 μg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1] pH range applies only before iodination

[2] Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3] The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4] Range of required level if iodine is used as a biocide

Analysis of Mir Archival Water Samples

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Co-Investigator: John Schultz, Ph.D.
Co-Author: Lizanna M. Pierre

(NASA 5 Preliminary Research Report)

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Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Background/History

Historically, water provided for crew consumption during U.S. space missions has either been launched from the ground or produced as a byproduct of fuel cell operation. Reclamation of spacecraft wastewaters as practiced on the Russian Space Station Mir, will be required for supplying crewmembers of the International Space Station with potable and hygiene water.

This experiment has flown under the Human Life Sciences Discipline during the Mir 18/NASA 1, Mir 19, Mir 20/STS-74, Mir 21/NASA 2/STS-79, and Mir 22/NASA 3/STS-81 missions. In addition, this activity was performed under the Space Medicine Program during the Mir 23/NASA 4/STS-84 mission.

METHODS/RESEARCH OPERATIONS

Functional Objectives

FO1. Preflight collection of ground-supplied water at RSC Energia, Korolov, Russia

FO2. Water Sampling Hardware Setup

FO3. Inflight collection of hot, cold, and SVO-ZV (stored) water

FO4. Inflight collection of humidity condensate

FO5. Postflight analysis of samples

Hardware Items

Major hardware items used inflight for this experiment:

HW1. Water Experiment Kit - NASA provided

HW2. Disinfectant/Antiseptic Wipes - NASA provided

HW3. Potable Water Samplers (with Mir port adapter interfaces) - NASA provided

HW4. Waste bags and Chemical Sample, Postflight Analysis Bags - NASA provided

HW5. Self Sealing Storage Bags - NASA provided

HW6. Atmospheric Condensate Sampler - RSA provided

Major hardware items used postflight for this experiment:

HW7. HP 5890 Gas Chromatograph (GC) with HP5971A Mass Spectrometer (MS)- NASA provided

HW8. Waters Quanta 4000 Capillary Electrophoresis System - NASA provided

HW9. OI 700 Carbon Analyzer - NASA provided

HW10. Sievers Model 800 Total Organic Carbon Analyzer - NASA and RSA provided

HW11. HP 7694 Headspace sampler with a HP 5890 GC and 5972 Mass Selective Detector - NASA provided

HW12. HP 5989 Mass Spectrometer (MS) with a 1090 Liquid Chromatograph with Particle beam & Thermospray interfaces - NASA provided

HW13. pH meter - RSA and NASA provided

HW14. Conductivity meter - RSA provided

Method/Protocol

During inflight water sampling sessions on board Mir, the water experiment kit was unstowed from its storage location. The water experiment kit contained the disinfectant wipes, potable water samplers, waste bags, chemical sample, postflight analysis bags, and storage bags needed for water sampling. A prepackaged disinfectant wipe containing 1 ml of benzalkonium chloride in 250 ml of water, was retrieved from the kit and used to disinfect the Mir galley-hot, galley-cold, or SVO-ZV water port. Next, a potable water sampler was connected to the port. A waste bag was then connected to the potable water sampler. Using the waste bag, 50 ml of water was collected and discarded. Next, 700 ml of water was collected into the chemical sample, postflight analysis bag. The sample bag was placed in a self sealing storage bag and stowed for return on the Shuttle. These procedures were used to collect galley-hot, galley-cold, and SVO-ZV (ground-supplied) water for postflight chemical analysis for this investigation. Following the collection of the chemical samples, microbiological samples were obtained for a separate experiment. The procedures used for microbiological sample collection, analysis, and preliminary results are reported in "Microbiological Investigations of the Mir Station and Flight Crew" [4].

Postflight chemical analysis of samples occurred at Johnson Space Center (JSC) and the Institute for Biomedical Problems (IBMP). Following recovery of the samples on the ground, the samples were allocated (See Table 2) for distribution to the water analysis laboratories at JSC and IBMP. Parameters tested at JSC included total carbon (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, nonvolatiles, formaldehyde), and silver. Parameters tested by IBMP included conductivity, pH, color, chemical oxygen demand, total solids, calcium, magnesium, total hardness, and silver.

RESULTS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

None

Inflight Anomalies

An accident aboard the Mir occurred on June 25, 1997, where a Progress resupply spacecraft collided with the Spektr module of the Mir Space Station. This module contained the hardware necessary for this project. Because of depressurization of the module, the hardware could not be retrieved. Therefore, no regenerated or stored water samples were collected during this mission. However, one sample of regenerated water was collected during the docking of STS-86 when new supplies were carried to the Mir. In addition, hardware for condensate sampling was delivered by a Soyuz vehicle. There were reports that one condensate sample was collected using this hardware.

Postflight Anomalies

Although one condensate sample was reported to have been collected in flight, the sample could not be found upon return of STS-86 to Earth.

Completeness/Quality of Data

All chemical analyses of the recycled water sample have been completed.

DISCUSSION

Status of Data Analysis

All chemical analyses of the recycled water sample have been completed.

Preliminary Research Findings

The results show that the regenerated water sample collected on 10/01/97 met the Russian requirement of 25 mg/L, but exceeded the U.S. maximum contaminant level of 0.5 mg/L for total organic carbon (TOC) (See Table 3). The TOC for this sample was 1.15 mg/L. This sample had no detectable levels of glycols, and had a silver concentration of 89.6 μg/L. All other parameters met the U.S. EPA and the Joint U.S./Russian specifications.

Overall, the results indicate the water is of potable quality, meeting both U.S. EPA and Russian water quality standards.

Conclusions

The findings from the analysis of the regenerated water sample show that the water met all requirements of the Joint U.S./Russian spacecraft water quality standards. It is noted, however, that the NASA requirement for TOC was exceeded in the sample. However, the water is of potable quality.

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TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

Session Name	FO#	HW#	Scheduled Day	Actual Day	Samples/ Parameters
Mir23					
galley-hot water collection	2,3,5	2-5,7-14	MD185	did not occur	
galley-hot water collection	2,3,5	2-5,7-14	MD195	did not occur	
galley-cold water collection	2,3,5	2-5,7-14	MD195	did not occur	
Mir24					
humidity condensate collection	4,5	6-14	MD26	MD28 2-Sep-97	sample was not received
galley-cold water collection	2,3,5	2-5,7-14	MD57	MD57 1-Oct-97	752 ml of water Split: 526 ml US, 226 ml RSA
SVO-ZV (ground supplied) water collection	2,3,5	2-5,7-14	MD57	cancelled	
humidity condensate collection	4,5	6-14	MD29	did not occur	

TABLE 2. ALLOCATION OF MIR 24/NASA 5/STS-86 SAMPLES

JSC Sample No.	**97-1008-01**
Mission	**Mir-24/Nasa-6**
Sample Description	**Regenerated Water**
Sample Location	**Galley Cold**
Sample Date	**10/1/97**
Analysis/Aliquot	**mL**
pH, conductivity, Turbidity	BNA split
Alcohols	12
Formaldehyde	12
Glycols/Urea	12
Organic Acids & Amines	5
Anions & Cations	15
Semivolatiles (BNA)	250
Metals	50
TOC	125
Volatiles	45
NASA Total	526
RSA Total	226
Total (mL)	752

TABLE 3. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH[1]	5.5-9.0 pH units	5.5-9.0 pH units
Color[2]	15 Pt-Co units	20 degrees
Taste[2]	3 TTN	2 grade
Odor[2]	3 TON	2 grade
Total Dissolved Solids[3]	100-1,000 mg/L	100-1,000 mg/L
Turbidity[2]	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20°C	5% volume @1 ATM, 20°C
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual[4]	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria[2]	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 μg/L	200 μg/L
Total Phenols	1 μg/L	1 μg/L
Total Organic Carbon (TOC)	500 μg/L	25,000 μg/L
Uncharacterized TOC	100 μg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-cold regenerated water 10/1/97 97-1008-03
Conductivity	µS/cm	U.S.			63.4
Conductivity	µS/cm	Russia			57
pH	pH units	U.S.	5.5-9.0	NASA/RSA	7.02
pH	pH units	Russia	5.5-9.0	NASA/RSA	7.5
Turbidity	NTU	U.S.	1/1.5 mg/L	NASA/RSA	3.43
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	10
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	NA
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	NA
Total Solids	mg/L	Russia	1.5	NASA/RSA	NA
Total Hardness	meq/L	Russia	7	NASA/RSA	0.9
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	5.0
Anions (CE/IC)					
Bromide	mg/L	U.S.			ND
Chloride	mg/L	U.S.	200	NASA/RSA	0.97
Fluoride	mg/L	U.S.	1.5	NASA/RSA	0.17
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	ND
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			ND
Phosphate	mg/L	U.S.			ND
Sulfate	mg/L	U.S.	250	NASA/RSA	0.22
Cations (CE/IC)					
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	0.008
Calcium	mg/L	U.S.	100	NASA/RSA	10.5
Lithium	mg/L	U.S.			ND
Magnesium	mg/L	U.S.	50	NASA/RSA	0.559
Potassium	mg/L	U.S.			0.009
Sodium	mg/L	U.S.			0.183
Minerals					
Ammonium (NH4)	mg/L	Russia	2	NASA/RSA	ND
Calcium	mg/L	Russia	100	NASA/RSA	10.4
Magnesium	mg/L	Russia	50	NASA/RSA	2.3
Metals					
Calcium	µg/L	U.S.	100000	NASA/RSA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA
Sodium	µg/L	U.S.			NA
Potassium	µg/L	U.S.			NA
Silver	µg/L	U.S.	500	NASA/RSA	89.6
Silver ion	µg/L	Russia			ND
Aluminum	µg/L	U.S.		NASA	9.4
Arsenic	µg/L	U.S.	10	NASA	ND
Barium	µg/L	U.S.	1000	NASA	1.3
Cadmium	µg/L	U.S.	5	NASA	ND
Chromium	µg/L	U.S.	100	NASA	ND
Cobalt	µg/L	U.S.		NASA	ND
Copper	µg/L	U.S.	1000	NASA	24.3
Iron	µg/L	U.S.	300	NASA	42.3
Mercury	µg/L	U.S.	2	NASA	ND
Manganese	µg/L	U.S.	50	NASA	2.2
Molybdenum	µg/L	U.S.		NASA	ND
Nickel	µg/L	U.S.	100	NASA	31.0
Lead	µg/L	U.S.	50	NASA	ND
Selenium	µg/L	U.S.	10	NASA	ND
Zinc	µg/L	U.S.	5000	NASA	27.9
Palladium	µg/L	U.S.		NASA	NA
Silicon	µg/L	U.S.		NASA	NA
Total Organic Carbon					
TIC (OI 1010)	mg/L	U.S.			NA
POC (OI 1010)	mg/L	U.S.			NA
NPOC (OI 1010)	mg/L	U.S.			NA
TOC (OI 1010)	mg/L	U.S.	0.5/25	NASA/RSA	NA
TIC (Sievers 800)	mg/L	U.S.			8.0
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	1.15
TOC (Sievers 800)	mg/L	Russia	0.5/25	NASA/RSA	NA

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-cold regenerated water 10/1/97 97-1008-03
Volatile Organics					
Acetaldehyde	µg/L	U.S.			ND
Acetone	µg/L	U.S.			ND
Acryloniltrile	µg/L	U.S.			ND
Benzene	µg/L	U.S.	5.0	EPA	ND
Bromodichloromethane	µg/L	U.S.	100	EPA	4.84
Bromoform	µg/L	U.S.	100	EPA	ND
2-Butanone	µg/L	U.S.			ND
Carbon disulfide	µg/L	U.S.			<5.00
Chloroform	µg/L	U.S.	100	EPA	ND
Dibromochloromethane	µg/L	U.S.	100	EPA	4.69
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPA HA	ND
1,1-Dichloroethene	µg/L	U.S.			5.09
cis1,2-dichloroethene	µg/L	U.S.			4.41
trans-1,2-dichloroethene	µg/L	U.S.			5.71
Diethyl ether	µg/L	U.S.			ND
Iodomethane	µg/L	U.S.			ND
4-Isopropyltoluene	µg/L	U.S.			ND
Linolool	µg/L	U.S.			ND
Methylene chloride	µg/L	U.S.	5	EPA	4.90
4-Methyl-2-pentanone	µg/L	U.S.			ND
alpha-Methyl styrene	µg/L	U.S.			ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND
Tetrahydrofuran	µg/L	U.S.			ND
Toluene	µg/L	U.S.	1000	EPA	<1.00
Trichloroethene	µg/L	U.S.	5	EPA	ND
1,1,2-Trichlorotrifluoroethane	µg/L	U.S.			ND
m&p-Xylene	µg/L	U.S.	Total Xylenes	EPA	ND
o-Xylene	µg/L	U.S.	Total Xylenes	EPA	ND
Extractable Organics					
Acetophenone	µg/L	U.S.			<8
2-Aminonaphthalene	µg/L	U.S.			ND
Aniline	µg/L	U.S.			ND
Azobenzene	µg/L	U.S.			ND
2,2'-Azobis-isobutyronitrile	µg/L	U.S.			ND
Benzaldehyde	µg/L	U.S.			ND
Benzoic acid	µg/L	U.S.			ND
Benzothiazole	µg/L	U.S.			7.0
Benzyl alcohol	µg/L	U.S.			8.2
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	ND
2-Butoxyethanol	µg/L	U.S.			ND
2-(2-Butoxyethoxy) Ethanol	µg/L	U.S.			ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND
N-Butylbenzenesulfonamide	µg/L	U.S.			ND
3-t-Butylphenol	µg/L	U.S.			<12
Caffeine	µg/L	U.S.			ND
Caprolactam	µg/L	U.S.			ND
tris-2-Chloroethyl phosphate	µg/L	U.S.			ND
Cyclododecane	µg/L	U.S.			ND
Cyclohexanone	µg/L	U.S.			ND
Decamethylcyclopentasiloxane	µg/L	U.S.			ND
1,4 Diacetylbenzene	µg/L	U.S.			ND
1,3- Dichlorobenzene	µg/L	U.S.	600	EPA	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND
Di-n-butylamine	µg/L	U.S.			ND
Diallyl Phthalate	µg/L	U.S.			ND
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	ND
N,N-Dibutylformamide	µg/L	U.S.			ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			ND
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			ND
2,4-Di-t-butylphenol	µg/L	U.S.			ND
N,N-Diethylformamide	µg/L	U.S.			ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-cold regenerated water 10/1/97 97-1008-03
Extractable Organics contd.					
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND
Diethylene glycol monoethyl ether	µg/L	U.S.			ND
Diethyl phthalate	µg/L	U.S.	5000	EPA HA	ND
Diisopropyl Adipate	µg/L	U.S.			ND
N,N-Dimethylacetamide	µg/L	U.S.			ND
N,N-Dimethylbenzylamine	µg/L	U.S.			ND
Dimethylcarbamyl chloride	µg/L	U.S.			ND
N,N-Dimethylformamide	µg/L	U.S.			ND
Dimethyl phthalate	µg/L	U.S.			ND
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND
Dipropylene glycol methyl ether	µg/L	U.S.			ND
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND
Eicosane	µg/L	U.S.			ND
2-Ethoxyethanol	µg/L	U.S.			ND
2-Ethylhexanoic acid	µg/L	U.S.			ND
2-Ethyl-1-hexanol	µg/L	U.S.			12.8
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	6	EPA HA	ND
4-Ethylmorpholine	µg/L	U.S.			ND
4-Ethylphenol	µg/L	U.S.			ND
1-Formylpiperidine	µg/L	U.S.			ND
Heneicosane	µg/L	U.S.			ND
2-Heptanone	µg/L	U.S.			ND
Hexanoic acid	µg/L	U.S.			ND
2-Hexanol	µg/L	U.S.			ND
2-Hydroxybenzothiazole	µg/L	U.S.			<4
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND
Indole	µg/L	U.S.			ND
Isophorone	µg/L	U.S.	100	EPA HA	ND
Limonene	µg/L	U.S.			ND
Menthol	µg/L	U.S.			ND
Menthone	µg/L	U.S.			ND
2-Mercaptobenzothiazole	µg/L	U.S.			ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND
Methyl-4-hydroxybenzoate	µg/L	U.S.			ND
3-Methylindole	µg/L	U.S.			ND
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND
4-Methylphenol	µg/L	U.S.			ND
2-Methylpyrazine	µg/L	U.S.			ND
1-Methyl-2-pyrrolidinone	µg/L	U.S.			ND
Methyl sulfone	µg/L	U.S.			ND
2-Methylthiobenzothiazole	µg/L	U.S.			<4
Monomethyl phthalate	µg/L	U.S.			ND
Neomenthol	µg/L	U.S.			<4
Nicotine	µg/L	U.S.			ND
Octadecanol	µg/L	U.S.			ND
Octamethylcyclotetrasiloxane	µg/L	U.S.			ND
Octanoic Acid	µg/L	U.S.			ND
4-t-Octylphenol	µg/L	U.S.			ND
Oxindole	µg/L	U.S.			ND
Pentacosane	µg/L	U.S.			ND
s-Phenethyl alcohol	µg/L	U.S.			ND
Phenol	µg/L	U.S.	1/4000	NASA/ EPA	ND
bis-Phenol A	µg/L	U.S.			ND
Phenoxyacetic acid	µg/L	U.S.			ND
2-Phenoxyethanol	µg/L	U.S.			ND
N-Phenyl-2-naphthylamine	µg/L	U.S.			ND
2-Phenylacetic Acid	µg/L	U.S.			ND
Phenylethyl alcohol	µg/L	U.S.			ND
2-Phenylphenol	µg/L	U.S.			ND
2-Phenyl-2-propanol	µg/L	U.S.			<4
Phenyl sulfone	µg/L	U.S.			ND
Phthalide	µg/L	U.S.			ND

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Extractable Organics contd.					
Salicyclic Acid	µg/L	U.S.			ND
Squalene	µg/L	U.S.			ND
1-alpha-Terpineol	µg/L	U.S.			ND
1-Tetradecanol	µg/L	U.S.			ND
Tetramethylsuccinonitrile	µg/L	U.S.			ND
Tetramethylthiourea	µg/L	U.S.			ND
Tetramethylurea	µg/L	U.S.			ND
Thymol	µg/L	U.S.			ND
o-Toluic acid	µg/L	U.S.			ND
1,3,5-Triallyl-1,3,5-triazine-	µg/L	U.S.			ND
Tricosane	µg/L	U.S.			ND
Tributyl Phosphate	µg/L	U.S.			ND
Triethyl Phosphate	µg/L	U.S.			ND
Triethylamine	µg/L	U.S.			ND
2,2,4-Trimethyl-1,3-pentanediol	µg/L	U.S.			ND
Undecanoic Acid	µg/L	U.S.			ND
2-Undecanone	µg/L	U.S.			ND
Urethane	µg/L	U.S.			ND
Vanillin	µg/L	U.S.			ND
Alcohols (DAI/GC/MS)					
Ethanol	µg/L	U.S.			ND
Methanol	µg/L	U.S.			ND
1-Methoxy-2-propanol	µg/L	U.S.			ND
2-Methyl-2-butanol	µg/L	U.S.			ND
2-Methyl-2-propanol	µg/L	U.S.			ND
2-Propanol	µg/L	U.S.			ND
Alcohols/Acetone					
Acetone	µg/L	Russia			NA
Ethanol	µg/L	Russia			NA
Isoamyl alcohol (3-Pentanol)	µg/L	Russia			NA
Propyl alcohol	µg/L	Russia			NA
Glycols (DAI/GC/MS)					
1,2-Ethanediol	µg/L	U.S.	7000	EPA HA	ND
1,2-Propanediol	µg/L	U.S.			ND
Glycols					
1,2-Ethanediol	µg/L	Russia	7000	EPA HA	NA
1,2-Propanediol	µg/L	Russia			NA
Organic Acids (SPE/GC/MS)					
Acetic acid	µg/L	U.S.			NA
Acetic acid	µg/L	Russia			NA
Lactic acid	µg/L	U.S.			NA
Propanoic acid	µg/L	U.S.			NA
Aldehydes					
Acetaldehyde	µg/L	U.S.			NA
Formaldehyde	µg/L	U.S.	1000	EPA HA	ND
Carboxylates (CE)					
Acetate	mg/L	U.S.			ND
Formate	mg/L	U.S.			ND
Lactate	mg/L	U.S.			ND
Glycolate	mg/L	U.S.			ND
Amines (CE)					
Methylamine	mg/L	U.S.			ND
Propylamine	mg/L	U.S.			ND
Trimethylamine	mg/L	U.S.			ND
Urea	mg/L	U.S.			ND
Organic Carbon Recovery	percent	U.S.			3.17

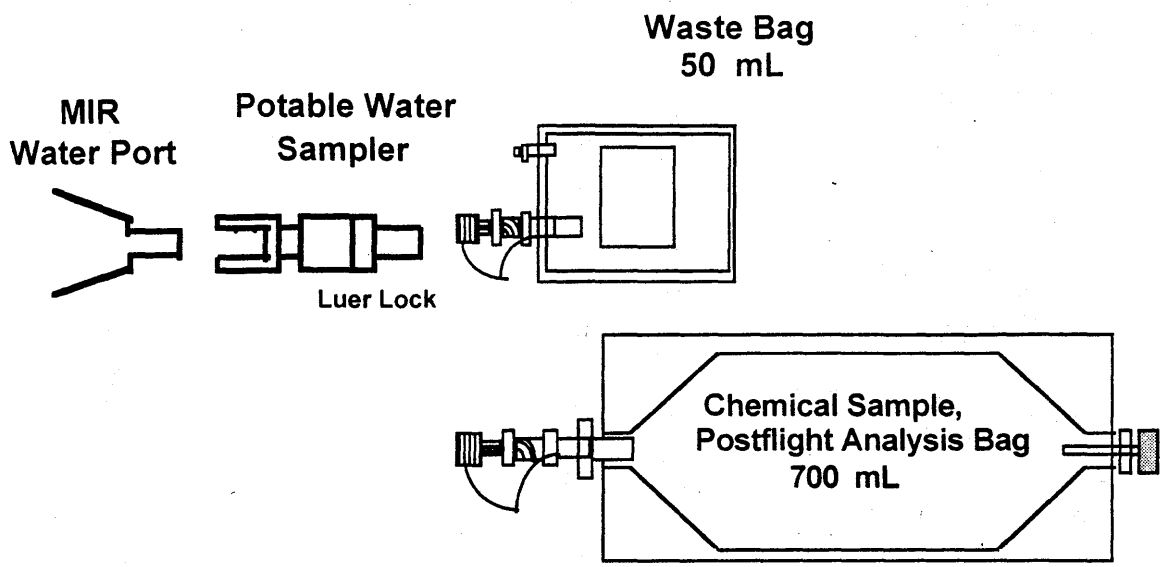

Figure 1. Sample Collection Methodology

Analysis of Mir Archival Water Samples

U.S. Principal Investigator: **RICHARD L. SAUER, P.E.**, NASA/Johnson Space Center
Russian Principal Investigator: **YURI SINYAK, PH.D.**, Institute of Biomedical Problems
Co-Investigator: John Schultz, Ph.D.
Co-Author: Marie Hwang

(NASA 6 Operational Accomplishments Report)

INTRODUCTION

Approximately fifty percent of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. The remainder comes from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water transferred from the Shuttle. This experiment is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain water of potable quality.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Previous Mission Experiments

This experiment has flown under the Human Life Sciences Discipline during the Mir 18/NASA 1, Mir 19, Mir 20/STS-74, Mir 21/NASA 2/STS-79, and Mir 22/NASA 3/STS-81 missions, and as part of the Space Medicine Program on Mir 23/NASA 4/STS-84 and Mir 23/24/NASA 5/STS-86 missions.

METHODS/RESEARCH OPERATIONS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment.

Inflight Anomalies

Sampling for galley hot water and SVO-ZV were planned for the docked phase, but no samples were received. One condensate sample from the Condensate Recovery System (CRS) (dated 1/17/98 2200 to 1/18/98 2200) contained only 0.25 ml of sample and the other condensate collected in a Teflon sample bag dated 1/26/98 1700 to 1/28/98 1500 was received empty. It appears that the CRS did not receive sufficient condensate during the docked phase because the Shuttle humidity control system was dominant.

Postflight Anomalies

Samples 98-0202-01 and 98-0202-04 are galley hot water samples collected in US supplied Teflon sample bags. These two samples leaked during transport from KSC to JSC after landing. The leakage from each sample was recovered in the outer Ziplock bags and were archived as samples 98-0202-02 and 98-0202-05, respectively. The leakage, however, did not adversely impact sample analysis.

Completeness/Quality of Data

Data for this experiment are derived from analyses of water samples returned from the mission. Sample analyses are in progress. Table 1 indicates sample allocations in Mir24/STS-89. Two water samples - one galley hot water and one SVO-ZV - were not collected during docked phase

as planned. In addition, the condensate Teflon bag dated 1/26/98 1700 to 1/28/98 1500 was received empty, hence, no analyses were performed.

DISCUSSION

Status of Data Analysis

Analyses completed to date include conductivity, pH, turbidity, TOC, trace metals, anions on all samples except 98-0202-06, carboxylates, amines, alcohols, glycols and target semivolatile organics. Work yet to be completed includes inorganic anions; cations; volatile organics, semivolatile organics, formaldehyde; urea; and preparation of the organic carbon balances.

Preliminary Research Findings

The preliminary results show that the galley hot water and SVO-ZV water samples met all requirements except the US levels for turbidity and TOC. These samples had turbidity and TOC levels ranging from 1.66 -4.29 NTU and 3.11 - 20 mg/l, respectively. Table 2 shows Joint U.S./Russian Potable Water Specifications for International Space Station. The galley hot water sample collected on 11/17/97 and the SVO-ZV sample collected on 11/27/97 contained formate and ethanol, indicating that US supplied water transferred from the Shuttle was being used when these samples were taken. The condensate samples collected in the Russian samplers on 1/19/98 and 1/28/98 had significant levels of ethylene glycol (342 and 270 mg/L, respectively) indicating thermal control system coolant leakage remains problematic. However, no ethylene glycol was detected in the condensate sample collected after the filter reactor in the U.S. bag on 1/17/98. The surface condensate sample contained significant solids and was centrifuged prior to analysis. The preliminary organic carbon constituents results are shown in Table 3. The TOC of the supernatant was 136 mg/L and measurable levels of aluminum (667 μg/L), cadmium (157 μg/L), iron (2180 μg/L), 3-t-butylphenol (402μg/L), and N,N-dimethyl acetamide (498μg/L) were detected.

Conclusions

The preliminary data indicate high TOC values in the potable samples from SVO-ZV. This is likely attributable to the presence of formate, which is counterion of the calcium and magnesium that are added to the fuel cell water to render it acceptable for potable water use by the Russians. Potable water supplied at the galley has two protective barriers - the filter reactor and multifiltration beds. The ethylene glycol analysis results indicate that the filter reactor was functioning well during the mission. The results for the galley and SVO-ZV samples available to date indicate that the NASA 6 water supply was of adequate quality.

TABLE 1. SAMPLE ALLOCATIONS IN MIR 24/STS-89

WAFAL ID	**98-0202-01**	**98-0202-02**	**98-0202-03**	**98-0202-04**	**98-0202-05**	**98-0202-06**
Mission	Mir24	Mir24	Mir24	Mir24	Mir24	Mir24
Sample Description	Regenerated Water	Regenerated Water	Regenerated Water	Regenerated Water	Regenerated Water	Stored Water
Sample Location	Galley-Hot	Galley-Hot	Galley-Hot	Galley-Hot	Galley-Hot	SVO-ZV
Sample Date	11/17/97 1418	**Leakage from 98-0202-01**	11/27/1997 1230	1/19/1998 1300	**Leakage from 98-0202-04**	11/27/97 1240
Analysis/Aliquot	ml	ml	ml	ml	ml	ml
pH, cond, Turb	BNA split	**HOLD**	BNA split	BNA split	**HOLD**	BNA split
Alcohols	5		5	2		5
Formaldehyde	5		10	5		5
Glycols/Nonvolatiles	5		5	5		5
Anions, Cations	4		4	4		4
Acids, Amines	4		4	2		4
Semivolatiles	*50		250	25		250
Metals (no Hg)	25		50	5		50
TOC	25		125	25		125
Volatiles	16		16	6		16
Iodine and Iodide	-		-	-		-
Fluoride	-		-	-		-
Micro	-		-	-		-
Archive	-	500	116	-	342	73
NASA Total	139		585	79		537
RSA Chemical	70		250	29		230
RSA Micro#	0	0	0	0	0	0
RSA TOTAL	70	0	250	29	0	230
Total (mL)	209	500	835	108	342	767

TABLE 1. SAMPLE ALLOCATIONS IN MIR 24/STS-89

WAFAL ID	**98-0202-07#**	**98-0202-08**	**98-0202-09**	**98-0202-10**	**98-0202-11#**	**98-0202-16**
Mission	Mir24	Mir24	Mir24	Mir24	Mir24	Mir24
Sample Description	Condensate*	Condensate*	Condensate*	Condensate**	Surface Condensate (Slime)	Condensate**
Sample Location	CRS	CRS	CRS	CRS		CRS
Sample Date	**11/17/97**	**1/19/98**	**1/28/98**	11/28/97 2000 to 11/29/97 2000	1/19/98 2135	1/17/98 2200 to 1/18/98 2200
Analysis/Aliquot	ml	ml	ml	ml	ml	ml
pH, cond, Turb	BNA split	BNA split	BNA split	BNA split	BNA split	-
Alcohols	1	1	1	5	2	-
Formaldehyde	5	5	2	5	5	-
Glycols/Nonvolatiles	2	2	2	5	5	0.25##
Anions, Cations	2	2	2	4	2	-
Acids, Amines	3	3	3	4	3	-
Semivolatiles	14	15	5	250	20	-
Metals (no Hg)	.5	5	4	50	9	-
TOC	10	10	4	125	10	-
Volatiles	6	6	6	16	6	-
Iodine and Iodide	-	-	-	-	-	-
Fluoride	-	-	-	-	-	-
Micro	-	-	-	-	-	-
Archive	-	-	-	38	19	-
NASA Total	48	49	29	502	81	0.25##
RSA Chemical	19	22	0	200	0	-
RSA Micro#	0	0	0	0	0	-
RSA TOTAL	19	22	0	200	0	-
Total (mL)	67	71	29	702	81	0.25##

Notes: *in Russian condensate sampler
**in 1 L teflon bag with Nomex restraints
contains solids, centrifugation required
##Essentially empty, recovered 0.25 mL and will analyze for ethylene glycol only
One more condensate teflon bag was received empty - Dated 1/26/98 1700 to 1/28/98 1500

TABLE 2. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH[1]	5.5-9.0 pH units	5.5-9.0 pH units
Color[2]	15 Pt-Co units	20 degrees
Taste[2]	3 TTN	2 grade
Odor[2]	3 TON	2 grade
Total Dissolved Solids[3]	100-1,000 mg/L	100-1,000 mg/L
Turbidity[2]	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20°C	5% volume @1 ATM, 20°C
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual[4]	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria[2]	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 μg/L	200 μg/L
Total Phenols	1 μg/L	1 μg/L
Total Organic Carbon (TOC)	500 μg/L	25,000 μg/L
Uncharacterized TOC	100 μg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1] pH range applies only before iodination

[2] Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3] The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4] Range of required level if iodine is used as a biocide

TABLE 3. PRELIMINARY ORGANIC CARBON CONSTITUENTS RESULTS

JSC Sample No	Sample Description	TOC (mg/L)	1,2-Ethanediol (mg/L)	1,2-Propanediol (mg/L)	Formate (mg/L)	Methanol (mg/L)	Ethanol (mg/L)	2-Propanol (mg/L)
STS-89/Mir 24								
98-0202-01	Regenerated Hot Water - Galley 11/17/97 1418 (US)	11.1	<1	<0.5	26.8	<0.1	1.13	<0.1
98-0202-03	Regenerated Hot Water - Galley 11/27/97 1230 (US)	3.11	<1	<0.5	5.3	<0.1	<0.1	<0.1
98-0202-04	Regenerated Hot Water - Galley 1/19/98 1300 (US)	5.79	<1	<0.5	<0.12	<0.1	<0.1	<0.1
98-0202-06	Stored Water - SVO-ZV 11/27/97 1240 (US)	20.0	<1	<0.5	61.7	<0.1	6.66	<0.1
98-0202-07	Humidity Condensate - CRS 11/17/97 (RS)	50.5	<1	<0.5	<0.12	<0.1	<0.1	<0.1
98-0202-08	Humidity Condensate - CRS 1/19/98 (RS)	184	342	18.2	0.44	1.56	<0.1	<0.1
98-0202-09	Humidity Condensate - CRS 1/28/98 (RS)	192	270	14.0	<1.2	0.47	<0.1	<0.1
98-0202-10	Humidity Condensate - CRS Post FR 11/28/97 2000 to 11/29/97 2000 (US)	9.86	<1	<0.5	<0.12	<0.1	<0.1	<0.1
98-0202-11	Surface Condensate - Mir interior 1/19/98 2135 (US)	136	<1	<0.5		<0.1	<0.1	<0.1
98-0202-16	Humidity Condensate - CRS Post FR 1/17/98 2200 to 1/18/98 2200 (US)	NA	<11*	<5.5*	NA	NA	NA	NA

NA = Not analyzed due to insufficient sample volume
* Diluted 1:11 due to insufficient sample volume

Analysis of Mir Archival Water Samples

U.S. Principal Investigator: **RICHARD L. SAUER, P.E.** NASA/Johnson Space Center

Russian Principal Investigator: **YURI SINYAK, PH.D.,** Institute of Biomedical Problems

Co-Investigator: John Schultz, Ph.D.

Co-Author: Lizanna M. Pierre

(NASA 6 Preliminary Research Report)

INTRODUCTION

A portion of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. Additional supplies come from ground supplied potable water that is delivered on a Progress resupply spacecraft, or processed fuel cell water transferred from the Shuttle. This project is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain water of potable quality.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Background/History

Historically, water provided for crew consumption during U.S. space missions has either been launched from the ground or produced as a byproduct of fuel cell operation. Reclamation and purification of spacecraft wastewaters as practiced on the Russian Space Station Mir, will be required for supplying crewmembers of the International Space Station with potable and hygiene water.

This experiment has flown under the Human Life Sciences Discipline during the Mir 18/NASA 1, the Mir 19, the Mir 20/STS-74, the Mir 21/NASA 2/STS-79 and the Mir 22/NASA 3/STS-81 missions. In addition, this activity was performed under the Space Medicine Program during the the Mir 23/NASA 4/STS-84 and the Mir 24/NASA 5/STS-86 missions.

METHODS/RESEARCH OPERATIONS

Functional Objectives

FO1. Preflight collection of ground-supplied water at RSC Energia, Korolov, Russia

FO2. Water Sampling Hardware Setup

FO3. Inflight collection of hot, cold, and SVO-ZV (stored) water

FO4. Inflight collection of humidity condensate

FO5. Inflight collection of partially processed humidity condensate

FO6. Postflight analysis of samples

Hardware Items

Major hardware items used inflight for this experiment:

HW1. Water Experiment Kit - NASA provided

HW2. Disinfectant/Antiseptic Wipes - NASA provided

HW3. Potable Water Samplers (with Mir port adapter interfaces) - NASA provided

HW4. Waste bags and Chemical Sample, Postflight Analysis Bags - NASA provided

HW5. Self Sealing Storage Bags - NASA provided

HW6. Atmospheric Condensate Sampler - RSA provided

Major hardware items used postflight for this experiment:

HW7. HP 5890 Gas Chromatograph (GC) with HP5971A Mass Spectrometer (MS)- NASA provided

HW8. Waters Quanta 4000 Capillary Electrophoresis System - NASA provided

HW9. OI 700 Carbon Analyzer - NASA provided

HW10. Sievers Model 800 Total Organic Carbon Analyzer - NASA and RSA provided

HW11. HP 7694 Headspace sampler with a HP 5890 GC and 5972 Mass Selective Detector - NASA provided

HW12. HP 5989 Mass Spectrometer (MS) with a 1090 Liquid Chromatograph with Particle beam & Thermospray interfaces - NASA provided

HW13. pH meter - RSA and NASA provided

HW14. Conductivity meter - RSA provided

Method/Protocol

The water experiment kit (WEK) contained the disinfectant wipes, potable water samplers, waste bags, chemical sample, postflight analysis bags, and storage bags needed for water sampling. During inflight water sampling sessions, the WEK was unstowed. A prepackaged disinfectant wipe containing 1 ml of benzalkonium chloride in 250 ml of water, was retrieved from the kit and used to disinfect the Mir galley-hot, galley-cold, or SVO-ZV water port. Next, a potable water sampler was connected to the port. A waste bag was then connected to the potable water sampler. Using the waste bag, 50 ml of water was collected and discarded. Next, 700 ml of water was collected into the chemical sample, postflight analysis bag. The sample bag was placed in a self sealing storage bag and stowed for return on the Shuttle. These procedures were used to collect galley-hot, galley-cold, and SVO-ZV (ground-supplied) water for postflight chemical analysis for this investigation. Following the collection of the chemical samples, microbiological samples were obtained for a separate experiment. The procedures used for microbiological sample collection, analysis, and preliminary results are reported elsewhere in "Microbiological Investigations of the Mir Station and Flight Crew" [4].

Postflight chemical analysis of samples occurred at Johnson Space Center (JSC) and the Institute of Biomedical Problems (IBMP). Following recovery of the samples on the ground, the samples were allocated (see Table 2) for distribution to the water analysis laboratories at JSC and IBMP. Parameters tested at JSC included total carbon components (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, nonvolatiles, formaldehyde), and metals. Parameters tested by IBMP included conductivity, pH, color, chemical oxygen demand, total solids, calcium, magnesium, total hardness, and silver.

RESULTS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

None

Inflight Anomalies

Sampling for galley hot water and SVO-ZV were planned for the docked phase, but no samples were received. One condensate sample from CRS (dated 1/17/98 2200 to 1/18/98 2200) contained only 0.25 ml of sample and the other condensate collected in a Teflon sample bag dated 1/26/98 1700 to 1/28/98 1500 was received empty. It appears that the SRV-K system did not receive sufficient condensate during the docked phase because the Shuttle humidity control system was dominant.

Postflight Anomalies

Samples 98-0202-01 and 98-0202-04 are galley hot water samples collected in US supplied Teflon sample bags. These two samples leaked during transport from KSC to JSC after landing. The leakage from each sample was recovered in the outer Ziplock bags and were archived as samples 98-0202-02 and 98-0202-05, respectively. The leakage, however, did not adversely impact sample analysis.

Completeness/Quality of Data

Sample analyses are in progress.

DISCUSSION

Status of Data Analysis

Chemical analyses of the recycled water sample are in progress. Analyses completed to date include conductivity, pH, turbidity, total organic carbon (TOC), trace metals, anions, cations, carboxylates, amines, volatile and semivolatile organics, glycols, urea, and alcohols. Analyses yet to be completed by IMBP include color,

taste, odor, total hardness, total solids, and chemical oxygen demand (COD).

Preliminary Research Findings

Regenerated Water

Preliminary results (Table 4) show that the regenerated water samples collected met the Russian requirement of 25 mg/L, but exceeded the U.S. maximum contaminant level of 0.5 mg/L for total organic carbon (TOC) (see Table 3). The TOC for these samples ranged from 3.11 mg/L to 11.1 mg/L according to results analyzed by the U.S. In contrast, measurements from IBMP (Russia) for the samples ranged from 4.8 mg/L to 23.2 mg/L. Turbidity was the only other parameter analyzed that exceeded the U.S. specifications. Turbidity in the regenerated water samples ranged from 2.88 to 4.29 NTU, whereas the U.S. potable water specification is 1 NTU. The Russian specification is 1.5 mg/L. Overall, the results indicate the regenerated water is of potable quality.

Stored Water

One SVO-ZV sample was collected during this mission (Table 5). This sample exceeded NASA water quality standards for TOC and turbidity. This sample, collected on 11/27/97 contained 20 mg/L TOC with a turbidity of 1.66 NTU. The U.S. specification for TOC is 0.5 mg/L; the specification for turbidity is 1 NTU.

Condensate

A variety of compounds have been identified in the humidity condensate samples (Table 6). Samples collected during this mission had TOC levels of 9.86 - 192 mg/L. Ethylene glycol (1,2-ethanediol) was detected in condensate samples collected on 1/19/98 and 1/28/98 and were 342.5 mg/L and 270 mg/L respectively. Propylene glycol (1,2-propanediol) levels were 18.2 mg/L and 14 mg/L in these samples. During this mission two samples of partially processed humidity condensate, identified as filter reactor effluent in Table 6, were collected. The results of these samples indicate that the catalytic reactor subsystem of the SRV-K is very effective in removing ethylene glycol and propylene glycol. These compounds were not detected in the filter reactor effluent samples.

Conclusions

Initial findings from the analysis of the regenerated and stored water samples show that the water met the Joint U.S./Russian spacecraft water quality standards. It is noted, however, that the NASA requirements for TOC and turbidity were exceeded in the samples. The water is however of potable quality.

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TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

Session Name	FO#	HW#	Scheduled Day	Actual day Day	Samples/ Parameters
Mir24					
galley-hot water collection	2,3,6	2-5,7-14	MD104	MD104 18 Nov 97	209 ml of water Split: 139 ml US, 70 ml RSA
humidity condensate collection	4,6	6-14	MD104	MD104 18 Nov 97	67 ml of water Split: 48 ml US, 19 ml RSA
galley-hot water collection	2,3,6	2-5,7-14	MD114	MD114 28 Nov 97	835 ml of water Split: 585 ml US, 250 ml RSA
SVO-ZV (ground supplied) water collection	2,3,6	2-5,7-14	MD114	MD114 28 Nov 97	767 ml of water Split: 537 US, 230 ml RSA
humidity condensate collection	4,6	6-14	MD114	MD115 29 Nov 97	702 ml of water Split: 502 ml US, 200 ml RSA
filter reactor condensate collection	5,6	6-14	unscheduled	MD165 18 Jan 98	0.25 ml of water Split: 0.25 ml US, 0 ml RSA
galley-hot water collection	2,3,6	2-5,7-14	MD162	MD167 20 Jan 98	108 ml of water Split: 79 ml US, 29 ml RSA
humidity condensate collection	4,6	6-14	MD162	MD167 20 Jan 98	71 ml of water Split: 49 ml US, 22 ml RSA
surface condensate collection	6	2-5,7-14	unscheduled	MD167 20 Jan 98	81 ml of water Split: 81 ml US, 0 ml RSA
filter reactor condensate collection	5,6	6-14	unscheduled	MD176 29 Jan 98	29 ml of water Split: 29 ml US, 0 ml RSA

TABLE 2. ALLOCATION OF MIR 24/NASA 6/STS-89 SAMPLES

WAFAL ID	**98-0202-01**	**98-0202-03**	**98-0202-04**	**98-0202-06**	**98-0202-07#**
Mission	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Description	Regenerated Water	Regenerated Water	Regenerated Water	Stored Water	Condensate
Sample Location	Galley-Hot	Galley-Hot	Galley-Hot	SVO-ZV	CRS
Sample Date	11/17/97	11/27/97 0:00	1/19/98 0:00	11/27/97	11/17/97
Analysis/Aliquot	ml	ml	ml	ml	ml
pH, conductivity, turbidity	BNA split	BNA split	BNA split	BNA split	BNA split
Alcohols	5	5	2	5	1
Formaldehyde	5	10	5	5	5
Glycols/Nonvolatiles	5	5	5	5	2
Anions, Cations	4	4	4	4	2
Acids, Amines	4	4	2	4	3
Semivolatiles (BNA)	50	250	25	250	14
Metals	25	50	5	50	5
Total Organic Carbon (TOC)	25	125	25	125	10
Volatiles	16	16	6	16	6
Archive	-	116	-	73	-
NASA Total	139	585	79	537	48
Russian Space Agency Total	70	250	29	230	19
Total (mL)	209	835	108	767	67

TABLE 2. ALLOCATION OF MIR 24/NASA 6/STS-89 SAMPLES

WAFAL ID	**98-0202-08**	**98-0202-09**	**98-0202-10**	**98-0202-11#**	**98-0202-16**
Mission	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Description	Condensate	Condensate	Filter reactor Condensate**	Surface Condensate	Filter reactor Condensate**
Sample Location	CRS	CRS	CRS	unknown	CRS
Sample Date	1/19/98	1/28/98	11/28-11/29/97	1/19/98	1/17-1/18/98
Analysis/Aliquot	ml	ml	ml	ml	ml
pH, conductivity, turbidity	BNA split	BNA split	BNA split	BNA split	-
Alcohols	1	1	5	2	-
Formaldehyde	5	2	5	5	-
Glycols/Nonvolatiles	2	2	5	5	0.25##
Anions, Cations	2	2	4	2	-
Acids, Amines	3	3	4	3	-
Semivolatiles (BNA)	15	5	250	20	-
Metals	5	4	50	9	-
Total Organic Carbon (TOC)	10	4	125	10	-
Volatiles	6	6	16	6	-
Archive	-	-	38	19	-
NASA Total	49	29	502	81	0.25##
Russian Space Agency Total	22	0	200	0	-
Total (mL)	71	29	702	81	0.25##

CRS = condensate recovery system
**partially processed humidity condensate
contains solids, centrifugation required
##Essentially empty, recovered 0.25 mL

TABLE 3. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH[1]	5.5-9.0 pH units	5.5-9.0 pH units
Color[2]	15 Pt-Co units	20 degrees
Taste[2]	3 TTN	2 grade
Odor[2]	3 TON	2 grade
Total Dissolved Solids[3]	100-1,000 mg/L	100-1,000 mg/L
Turbidity[2]	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20°C	5% volume @1 ATM, 20°C
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual[4]	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria[2]	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 μg/L	200 μg/L
Total Phenols	1 μg/L	1 μg/L
Total Organic Carbon (TOC)	500 μg/L	25,000 μg/L
Uncharacterized TOC	100 μg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-hot regenerated water 34289 98-0202-01	Mir 24 galley-hot regenerated water 34299 98-0202-03	Mir 24 galley-hot regenerated water 34352 98-0202-04
Conductivity	µS/cm	U.S.			102	48	200
Conductivity	µS/cm	Russia			183	52	NA
pH	pH units	U.S.	5.5-9.0	NASA/RSA	6.72	6.81	7.53
pH	pH units	Russia	5.5-9.0	NASA/RSA	7.2	7.3	NA
Turbidity	NTU	U.S.	1	NASA/RSA	4.29	2.88	4.21
Turbidity	mg/L	Russia	1.5	NASA/RSA	NA	NA	NA
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	15	10	NA
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	0	0	0
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	NA	NA	NA
Total Solids	mg/L	Russia	1.5	NASA/RSA	NA	NA	NA
Total Hardness	meq/L	Russia	7	NASA/RSA	NA	0.6	NA
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	17	12	17
Anions (CE/IC)							
Bromide	mg/L	U.S.			<0.50	<0.50	<0.50
Chloride	mg/L	U.S.	200	NASA/RSA	<0.15	<0.15	11.6
Fluoride	mg/L	U.S.	1.5	NASA/RSA	<0.10	<0.10	0.12
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	<0.11	<0.11	0.18
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			<0.08	<0.08	<0.08
Phosphate	mg/L	U.S.			<0.24	<0.24	<0.24
Sulfate	mg/L	U.S.	250	NASA/RSA	<0.75	<0.75	13.3
Cations (CE/IC)							
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	<0.002	<0.002	<0.002
Calcium	mg/L	U.S.	100	NASA/RSA	17.3	6.83	26.4
Lithium	mg/L	U.S.			<0.002	<0.002	<0.002
Magnesium	mg/L	U.S.	50	NASA/RSA	2.41	0.786	5.97
Potassium	mg/L	U.S.			<0.002	<0.002	1.55
Sodium	mg/L	U.S.			0.219	0.057	3.79
Minerals							
Ammonium (NH4)	mg/L	Russia	2	NASA/RSA	0.2	0.3	NA
Calcium	mg/L	Russia	100	NASA/RSA	NA	NA	NA
Magnesium	mg/L	Russia	50	NASA/RSA	NA	NA	NA

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-hot regenerated water 34289 98-0202-01	Mir 24 galley-hot regenerated water 34299 98-0202-03	Mir 24 galley-hot regenerated water 34352 98-0202-04
Metals							
Calcium	µg/L	U.S.	100000	NASA/RSA	NA	NA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA	NA	NA
Sodium	µg/L	U.S.			NA	NA	NA
Potassium	µg/L	U.S.			NA	NA	NA
Silver	µg/L	U.S.	500	NASA/RSA	83	61.6	236
Silver ion	µg/L	Russia			NA	NA	NA
Aluminum	µg/L	U.S.		NASA	3.4	4.2	15.5
Arsenic	µg/L	U.S.	10	NASA	ND	ND	ND
Barium	µg/L	U.S.	1000	NASA	3.6	1.4	31.6
Cadmium	µg/L	U.S.	5	NASA	ND	ND	ND
Chromium	µg/L	U.S.	100	NASA	ND	ND	ND
Cobalt	µg/L	U.S.		NASA	ND	ND	ND
Copper	µg/L	U.S.	1000	NASA	13.4	10.7	20.7
Iron	µg/L	U.S.	300	NASA	58.3	32.4	99.1
Mercury	µg/L	U.S.	2	NASA	ND	ND	ND
Manganese	µg/L	U.S.	50	NASA	ND	1.3	23.1
Molybdenum	µg/L	U.S.		NASA	ND	ND	ND
Nickel	µg/L	U.S.	100	NASA	8.2	8.9	66.4
Lead	µg/L	U.S.	50	NASA	ND	ND	5.5
Selenium	µg/L	U.S.	10	NASA	ND	ND	ND
Zinc	µg/L	U.S.	5000	NASA	10.4	19.1	117
Palladium	µg/L	U.S.		NASA	NA	NA	NA
Silicon	µg/L	U.S.		NASA	NA	NA	NA
Tungsten	µg/L	U.S.			NA	NA	NA
Total Organic Carbon							
TIC (OI 1010)	mg/L	U.S.			NA	NA	NA
POC (OI 1010)	mg/L	U.S.			NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.			NA	NA	NA
TOC (OI 1010)	mg/L	U.S.	0.5/25	NASA/RSA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.			5.38	4.98	18.9

TABLE 4. REGENERATED WATER RESULTS

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Total Organic Carbon contd.							
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	11.1	3.11	5.79
TOC (Sievers 800)	mg/L	Russia	0.5/25	NASA/RSA	23.2	4.8	22.8
Volatile Organics							
Acetaldehyde	µg/L	U.S.			NA	NA	NA
Acetone	µg/L	U.S.			52	ND	ND
Acryloniltrile	µg/L	U.S.			ND	ND	ND
Allyl chloride	ND	U.S.			ND	ND	ND
Benzene	µg/L	U.S.	5	EPA	ND	ND	ND
Bromobenzene	µg/L	U.S.			ND	ND	ND
Bromochloromethane	µg/L	U.S.	50	EPA DWEL	ND	ND	ND
Bromodichloromethane	µg/L	U.S.	100	EPA	ND	ND	ND
Bromoform	µg/L	U.S.	100	EPA	ND	ND	ND
Bromomethane	µg/L	U.S.	10	EPA HA	ND	ND	ND
2-Butanone	µg/L	U.S.			ND	ND	ND
n-Butylbenzene	µg/L	U.S.			ND	ND	ND
s-Butylbenzene	µg/L	U.S.			ND	ND	ND
t-Butylbenzene	µg/L	U.S.			ND	ND	ND
Carbon disulfide	µg/L	U.S.			<5.00	<5.00	<10.00
Carbon tetrachloride	µg/L	U.S.	5	EPA	ND	ND	ND
Chloroacetonitrile	µg/L	U.S.			ND	ND	ND
Chlorobenzene	µg/L	U.S.	100	EPA	ND	ND	ND
1-Chlorobutane	µg/L	U.S.			ND	ND	ND
Chloroethane	µg/L	U.S.			ND	ND	ND
Chloroform	µg/L	U.S.	100	EPA	ND	ND	37.04
Chloromethane	µg/L	U.S.	3	EPA HA	ND	ND	ND
2-Chlorotoluene	µg/L	U.S.	100	EPA HA	ND	ND	ND
4-Chlorotoluene	µg/L	U.S.	100	EPA HA	ND	ND	ND
Dibromochloromethane	µg/L	U.S.	100	EPA	ND	ND	ND
1,2-Dibromo-3-chloropropane	µg/L	U.S.	0.2	EPA	ND	ND	ND
1,2-Dibromoethane	µg/L	U.S.	0.05	EPA	ND	ND	ND

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Volatile Organics contd.							
Dibromomethane	µg/L	U.S.			ND	ND	ND
1,2-Dichlorobenzene	µg/L	U.S.	600	EPA	ND	ND	ND
1,3-Dichlorobenzene	µg/L	U.S.	600	EPA	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND
trans-1,4-dichloro-2-butene	µg/L	U.S.			ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPA HA	ND	ND	ND
1,1-Dichloroethane	µg/L	U.S.			ND	ND	ND
1,2-Dichloroethane	µg/L	U.S.	5	EPA	ND	ND	ND
1,1-Dichloroethene	µg/L	U.S.	7	EPA	ND	ND	ND
cis1,2-dichloroethene	µg/L	U.S.	70	EPA	ND	ND	ND
trans-1,2-dichloroethene	µg/L	U.S.	100	EPA	ND	ND	ND
1,2-Dichloropropane	µg/L	U.S.	5	EPA	ND	ND	ND
1,3-Dichloropropane	µg/L	U.S.			ND	ND	ND
2,2-Dichloropropane	µg/L	U.S.			ND	ND	ND
1,2-Dichloropropene	µg/L	U.S.			ND	ND	ND
cis-1,3-Dichloropropene	µg/L	U.S.			ND	ND	ND
trans-1,3-Dichloropropene	µg/L	U.S.			ND	ND	ND
Diethyl ether	µg/L	U.S.			ND	ND	ND
Ethylbenzene	µg/L	U.S.			ND	ND	ND
Ethyl methacylate	µg/L	U.S.			ND	ND	ND
Hexachlorobutadiene	µg/L	U.S.			ND	ND	ND
2-Hexanone	µg/L	U.S.			ND	ND	ND
Iodomethane	µg/L	U.S.			ND	ND	ND
Isopropylbenzene	µg/L	U.S.			ND	ND	ND
4-Isopropyltoluene	µg/L	U.S.			ND	ND	ND
Linolool	µg/L	U.S.			NA	NA	NA
Methacrylonitrile	µg/L	U.S.			ND	ND	ND
Methylacrylate	µg/L	U.S.			ND	ND	ND
Methyl-t-butylether	µg/L	U.S.	20	EPA HA	ND	ND	ND
Methylene chloride	µg/L	U.S.	5	EPA	ND	ND	ND

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Volatile Organics contd.							
Methylmethacrylate	µg/L	U.S.			ND	ND	ND
4-Methyl-2-pentanone	µg/L	U.S.			ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.			NA	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			NA	ND	ND
Tetrahydrofuran	µg/L	U.S.			ND	ND	ND
Toluene	µg/L	U.S.			ND	ND	ND
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND
o-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	<1.00	ND	ND
Acetophenone	µg/L	U.S.			ND	ND	ND
2-Aminonaphthalene	µg/L	U.S.			ND	ND	ND
Aniline	µg/L	U.S.			ND	ND	ND
Azobenzene	µg/L	U.S.			ND	ND	ND
2,2′-Azobis-isobutyronitrile	µg/L	U.S.			ND	ND	ND
Benzaldehyde	µg/L	U.S.			ND	ND	ND
Benzoic acid	µg/L	U.S.			ND	ND	ND
Benzothiazole	µg/L	U.S.			ND	<4	ND
Benzyl alcohol	µg/L	U.S.			ND	5	ND
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	ND	ND	ND
2-Butoxyethanol	µg/L	U.S.			ND	ND	ND
2-(2-Butoxyethoxy)ethanol	µg/L	U.S.			ND	ND	ND
2-(2-Butoxyethoxy)ethyl acetate	µg/L	U.S.			ND	ND	ND
n-Butylpalmitate	µg/L	U.S.			ND	<8	ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND	ND	ND
N-Butylbenzenesulfonamide	µg/L	U.S.			ND	ND	ND
3-tert-Butylphenol	µg/L	U.S.			ND	ND	ND
Caffeine	µg/L	U.S.			ND	ND	ND
Caprolactam	µg/L	U.S.			ND	ND	ND
tris-2-Chloroethyl phosphate	µg/L	U.S.			ND	ND	ND
Cyclododecane	µg/L	U.S.			ND	ND	ND
Cyclohexanone	µg/L	U.S.			ND	ND	ND

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Extractable Organics contd.							
Decamethylcyclopentasiloxane	µg/L	U.S.			ND	ND	ND
1,4 Diacetylbenzene	µg/L	U.S.			ND	ND	ND
1,3- Dichlorobenzene	µg/L	U.S.	600	EPA	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND
Di-n-butylamine	µg/L	U.S.			ND	ND	ND
Diallyl Phthalate	µg/L	U.S.			ND	ND	ND
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	ND	ND	ND
N,N-Dibutylformamide	µg/L	U.S.			ND	ND	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			ND	ND	ND
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			ND	ND	ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			ND	ND	ND
2,4-Di-t-butylphenol	µg/L	U.S.			ND	ND	ND
Dicyclohexyl	µg/L	U.S.			ND	ND	ND
N,N-Diethylformamide	µg/L	U.S.			ND	ND	ND
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND	ND	ND
Diethylene glycol di-n-butyl ether	µg/L	U.S.			ND	ND	ND
Diethylene glycol monoethyl ether	µg/L	U.S.			ND	ND	ND
Diethyl phthalate	µg/L	U.S.	5000	EPA HA	ND	ND	ND
Diisopropyl Adipate	µg/L	U.S.			ND	ND	ND
N,N-Dimethylacetamide	µg/L	U.S.			ND	ND	ND
N,N-Dimethylbenzylamine	µg/L	U.S.			ND	ND	ND
Dimethylcarbamyl chloride	µg/L	U.S.			ND	ND	ND
N,N-Dimethylformamide	µg/L	U.S.			ND	ND	ND
Dimethyl phthalate	µg/L	U.S.			ND	ND	ND
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND	ND	ND
Dipropylene glycol methyl ether	µg/L	U.S.			ND	ND	ND
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND	ND	ND
Dodecanoic acid	µg/L	U.S.			ND	ND	ND
Eicosane	µg/L	U.S.			ND	ND	ND
2-Ethoxyethanol	µg/L	U.S.			ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-hot regenerated water 34289 98-0202-01	Mir 24 galley-hot regenerated water 34299 98-0202-03	Mir 24 galley-hot regenerated water 34352 98-0202-04
Extractable Organics contd.							
2-Ethylhexanoic acid	µg/L	U.S.			ND	ND	ND
2-Ethyl-1-hexanol	µg/L	U.S.			ND	6.7	ND
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	ND	ND	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	6	EPA HA	ND	ND	ND
4-Ethylmorpholine	µg/L	U.S.			ND	ND	ND
4-Ethylphenol	µg/L	U.S.			ND	ND	ND
1-Formylpiperidine	µg/L	U.S.			ND	ND	ND
Heneicosane	µg/L	U.S.			ND	ND	ND
2-Heptanone	µg/L	U.S.			ND	ND	ND
Hexanoic acid	µg/L	U.S.			ND	ND	ND
2-Hexanol	µg/L	U.S.			ND	ND	ND
Hexanamide	µg/L	U.S.			ND	ND	ND
Hydrocinnamic acid	µg/L	U.S.			ND	ND	ND
2-Hydroxybenzothiazole	µg/L	U.S.			ND	ND	ND
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND	ND	ND
Indole	µg/L	U.S.			ND	ND	ND
Isophorone	µg/L	U.S.	100	EPA HA	ND	ND	ND
Isophorone	µg/L	U.S.			ND	ND	ND
Limonene	µg/L	U.S.			ND	ND	ND
Menthol	µg/L	U.S.			ND	ND	ND
Menthone	µg/L	U.S.			ND	ND	ND
2-Mercaptobenzothiazole	µg/L	U.S.			ND	ND	ND
2,2′-Methylenebis (6-t-butyl-4-ethylphenol)	µg/L	U.S.			ND	ND	ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND	ND	ND
Methyl-4-hydroxybenzoate	µg/L	U.S.			ND	ND	ND
3-Methylindole	µg/L	U.S.			ND	ND	ND
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND	ND	ND
2-Methylphenol	µg/L	U.S.			ND	ND	ND
4-Methylphenol	µg/L	U.S.			ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-hot regenerated water 34289 98-0202-01	Mir 24 galley-hot regenerated water 34299 98-0202-03	Mir 24 galley-hot regenerated water 34352 98-0202-04
Extractable Organics contd.							
2-Methylpyrazine	µg/L	U.S.			ND	ND	ND
1-Methyl-2-pyrrolidinone	µg/L	U.S.			ND	ND	ND
Methyl sulfone	µg/L	U.S.			ND	ND	ND
2-Methylthiobenzothiazole	µg/L	U.S.			ND	<4	ND
Monomethyl phthalate	µg/L	U.S.			ND	ND	ND
Neomenthol	µg/L	U.S.			ND	ND	ND
Nicotine	µg/L	U.S.			ND	ND	ND
Nonadecane	µg/L	U.S.			ND	ND	ND
Octadecanol	µg/L	U.S.			ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L	U.S.			ND	ND	ND
Octanoic Acid	µg/L	U.S.			ND	ND	ND
4-t-Octylphenol	µg/L	U.S.			ND	ND	ND
Oxindole	µg/L	U.S.			ND	ND	ND
Pentacosane	µg/L	U.S.			ND	<4	ND
s-Phenethyl alcohol	µg/L	U.S.			ND	ND	ND
Phenol	µg/L	U.S.	1/4000	NASA/ EPA HA	ND	ND	ND
bis-Phenol A	µg/L	U.S.			ND	ND	ND
Phenoxyacetic acid	µg/L	U.S.			ND	ND	ND
2-Phenoxyethanol	µg/L	U.S.			ND	ND	ND
N-Phenyl-2-naphthylamine	µg/L	U.S.			ND	ND	ND
2-Phenylacetic Acid	µg/L	U.S.			ND	ND	ND
Phenylethyl alcohol	µg/L	U.S.			ND	ND	ND
2-Phenylphenol	µg/L	U.S.			ND	ND	ND
2-Phenyl-2-propanol	µg/L	U.S.			ND	ND	ND
Phenyl sulfone	µg/L	U.S.			ND	ND	ND
Phthalide	µg/L	U.S.			ND	ND	ND
Salicyclic Acid	µg/L	U.S.			ND	ND	ND
Squalene	µg/L	U.S.			ND	ND	ND
1-alpha-Terpineol	µg/L	U.S.			ND	ND	ND
1-Tetradecanol	µg/L	U.S.			ND	ND	ND
Tetramethylsuccinonitrile	µg/L	U.S.			ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-hot regenerated water 34289 98-0202-01	Mir 24 galley-hot regenerated water 34299 98-0202-03	Mir 24 galley-hot regenerated water 34352 98-0202-04
Extractable Organics contd.							
Tetramethylthiourea	µg/L	U.S.			ND	ND	ND
Tetramethylurea	µg/L	U.S.			ND	ND	ND
Thymol	µg/L	U.S.			ND	ND	ND
o-Toluic acid	µg/L	U.S.			ND	ND	ND
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.			ND	ND	ND
Tricosane	µg/L	U.S.			ND	ND	ND
Tributyl Phosphate	µg/L	U.S.			ND	ND	ND
Triethyl Phosphate	µg/L	U.S.			ND	ND	ND
Triethylamine	µg/L	U.S.			ND	ND	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			ND	<8	ND
Undecanoic Acid	µg/L	U.S.			ND	ND	ND
2-Undecanone	µg/L	U.S.			ND	ND	ND
Urethane	µg/L	U.S.			ND	ND	ND
Vanillin	µg/L	U.S.			ND	ND	ND
Alcohols (DAI/GC/MS)							
Ethanol	µg/L	U.S.			1129	ND	ND
Methanol	µg/L	U.S.			ND	ND	ND
1-Methoxy-2-propanol	µg/L	U.S.			ND	ND	ND
2-Methyl-2-butanol	µg/L	U.S.			ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.			ND	ND	ND
2-Propanol	µg/L	U.S.			ND	ND	ND
Alcohols/Acetone							
Acetone	µg/L	Russia			ND	ND	ND
Butanol	µg/L	Russia			ND	ND	ND
Ethanol	µg/L	Russia			ND	ND	ND
Isoamyl alcohol	µg/L	Russia			ND	ND	ND
Methanol	µg/L	Russia			ND	ND	ND
Propanol	µg/L	Russia			ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 galley-hot regenerated water 34289 98-0202-01	Mir 24 galley-hot regenerated water 34299 98-0202-03	Mir 24 galley-hot regenerated water 34352 98-0202-04
Glycols (DAI/GC/MS)							
1,2-Ethanediol	µg/L	U.S.	7000	EPA HA	ND	ND	ND
1,2-Propanediol	µg/L	U.S.			ND	ND	ND
Glycols							
1,2-Ethanediol	µg/L	Russia	7000	EPA HA	ND	ND	ND
1,2-Propanediol	µg/L	Russia			NA	NA	NA
Organic Acids (SPE/GC/MS)							
Acetic acid	µg/L	U.S.			NA	NA	NA
Acetic acid	µg/L	Russia			ND	ND	ND
Lactic acid	µg/L	U.S.			NA	NA	NA
Propionic acid	µg/L	U.S.			NA	NA	NA
Aldehydes							
Acetaldehyde	µg/L	U.S.			NA	NA	NA
Formaldehyde	µg/L	U.S.	1000	EPA HA	2.3	<2	<2
Carboxylates (CE)							
Acetate	mg/L	U.S.			<0.12	<0.12	<0.12
Butyrate	mg/L	U.S.			NA	NA	NA
Formate	mg/L	U.S.			26.8	5.3	<0.12
Glycolate	mg/L	U.S.			<0.12	<0.12	<0.12
Glyoxylate	mg/L	U.S.			<0.12	<0.12	<0.12
Lactate	mg/L	U.S.			0.45	<0.12	<0.12
Propionate	mg/L	U.S.			<0.12	<0.12	<0.12
Oxalate	mg/L	U.S.			<0.12	<0.12	<0.12
Amines (CE)							
Ethylamine	mg/L	U.S.			<0.12	<0.12	<0.12
Methylamine	mg/L	U.S.			<0.12	<0.12	<0.12
Propylamine	mg/L	U.S.			<0.12	<0.12	<0.12
Trimethylamine	mg/L	U.S.			<0.12	<0.12	<0.12
Urea	mg/L	U.S.			ND	ND	ND
Organic Carbon Recovery	percent	U.S.			70.25	44.98	0.07

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Conductivity	µS/cm	U.S.			195
Conductivity	µS/cm	Russia			175
pH	pH units	U.S.	5.5-9.0	NASA/RSA	7.16
pH	pH units	Russia	5.5-9.0	NASA/RSA	7.3
Turbidity	NTU	U.S.	1	NASA/RSA	1.66
Turbidity	mg/L	Russia	1.5	NASA/RSA	0.0
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	10
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	0
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	NA
Total Solids	mg/L	Russia	1.5	NASA/RSA	NA
Total Hardness	meq/L	Russia	7	NASA/RSA	1.9
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	25
Anions (CE/IC)					
Bromide	mg/L	U.S.			<0.50
Chloride	mg/L	U.S.	200	NASA/RSA	<0.15
Fluoride	mg/L	U.S.	1.5	NASA/RSA	0.26
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	<0.11
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			<0.08
Phosphate	mg/L	U.S.			<0.24
Sulfate	mg/L	U.S.	250	NASA/RSA	<0.75
Cations (CE/IC)					
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	<0.002
Calcium	mg/L	U.S.	100	NASA/RSA	28.7
Lithium	mg/L	U.S.			<0.002
Magnesium	mg/L	U.S.	50	NASA/RSA	5.05
Potassium	mg/L	U.S.			<0.002
Sodium	mg/L	U.S.			0.51
Minerals					
Ammonium (NH4)	mg/L	Russia	2	NASA/RSA	0.2
Calcium	mg/L	Russia	100	NASA/RSA	NA
Magnesium	mg/L	Russia	50	NASA/RSA	NA

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Metals					
Calcium	µg/L	U.S.	100000	NASA/RSA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA
Sodium	µg/L	U.S.			NA
Potassium	µg/L	U.S.			NA
Silver	µg/L	U.S.	500	NASA/RSA	330
Silver ion	µg/L	Russia			NA
Aluminum	µg/L	U.S.		NASA	1.5
Arsenic	µg/L	U.S.	10	NASA	ND
Barium	µg/L	U.S.	1000	NASA	6.2
Cadmium	µg/L	U.S.	5	NASA	5.6
Chromium	µg/L	U.S.	100	NASA	ND
Cobalt	µg/L	U.S.		NASA	ND
Copper	µg/L	U.S.	1000	NASA	ND
Iron	µg/L	U.S.	300	NASA	103.0
Mercury	µg/L	U.S.	2	NASA	ND
Manganese	µg/L	U.S.	50	NASA	ND
Molybdenum	µg/L	U.S.		NASA	ND
Nickel	µg/L	U.S.	100	NASA	1.2
Lead	µg/L	U.S.	50	NASA	ND
Selenium	µg/L	U.S.	10	NASA	ND
Zinc	µg/L	U.S.	5000	NASA	29.4
Palladium	µg/L	U.S.		NASA	NA
Silicon	µg/L	U.S.		NASA	NA
Tungsten	µg/L	U.S.			NA
Total Organic Carbon					
TIC (OI 1010)	mg/L	U.S.			NA
POC (OI 1010)	mg/L	U.S.			NA
NPOC (OI 1010)	mg/L	U.S.			NA
TOC (OI 1010)	mg/L	U.S.	0.5/25	NASA/RSA	NA
TIC (Sievers 800)	mg/L	U.S.			9.67
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	20.0
TOC (Sievers 800)	mg/L	Russia	0.5/25	NASA/RSA	19.9

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Volatile Organics					
Acetaldehyde	µg/L	U.S.			NA
Acetone	µg/L	U.S.			230.22
Acryloniltrile	µg/L	U.S.			ND
Allyl chloride	ND	U.S.			ND
Benzene	µg/L	U.S.	5.0	EPA	ND
Bromobenzene	µg/L	U.S.			ND
Bromochloromethane	µg/L	U.S.	50.0	EPA DWEL	ND
Bromodichloromethane	µg/L	U.S.	100	EPA	ND
Bromoform	µg/L	U.S.	100	EPA	ND
Bromomethane	µg/L	U.S.	10	EPA HA	ND
2-Butanone	µg/L	U.S.			ND
n-Butylbenzene	µg/L	U.S.			ND
s-Butylbenzene	µg/L	U.S.			ND
t-Butylbenzene	µg/L	U.S.			ND
Carbon disulfide	µg/L	U.S.			<5.00
Carbon tetrachloride	µg/L	U.S.	5	EPA	ND
Chloroacetonitrile	µg/L	U.S.			ND
Chlorobenzene	µg/L	U.S.	100	EPA	ND
1-Chlorobutane	µg/L	U.S.			ND
Chloroethane	µg/L	U.S.			ND
Chloroform	µg/L	U.S.	100	EPA	ND
Chloromethane	µg/L	U.S.	3	EPA HA	ND
2-Chlorotoluene	µg/L	U.S.	100	EPA HA	ND
4-Chlorotoluene	µg/L	U.S.	100	EPA HA	ND
Dibromochloromethane	µg/L	U.S.	100	EPA	ND
1,2-Dibromo-3-chloropropane	µg/L	U.S.	0.2	EPA	ND
1,2-Dibromoethane	µg/L	U.S.	0.05	EPA	ND
Dibromomethane	µg/L	U.S.			ND
1,2-Dichlorobenzene	µg/L	U.S.	600	EPA	ND
1,3-Dichlorobenzene	µg/L	U.S.	600	EPA	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Volatile Organics contd.					
trans-1,4-dichloro-2-butene	µg/L	U.S.			ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPA HA	ND
1,1-Dichloroethane	µg/L	U.S.			ND
1,2-Dichloroethane	µg/L	U.S.	5	EPA	ND
1,1-Dichloroethene	µg/L	U.S.	7	EPA	ND
cis1,2-dichloroethene	µg/L	U.S.	70	EPA	ND
trans-1,2-dichloroethene	µg/L	U.S.	100	EPA	ND
1,2-Dichloropropane	µg/L	U.S.	5	EPA	ND
1,3-Dichloropropane	µg/L	U.S.			ND
2,2-Dichloropropane	µg/L	U.S.			ND
1,2-Dichloropropene	µg/L	U.S.			ND
cis-1,3-Dichloropropene	µg/L	U.S.			ND
trans-1,3-Dichloropropene	µg/L	U.S.			ND
Diethyl ether	µg/L	U.S.			ND
Ethylbenzene	µg/L	U.S.			ND
Ethyl methacylate	µg/L	U.S.			ND
Hexachlorobutadiene	µg/L	U.S.			ND
2-Hexanone	µg/L	U.S.			ND
Iodomethane	µg/L	U.S.			ND
Isopropylbenzene	µg/L	U.S.			ND
4-Isopropyltoluene	µg/L	U.S.			ND
Linolool	µg/L	U.S.			ND
Methacrylonitrile	µg/L	U.S.			ND
Methylacrylate	µg/L	U.S.			ND
Methyl-t-butylether	µg/L	U.S.	20	EPA HA	ND
Methylene chloride	µg/L	U.S.	5	EPA	ND
Methylmethacrylate	µg/L	U.S.			ND
4-Methyl-2-pentanone	µg/L	U.S.			ND
alpha-Methyl styrene	µg/L	U.S.			ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND
Tetrahydrofuran	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Volatile Organics contd.					
Toluene	µg/L	U.S.			<1.00
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND
o-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND
Extractable Organics					
Acetophenone	µg/L	U.S.			ND
2-Aminonaphthalene	µg/L	U.S.			ND
Aniline	µg/L	U.S.			ND
Azobenzene	µg/L	U.S.			ND
2,2′-Azobis-isobutyronitrile	µg/L	U.S.			ND
Benzaldehyde	µg/L	U.S.			4.9
Benzoic acid	µg/L	U.S.			ND
Benzothiazole	µg/L	U.S.			ND
Benzyl alcohol	µg/L	U.S.			43.5
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	<4
2-Butoxyethanol	µg/L	U.S.			ND
2-(2-Butoxyethoxy)ethanol	µg/L	U.S.			ND
2-(2-Butoxyethoxy)ethyl acetate	µg/L	U.S.			ND
n-Butylpalmitate	µg/L	U.S.			ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND
N-Butylbenzenesulfonamide	µg/L	U.S.			<4
3-tert-Butylphenol	µg/L	U.S.			<12
Caffeine	µg/L	U.S.			ND
Caprolactam	µg/L	U.S.			117.5
tris-2-Chloroethyl phosphate	µg/L	U.S.			<4
Cyclododecane	µg/L	U.S.			ND
Cyclohexanone	µg/L	U.S.			ND
Decamethylcyclopentasiloxane	µg/L	U.S.			ND
1,4 Diacetylbenzene	µg/L	U.S.			ND
1,3-Dichlorobenzene	µg/L	U.S.	600	EPA	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND
Di-n-butylamine	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Extractable Organics contd.					
Diallyl Phthalate	µg/L	U.S.			ND
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	<4
N,N-Dibutylformamide	µg/L	U.S.			ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			ND
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			ND
2,4-Di-t-butylphenol	µg/L	U.S.			ND
Dicyclohexyl	µg/L	U.S.			ND
N,N-Diethylformamide	µg/L	U.S.			ND
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND
Diethylene glycol di-n-butyl ether	µg/L	U.S.			ND
Diethylene glycol monoethyl ether	µg/L	U.S.			ND
Diethyl phthalate	µg/L	U.S.	5000	EPA HA	6.6
Diisopropyl Adipate	µg/L	U.S.			ND
N,N-Dimethylacetamide	µg/L	U.S.			ND
N,N-Dimethylbenzylamine	µg/L	U.S.			ND
Dimethylcarbamyl chloride	µg/L	U.S.			ND
N,N-Dimethylformamide	µg/L	U.S.			ND
Dimethyl phthalate	µg/L	U.S.			<4
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND
Dipropylene glycol methyl ether	µg/L	U.S.			ND
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND
Dodecanoic acid	µg/L	U.S.			<120
Eicosane	µg/L	U.S.			ND
2-Ethoxyethanol	µg/L	U.S.			ND
2-Ethylhexanoic acid	µg/L	U.S.			ND
2-Ethyl-1-hexanol	µg/L	U.S.			20.2
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	6	EPA HA	ND
4-Ethylmorpholine	µg/L	U.S.			ND
4-Ethylphenol	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Extractable Organics contd.					
1-Formylpiperidine	µg/L	U.S.			ND
Heneicosane	µg/L	U.S.			ND
2-Heptanone	µg/L	U.S.			ND
Hexanoic acid	µg/L	U.S.			ND
2-Hexanol	µg/L	U.S.			ND
Hexanamide	µg/L	U.S.			ND
Hydrocinnamic acid	µg/L	U.S.			<8
2-Hydroxybenzothiazole	µg/L	U.S.			ND
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND
Indole	µg/L	U.S.			ND
Isophorone	µg/L	U.S.	100	EPA HA	ND
Isophorone	µg/L	U.S.			ND
Limonene	µg/L	U.S.			ND
Menthol	µg/L	U.S.			ND
Menthone	µg/L	U.S.			ND
2-Mercaptobenzothiazole	µg/L	U.S.			ND
2,2′-Methylenebis(6-t-butyl-4-ethylphenol)	µg/L	U.S.			ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND
Methyl-4-hydroxybenzoate	µg/L	U.S.			ND
3-Methylindole	µg/L	U.S.			ND
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND
2-Methylphenol	µg/L	U.S.			<4
4-Methylphenol	µg/L	U.S.			ND
2-Methylpyrazine	µg/L	U.S.			ND
1-Methyl-2-pyrrolidinone	µg/L	U.S.			ND
Methyl sulfone	µg/L	U.S.			ND
2-Methylthiobenzothiazole	µg/L	U.S.			ND
Monomethyl phthalate	µg/L	U.S.			ND
Neomenthol	µg/L	U.S.			ND
Nicotine	µg/L	U.S.			ND
Nonadecane	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Extractable Organics contd.					
Octadecanol	µg/L	U.S.			ND
Octamethylcyclotetrasiloxane	µg/L	U.S.			ND
Octanoic Acid	µg/L	U.S.			ND
4-t-Octylphenol	µg/L	U.S.			ND
Oxindole	µg/L	U.S.			ND
Pentacosane	µg/L	U.S.			ND
s-Phenethyl alcohol	µg/L	U.S.			ND
Phenol	µg/L	U.S.	1/4000	NASA/ EPA HA	12.8
bis-Phenol A	µg/L	U.S.			ND
Phenoxyacetic acid	µg/L	U.S.			ND
2-Phenoxyethanol	µg/L	U.S.			ND
N-Phenyl-2-naphthylamine	µg/L	U.S.			ND
2-Phenylacetic Acid	µg/L	U.S.			ND
Phenylethyl alcohol	µg/L	U.S.			ND
2-Phenylphenol	µg/L	U.S.			ND
2-Phenyl-2-propanol	µg/L	U.S.			<4
Phenyl sulfone	µg/L	U.S.			ND
Phthalide	µg/L	U.S.			ND
Salicyclic Acid	µg/L	U.S.			ND
Squalene	µg/L	U.S.			ND
1-alpha-Terpineol	µg/L	U.S.			ND
1-Tetradecanol	µg/L	U.S.			ND
Tetramethylsuccinonitrile	µg/L	U.S.			<4
Tetramethylthiourea	µg/L	U.S.			ND
Tetramethylurea	µg/L	U.S.			ND
Thymol	µg/L	U.S.			<4
o-Toluic acid	µg/L	U.S.			ND
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.			ND
Tricosane	µg/L	U.S.			ND
Tributyl Phosphate	µg/L	U.S.			ND
Triethyl Phosphate	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Extractable Organics contd.					
Triethylamine	µg/L	U.S.			ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			<8
Undecanoic Acid	µg/L	U.S.			ND
2-Undecanone	µg/L	U.S.			ND
Urethane	µg/L	U.S.			ND
Vanillin	µg/L	U.S.			ND
Alcohols (DAI/GC/MS)					
Ethanol	µg/L	U.S.			6662
Methanol	µg/L	U.S.			ND
1-Methoxy-2-propanol	µg/L	U.S.			ND
2-Methyl-2-butanol	µg/L	U.S.			ND
2-Methyl-2-propanol	µg/L	U.S.			ND
2-Propanol	µg/L	U.S.			ND
Alcohols/Acetone					
Acetone	µg/L	Russia			ND
Butanol	µg/L	Russia			NA
Ethanol	µg/L	Russia			ND
Isoamyl alcohol	µg/L	Russia			ND
Methanol	µg/L	Russia			ND
Propanol	µg/L	Russia			ND
Glycols (DAI/GC/MS)					
1,2-Ethanediol	µg/L	U.S.	7000	EPA HA	ND
1,2-Propanediol	µg/L	U.S.			ND
Glycols					
1,2-Ethanediol	µg/L	Russia	7000	EPA HA	1500
1,2-Propanediol	µg/L	Russia			NA
Organic Acids (SPE/GC/MS)					
Acetic acid	µg/L	U.S.			NA
Acetic acid	µg/L	Russia			15400
Lactic acid	µg/L	U.S.			NA
Propionic acid	µg/L	U.S.			NA

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 24 SVO-ZV stored water 11/27/97 98-0202-06
Aldehydes					
Acetaldehyde	µg/L	U.S.			NA
Formaldehyde	µg/L	U.S.	1000	EPA HA	<2
Carboxylates (CE)					
Acetate	mg/L	U.S.			0.19
Butyrate	mg/L	U.S.			NA
Formate	mg/L	U.S.			61.7
Glycolate	mg/L	U.S.			<0.12
Glyoxylate	mg/L	U.S.			<0.12
Lactate	mg/L	U.S.			<0.12
Propionate	mg/L	U.S.			<0.12
Oxalate	mg/L	U.S.			<0.12
Amines (CE)					
Ethylamine	mg/L	U.S.			<0.12
Methylamine	mg/L	U.S.			<0.12
Propylamine	mg/L	U.S.			<0.12
Trimethylamine	mg/L	U.S.			<0.12
Urea	mg/L	U.S.			ND
Organic Carbon Recovery	percent	U.S.			100.07

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Conductivity	µS/cm	U.S.	370	280	330	200	NA	310
Conductivity	µS/cm	Russia	NA	260	pending	180	NA	pending
pH	pH units	U.S.	6.19	7.66	7.67	5.55	NA	7.63
pH	pH units	Russia	NA	NA	pending	6.0	NA	pending
Turbidity	NTU	U.S.	NA	NA	NA	7.5	NA	NA
Turbidity	mg/L	Russia	NA	0.12	NA	0.2	NA	NA
Color True	degrees	Russia	NA	NA	pending	10	NA	pending
Odor at 20°C	grade	Russia	1	1	pending	2	NA	pending
Taste at 20°C	grade	Russia	NA	NA	pending	NA	NA	pending
Total Solids	mg/L	Russia	NA	NA	pending	NA	NA	pending
Total Hardness	meq/L	Russia	NA	NA	pending	1.9	NA	pending
Chemical Oxygen Demand	mg O_2/L	Russia	155	700	pending	55	NA	pending
Anions (CE/IC)								
Bromide	mg/L	U.S.	<0.50	<0.50	<0.50	<0.05	NA	0.52
Chloride	mg/L	U.S.	5.43	<0.15	<0.15	0.44	NA	3.07
Fluoride	mg/L	U.S.	0.20	<0.10	<0.10	<0.10	NA	0.14
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	<0.08	<0.11	0.22	<0.11	NA	< 0.11
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.	0.27	<0.08	<0.08	<0.08	NA	< 0.08
Phosphate	mg/L	U.S.	<0.24	0.25	<0.24	<0.24	NA	<0.24
Sulfate	mg/L	U.S.	4.60	<0.75	7.10	<0.75	NA	2.10
Cations (CE/IC)								
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	34.1	34.3	31.2	24.8	NA	35.4
Calcium	mg/L	U.S.	0.728	0.06	6.11	<0.002	NA	0.775
Lithium	mg/L	U.S.	<0.002	<0.002	<0.002	<0.002	NA	<0.002
Magnesium	mg/L	U.S.	6.57	0.397	1.39	0.149	NA	0.861
Potassium	mg/L	U.S.	0.651	<0.002	0.225	<0.002	NA	2.26
Sodium	mg/L	U.S.	7.77	0.619	1.54	0.328	NA	2.09
Minerals								
Ammonium (NH4)	mg/L	Russia	NA	61	pending	42	NA	pending
Calcium	mg/L	Russia	NA	NA	pending	NA	NA	pending
Magnesium	mg/L	Russia	NA	NA	pending	NA	NA	pending

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Metals								
Calcium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Sodium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Potassium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Silver	µg/L	U.S.	<20	<20	<20	53.7	NA	<20
Silver ion	µg/L	Russia	0	0	pending	0	NA	pending
Aluminum	µg/L	U.S.	90.1	61.8	<20	7.4	NA	667
Arsenic	µg/L	U.S.	<10	<10	<10	<1	NA	<10
Barium	µg/L	U.S.	34.4	23.0	43.2	1.2	NA	19.8
Cadmium	µg/L	U.S.	30.3	14.2	<10	<1	NA	157.0
Chromium	µg/L	U.S.	<50	<50	77.4	<5	NA	<50
Cobalt	µg/L	U.S.	<10	<10	<10	<1	NA	<10
Copper	µg/L	U.S.	<10	21.6	30.0	1.6	NA	35.8
Iron	µg/L	U.S.	70.9	60.2	160	<5	NA	2180
Mercury	µg/L	U.S.	<2.5	<2.5	4.53	<0.5	NA	<2.5
Manganese	µg/L	U.S.	86.7	<10	15.5	1.0	NA	86.5
Molybdenum	µg/L	U.S.	11.6	<10	20.6	2.5	NA	135
Nickel	µg/L	U.S.	95.9	135	52.3	4010	NA	38.8
Lead	µg/L	U.S.	26.8	29.4	<10	21.3	NA	<10
Selenium	µg/L	U.S.	<10	<10	<10	<1	NA	<10
Zinc	µg/L	U.S.	2760	954	1540	157	NA	120
Palladium	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Silicon	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Tungsten	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Total Organic Carbon								
TIC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA
POC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA
TOC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.	44.4	33.0	35.4	23.7	NA	36.0

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Total Organic Carbon contd.								
TOC (Sievers 800)	mg/L	U.S.	50.5	184.0	192	9.86	NA	136
TOC (Sievers 800)	mg/L	Russia	49	64.8	pending	11.1	NA	pending
Volatile Organics								
Acetaldehyde	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Acetone	µg/L	U.S.	ND	199.61	88.31	56.31	NA	174.30
Acryloniltrile	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Allyl chloride	ND	U.S.	ND	ND	ND	ND	NA	ND
Benzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Bromobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Bromochloromethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Bromodichloromethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Bromoform	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Bromomethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Butanone	µg/L	U.S.	ND	26.44	15.16	ND	NA	ND
n-Butylbenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
s-Butylbenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
t-Butylbenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Carbon disulfide	µg/L	U.S.	544.63	1339.1	2750.9	13.49	NA	ND
Carbon tetrachloride	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Chloroacetonitrile	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Chlorobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1-Chlorobutane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Chloroethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Chloroform	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Chloromethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Chlorotoluene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
4-Chlorotoluene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Dibromochloromethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,2-Dibromo-3-chloropropane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,2-Dibromoethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Volatile Organics contd.								
Dibromomethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,2-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,3-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
trans-1,4-dichloro-2-butene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Dichlorodifluoromethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,1-Dichloroethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,2-Dichloroethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,1-Dichloroethene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
cis1,2-dichloroethene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
trans-1,2-dichloroethene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,2-Dichloropropane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,3-Dichloropropane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2,2-Dichloropropane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,2-Dichloropropene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
cis-1,3-Dichloropropene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
trans-1,3-Dichloropropene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Diethyl ether	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Ethylbenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Ethyl methacylate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Hexachlorobutadiene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Hexanone	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Iodomethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Isopropylbenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
4-Isopropyltoluene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Linolool	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Methacrylonitrile	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Methylacrylate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Methyl-t-butylether	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Methylene chloride	µg/L	U.S.	3.69	ND	ND	1.56	NA	4.43

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Volatile Organics contd.								
Methylmethacrylate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
4-Methyl-2-pentanone	µg/L	U.S.	ND	ND	ND	ND	NA	ND
alpha-Methyl styrene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Tetrahydrofuran	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Toluene	µg/L	U.S.	ND	ND	<2.00	<1.00	NA	ND
m&p-Xylene	µg/L	U.S.	ND	ND	ND	<2.00	NA	ND
o-Xylene	µg/L	U.S.	ND	ND	ND	<1.00	NA	<2.00
Extractable Organics								
Acetophenone	µg/L	U.S.	ND	35.2	ND	<8	NA	ND
2-Aminonaphthalene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Aniline	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Azobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2,2′-Azobis-isobutyronitrile	µg/L	U.S.	41.6	41.5	36.4	<24	NA	52.0
Benzaldehyde	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Benzoic acid	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Benzothiazole	µg/L	U.S.	128.3	90.7	73.3	11	NA	34.9
Benzyl alcohol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Benzyl butyl phthlate	µg/L	U.S.	ND	ND	ND	<4	NA	ND
2-Butoxyethanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-(2-Butoxyethoxy)ethanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-(2-Butoxyethoxy)ethyl acetate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
n-Butylpalmitate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.	ND	ND	ND	<4	NA	ND
N-Butylbenzenesulfonamide	µg/L	U.S.	ND	ND	ND	ND	NA	ND
3-tert-Butylphenol	µg/L	U.S.	246.1	340.5	279	<12	NA	402.4
Caffeine	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Caprolactam	µg/L	U.S.	942.4	17996.7	2921.5	ND	NA	ND
tris-2-Chloroethyl phosphate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Cyclododecane	µg/L	U.S.	ND	ND	ND	ND	NA	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Extractable Organics contd.								
Cyclohexanone	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Decamethylcyclopentasiloxane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,4 Diacetylbenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,3- Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Di-n-butylamine	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Diallyl Phthalate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Di-n-butyl phthalate	µg/L	U.S.	ND	21.1	ND	<4	NA	ND
N,N-Dibutylformamide	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.	ND	ND	ND	ND	NA	ND
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2,4-Di-t-butylphenol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Dicyclohexyl	µg/L	U.S.	4.9	8.8	ND	<4	NA	11.8
N,N-Diethylformamide	µg/L	U.S.	107.3	219.6	ND	<12	NA	81.2
N,N-Diethyl-m-toluamide	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Diethylene glycol di-n-butyl ether	µg/L	U.S.	7.9	<4	ND	ND	NA	9.9
Diethylene glycol monoethyl ether	µg/L	U.S.	90.6	167.3	ND	9.3	NA	44.9
Diethyl phthalate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Diisopropyl Adipate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
N,N-Dimethylacetamide	µg/L	U.S.	ND	4203.1	3293.2	ND	NA	497.9
N,N-Dimethylbenzylamine	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Dimethylcarbamyl chloride	µg/L	U.S.	103	163.5	ND	ND	NA	ND
N,N-Dimethylformamide	µg/L	U.S.	ND	4222.5	ND	ND	NA	ND
Dimethyl phthalate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Dimethylthiocarbamoyl chloride	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Dipropylene glycol methyl ether	µg/L	U.S.	ND	73.0	ND	<4	NA	ND
Dodecamethylcyclohexasiloxane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Dodecanoic acid	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Eicosane	µg/L	U.S.	ND	ND	ND	ND	NA	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Extractable Organics contd.								
2-Ethoxyethanol	µg/L	U.S.	ND	2428.4	ND	ND	NA	ND
2-Ethylhexanoic acid	µg/L	U.S.	88.1	142.9	ND	ND	NA	ND
2-Ethyl-1-hexanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
bis-2-Ethylhexyl adipate	µg/L	U.S.	ND	ND	18674	<4	NA	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	ND	52.5	ND	4.7	NA	76.8
4-Ethylmorpholine	µg/L	U.S.	79.6	81.7	278.2	ND	NA	ND
4-Ethylphenol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1-Formylpiperidine	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Heneicosane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Heptanone	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Hexanoic acid	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Hexanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Hexanamide	µg/L	U.S.	80.9	105.0	ND	<4	NA	67.0
Hydrocinnamic acid	µg/L	U.S.	ND	ND	ND	ND	NA	103.7
2-Hydroxybenzothiazole	µg/L	U.S.	48.6	126.5	ND	<4	NA	ND
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.	ND	159.9	878.5	<4	NA	ND
Indole	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Isophorone	µg/L	U.S.	ND	ND	ND	<4	NA	ND
Isophorone	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Limonene	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Menthol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Menthone	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Mercaptobenzothiazole	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2,2′-Methylenebis (6-t-butyl-4-ethylphenol)	µg/L	U.S.	ND	ND	ND	105.1	NA	ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Methyl-4-hydroxybenzoate	µg/L	U.S.	ND	ND	ND	<4	NA	ND
3-Methylindole	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Methyl-2,4-pentanediol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Methylphenol	µg/L	U.S.	ND	ND	ND	ND	NA	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Extractable Organics contd.								
4-Methylphenol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Methylpyrazine	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1-Methyl-2-pyrrolidinone	µg/L	U.S.	311.4	675.7	276.4	4.0	NA	ND
Methyl sulfone	µg/L	U.S.	39.3	195.1	100	11.6	NA	44.4
2-Methylthiobenzothiazole	µg/L	U.S.	15.2	95.6	82.7	26.3	NA	ND
Monomethyl phthalate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Neomenthol	µg/L	U.S.	ND	ND	ND	<4	NA	ND
Nicotine	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Nonadecane	µg/L	U.S.	ND	ND	ND	<4	NA	ND
Octadecanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Octamethylcyclotetrasiloxane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Octanoic Acid	µg/L	U.S.	ND	ND	ND	ND	NA	ND
4-t-Octylphenol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Oxindole	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Pentacosane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
s-Phenethyl alcohol	µg/L	U.S.	ND	8.6	ND	ND	NA	ND
Phenol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
bis-Phenol A	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Phenoxyacetic acid	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Phenoxyethanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
N-Phenyl-2-naphthylamine	µg/L	U.S.	ND	ND	ND	5.7	NA	ND
2-Phenylacetic Acid	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Phenylethyl alcohol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Phenylphenol	µg/L	U.S.	ND	ND	ND	<4	NA	ND
2-Phenyl-2-propanol	µg/L	U.S.	185.3	183	154.7	<4	NA	158.5
Phenyl sulfone	µg/L	U.S.	ND	19.0	ND	<4	NA	ND
Phthalide	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Salicyclic Acid	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Squalene	µg/L	U.S.	ND	ND	ND	<8	NA	ND
1-alpha-Terpineol	µg/L	U.S.	ND	ND	ND	<4	NA	ND
1-Tetradecanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Extractable Organics contd.								
Tetramethylsuccinonitrile	µg/L	U.S.	44.9	44.9	39.4	6.6	NA	56.1
Tetramethylthiourea	µg/L	U.S.	553.6	472.9	925.9	14.8	NA	30.9
Tetramethylurea	µg/L	U.S.	225.9	370.4	388.5	6.3	NA	139.8
Thymol	µg/L	U.S.	125.4	159.0	151	<4	NA	194.0
o-Toluic acid	µg/L	U.S.	ND	ND	ND	ND	NA	ND
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.	ND	ND	ND	<4	NA	ND
Tricosane	µg/L	U.S.	ND	ND	ND	<4	NA	ND
Tributyl Phosphate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Triethyl Phosphate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Triethylamine	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Undecanoic Acid	µg/L	U.S.	ND	ND	ND	<24	NA	ND
2-Undecanone	µg/L	U.S.	ND	ND	ND	<4	NA	ND
Urethane	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Vanillin	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Alcohols (DAI/GC/MS)								
Ethanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Methanol	µg/L	U.S.	ND	1565	470	ND	NA	ND
1-Methoxy-2-propanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Methyl-2-butanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Methyl-2-propanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
2-Propanol	µg/L	U.S.	ND	ND	ND	ND	NA	ND
Alcohols/Acetone								
Acetone	µg/L	Russia	ND	ND	Pending	ND	NA	Pending
Butanol	µg/L	Russia	ND	ND	Pending	ND	NA	Pending
Ethanol	µg/L	Russia	ND	ND	Pending	ND	NA	Pending
Isoamyl alcohol	µg/L	Russia	ND	ND	Pending	ND	NA	Pending
Methanol	µg/L	Russia	ND	1500	Pending	ND	NA	Pending
Propanol	µg/L	Russia	ND	ND	Pending	ND	NA	Pending

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESULTS

Mission			Mir 24	Mir 24	Mir 24	Mir 24	Mir 24	Mir 24
Sample Location			CRS	CRS	CRS	CRS	CRS	unknown
Sample Description			condensate	condensate	condensate	filter reactor effluent	filter reactor effluent	surface condensate
Sample Date		Test Conducted	11/17/97	1/19/98	1/28/98	11/28-11/29/97	1/17-1/18/97	34352
Analysis/Sample ID	Units	by	98-0202-07	98-0202-08	98-0202-09	98-0202-10	98-0202-16	98-0202-11
Glycols (DAI/GC/MS)								
1,2-Ethanediol	µg/L	U.S.	ND	342500	270000	ND	ND	ND
1,2-Propanediol	µg/L	U.S.	ND	18200	14000	ND	ND	ND
Glycols								
1,2-Ethanediol	µg/L	Russia	ND	35100	pending	1000	NA	pending
1,2-Propanediol	µg/L	Russia	NA	NA	pending	NA	NA	pending
Organic Acids (SPE/GC/MS)								
Acetic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Acetic acid	µg/L	Russia	24500	33500	pending	7500	NA	pending
Lactic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Propionic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Aldehydes								
Acetaldehyde	µg/L	U.S.	NA	NA	NA	NA	NA	NA
Formaldehyde	µg/L	U.S.	24.8	40.7	41.8	5.1	NA	16.2
Carboxylates (CE)								
Acetate	mg/L	U.S.	<2.5	<0.12	<1.25	<0.12	NA	<2.5
Butyrate	mg/L	U.S.	NA	NA	NA	NA	NA	NA
Formate	mg/L	U.S.	<0.12	0.44	<1.25	<0.12	NA	<2.5
Glycolate	mg/L	U.S.	<0.12	4.95	2.43	<0.12	NA	<2.5
Glyoxylate	mg/L	U.S.	<0.12	<0.12	<1.25	<0.12	NA	<2.5
Lactate	mg/L	U.S.	<2.5	0.71	3.11	0.21	NA	<2.5
Propionate	mg/L	U.S.	<2.5	4.71	4.20	<1.25	NA	<2.5
Oxalate	mg/L	U.S.	<0.12	<0.12	<1.25	<0.12	NA	<2.5
Amines (CE)								
Ethylamine	mg/L	U.S.	<0.12	<0.12	<0.12	<0.12	NA	<0.12
Methylamine	mg/L	U.S.	0.53	<0.12	0.12	<0.12	NA	<0.12
Propylamine	mg/L	U.S.	<0.12	<0.12	<0.12	<0.12	NA	<0.12
Trimethylamine	mg/L	U.S.	<0.12	<0.12	<0.12	<0.12	NA	<0.12
Urea	mg/L	U.S.	6.19	ND	2.18	ND	NA	ND
Organic Carbon Recovery	percent	U.S.	7.20	90.17	70.81	3.14	NA	1.06

Analysis of Mir Archival Water Samples

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Russian Principal Investigator: **YURI SINYAK, PH.D.,** Institute of Biomedical Problems

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(NASA 7 Operational Accomplishments Report)

INTRODUCTION

A portion of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the current Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. Additional supplies come from ground supplied potable water that is delivered on a Progress resupply spacecraft, or fuel cell water transferred from the Shuttle. This project is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of reclaimed and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain water of potable quality.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of on board water processors and aid in the development of ISS water processing and monitoring technology.

Compare the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Previous Mission Experience

This experiment has flown under the Human Life Sciences Discipline during the Mir 18/NASA 1, the Mir 19, the Mir 20/STS-74, and the Mir 21/NASA 2/STS-79 missions. In addition, this activity was performed under the Space Medicine Program during the Mir 22/NASA 3/STS-81, the Mir 23/NASA 4/STS-84, the Mir 24/NASA 5/STS-86, and the Mir 24/NASA 6/STS-89 missions.

METHODS/RESEARCH OPERATIONS

Method/Protocol

During inflight water sampling sessions on board Mir, the water experiment kit was unstowed from its storage location. The water experiment kit contained the disinfectant wipes, potable water samplers, waste bags, chemical sample bags, and storage bags needed for water sampling. A prepackaged disinfectant wipe containing 1 ml of benzalkonium chloride in 250 ml of water, was retrieved from the kit and used to disinfect the Mir galley-hot, galley-cold, or SVO-ZV water port. Next, a potable water sampler was connected to the port. A waste bag was then connected to the potable water sampler. Using the waste bag, 50 ml of water was collected and discarded. Next, 700 ml of water was collected into the chemical sample bag. The sample bag was placed in a self sealing storage bag and stowed for return on the Shuttle. These procedures were used to collect galley-hot, galley-cold, and SVO-ZV (ground-supplied) water for postflight chemical analysis for this investigation. Following the collection of the chemical samples, microbiological samples were obtained for a separate experiment. In addition, humidity condensate samples were also collected for this experiment.

Postflight chemical analysis of samples will occur at Johnson Space Center (JSC) and the Institute for Biomedical Problems (IBMP). Following recovery of the samples on the ground, the samples were allocated (See Table 2) for distribution to the water analysis laboratories at JSC and IBMP. Parameters to be tested at JSC include

total carbon (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, nonvolatiles, formaldehyde), and silver. Parameters to be tested by IBMP include conductivity, pH, color, chemical oxygen demand, total solids, calcium, magnesium, total hardness, and silver.

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

One SVO-ZV sample was scheduled to be collected during the mission, but the sample was not received upon the return of STS-91.

Postflight Anomalies

None

Completeness/Quality of Data

Eleven samples were received from the return of STS-91. They are listed in Table 1. Sample analyses are in progress.

DISCUSSION

Status of Data Analysis

Chemical analyses of the recycled water sample is in progress. Analyses completed to date include total organic carbon (TOC), glycols, formaldehyde, and some alcohols and carboxylates. Analyses yet to be completed include trace metals, anions, cations, carboxylates, amines, volatile and semivolatile organics, urea, alcohols, color, taste, odor, total hardness, total solids, chemical oxygen demand (COD), and the identification of unknown compounds.

Research Findings

Preliminary results show that reclaimed water samples collected on 4/9/98, 4/23/98, and 6/7/98 met the Russian Space Agency (RSA) requirement of 25 mg/L, but exceeded the NASA maximum contaminant level of 0.5 mg/L for total organic carbon (TOC) (See Table 2 and Table 3). The TOC for these samples ranged from 7.35 to 7.52 mg/L. No detectable levels of glycols have been observed in these potable water samples. No other parameters analyzed to date exceeded the U.S. EPA or the Joint U.S./Russian specifications. Overall, the results indicate the water is of potable quality, meeting both U.S. EPA and Russian water quality standards.

Conclusions

Initial findings from the analysis of the potable water samples show that the water met all requirements of the Joint U.S./Russian spacecraft water quality standards except the NASA requirement for TOC. Since no organic compounds have been detected at toxicologically significant levels to date, it can be initially concluded that the water is of potable quality.

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TABLE 1. MIR 25/STS-91 SAMPLE ALLOCATION TABLE

WAFAL ID	**98-0615-01**	**98-0615-02**	**98-0615-03**	**98-0615-04**	**98-0615-05**	**98-0615-06**
Mission	Mir24	Mir24	Mir24	Mir25	Mir25	Mir25
Sample Description	Regenerated Water	Regenerated Water	Regenerated Water	Regenerated Water	Stored Water	Humidity Condensate
Sample Location	Galley-Hot	Galley-Hot	Galley-Hot	Galley-Hot	SVO-ZV	CRS
Sample Date	**4/9/98 1140**	**4/23/98 1650**	**5/21/98 1530**	**6/7/1998 1836**	**6/7/98 1733**	**4/28/98**
Analysis/Aliquot	ml	ml	ml	ml	ml	ml
pH, cond, Turb	BNA split	BNA split	BNA split	BNA split	BNA split	BNA split
Alcohols	6	6	6	6	6	3
Formaldehyde	10	10	10	10	10	5
Glycols/Nonvolatiles	5	5	5	5	5	5
Anions, Cations	4	4	4	4	4	4
Acids, Amines	4	4	4	4	4	4
Semivolatiles (BNA)	250	250	100	100	100	25
Metals	50	50	50	50	50	10
TOC	131	129	50	68	68	25
Volatiles	14	14	14	14	14	15
NASA Total	474	472	243	261	261	96
RSA Chemical	267	231	110	124	120	43
RSA Micro	0	0	0	0	0	0
RSA TOTAL	267	231	110	124	120	43
Total (mL)	741	703	353	385	381	139

CRS = condensate recovery system

TABLE 1. MIR 25/STS-91 SAMPLE ALLOCATION TABLE

WAFAL ID	**98-0615-07**	**98-0615-08**	**98-0615-09**	**98-0615-10**	**98-0615-11**
Mission	Mir25	Mir25	Mir25	Mir25	Mir25
Sample Description	Humidity Condensate	Humidity Condensate	Filter Reactor Humidity Condensate	Surface Condensate #	Surface Condensate #
Sample Location	CRS	CRS	CRS	Kvant-2	Kvant-2 Elektron
Sample Date	**5/11/98**	**6/7/98**	**5/11/98**	**5/28/98 1215**	**5/28/98 1220**
Analysis/Aliquot	ml	ml	ml	ml	ml
pH, cond, Turb	BNA split	BNA split	BNA split	BNA split	BNA split
Alcohols	3	3	2	3	3
Formaldehyde	6	6	6	5	5
Glycols/Nonvolatiles	5	6	5	5	3
Anions, Cations	4	4	4	4	4
Acids, Amines	4	4	4	4	4
Semivolatiles (BNA)	26	42	75	25	16
Metals	10	10	10	10	10
TOC	25	25	25	10	10
Volatiles	16	14	14	6	6
NASA Total	99	114	145	72	61
RSA Chemical	38	51	56	0	0
RSA Micro	0	0	0	0	0
RSA TOTAL	38	51	56	0	0
Total (mL)	137	165	201	72	61

CRS = condensate recovery system

TABLE 2. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR INTERNATIONAL SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH[1]	5.5-9.0 pH units	5.5-9.0 pH units
Color[2]	15 Pt-Co units	20 degrees
Taste[2]	3 TTN	2 grade
Odor[2]	3 TON	2 grade
Total Dissolved Solids[3]	100-1,000 mg/L	100-1,000 mg/L
Turbidity[2]	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20°C	5% volume @1 ATM, 20°C
Ammonia (NH3-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl-)	200 mg/L	200 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I-)	15 mg/L	15 mg/L
Iodine-residual[4]	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO3-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria[2]	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 μg/L	200 μg/L
Total Phenols	1 μg/L	1 μg/L
Total Organic Carbon (TOC)	500 μg/L	25,000 μg/L
Uncharacterized TOC	100 μg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

TABLE 3. MIR 25/STS-91 TOC AND ORGANIC ANALYSIS RESULTS SUMMARY

JSC Sample#	Sample Description	TOC (mg/L)	1,2-Ethanediol (mg/L)	1,2-Propanediol (mg/L)	Acetate (mg/L)	Formate (mg/L)	Glycolate (mg/L)	Lactate (mg/L)	Oxalate (mg/L)
98-0615-01	Regenerated Hot Water-Galley 4/9/98 1140	7.52	<1	<0.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
98-0615-02	Regenerated Hot Water-Galley 4/23/98 1650	7.35	<1	<0.5	< 0.12	< 0.12	< 0.12	0.12	< 0.12
98-0615-03	Regenerated Hot Water-Galley 5/21/98 1530	0.312	<1	<0.5	< 0.12	< 0.12	< 0.12	< 0.12	< 0.12
98-0615-04	Regenerated Hot Water-Galley 6/7/98 1836	7.45	<1	<0.5	< 0.25	< 0.12	< 0.25	< 0.25	< 0.12
98-0615-05	Stored Water - SVO-ZV 6/7/98 1733	7.67	<1	<0.5	< 0.25	< 0.12	< 0.25	< 0.25	< 0.12
98-0615-06	Humidity Condensate-CRS 4/28/98	211	275	8.94	< 0.12	< 0.12	< 0.12	< 0.25	< 0.12
98-0615-07	Humidity Condensate-CRS 5/11/98	265	435	9.53	< 0.12	< 0.12	< 0.12	< 0.25	< 0.12
98-0615-08	Humidity Condensate-CRS 6/7/98	372	271	7.25	34.8	< 0.63	5.88	< 2.5	2.96
98-0615-09	Humidity Condensate (after Filter Reactor)-CRS 5/11/98	49.1	43.5	1.83	< 0.63	< 0.63	< 0.63	< 6.25	< 1.25
98-0615-10	Surface Condensate-Kvant-2 5/28/98 1215*	93.9	4.83	0.62	< 1.25	< 2.5	< 1.25	< 1.25	< 1.25
98-0615-11	Surface Condensate-Kvant-2 Elektron 5/28/98 1220*	239	109	6.35	59.8	< 0.25	< 1.25	< 1.25	< 0.25

CRS = condensate recovery system

TABLE 3. MIR 25/STS-91 TOC AND ORGANIC ANALYSIS RESULTS SUMMARY

JSC Sample#	Sample Description	Acetone (mg/L)	1-Butanol (mg/L)	Ethanol (mg/L)	Methanol (mg/L)	2-Methyl-2-Propanol (mg/L)	1-Propanol (mg/L)	2-Propanol (mg/L)	Formaldehyde (mg/L)
98-0615-01	Regenerated Hot Water-Galley 4/9/98 1140	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.003
98-0615-02	Regenerated Hot Water-Galley 4/23/98 1650	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.003
98-0615-03	Regenerated Hot Water-Galley 5/21/98 1530	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.002
98-0615-04	Regenerated Hot Water-Galley 6/7/98 1836	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.003
98-0615-05	Stored Water - SVO-ZV 6/7/98 1733	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.002
98-0615-06	Humidity Condensate-CRS 4/28/98	1.72	0.62	27.1	4.26	< 0.20	< 0.20	11.8	0.021
98-0615-07	Humidity Condensate-CRS 5/11/98	1.00	2.67	70.8	7.35	< 0.10	< 0.10	0.33	0.022
98-0615-08	Humidity Condensate-CRS 6/7/98	5.00	5.47	334	13.9	< 0.10	0.44	1.51	0.027
98-0615-09	Humidity Condensate (after Filter Reactor)-CRS 5/11/98	< 0.20	< 0.20	< 0.20	3.32	< 0.20	< 0.20	< 0.20	0.007
98-0615-10	Surface Condensate-Kvant-2 5/28/98 1215 *	0.16	< 0.10	< 0.10	0.23	0.11	< 0.10	< 0.10	0.023
98-0615-11	Surface Condensate-Kvant-2 Elektron 5/28/98 1220 *	1.57	2.20	167	7.51	< 0.20	< 0.20	< 0.20	0.021

CRS = condensate recovery system

Analysis of Mir Archival Water

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(NASA 7 Preliminary Research Report)

INTRODUCTION

A portion of the potable water supplied to the Russian cosmonauts, American astronauts, and other occupants of the Russian Mir Space Station is produced by the direct recycle of water from humidity condensate. Additional supplies come from ground supplied potable water that is delivered on a Progress resupply spacecraft, or processed fuel cell water transferred from the Shuttle. This project is being conducted to determine the potability of the water supplied on Mir, to assess the reliability of the water reclamation and distribution systems and to aid in developing water quality monitoring standards for International Space Station.

Hypothesis

Detailed analysis of recycled and other Mir supplied potable waters will confirm that the design of the Mir purification and distribution systems are adequate to maintain water of potable quality.

Objectives

Characterize the chemical composition of Mir humidity condensate to support development and testing of the water recycling and monitoring systems for the International Space Station (ISS).

Characterize the chemical composition of the ground-resupply water prior to launch and on orbit.

Characterize the chemical composition of Mir recycled water to evaluate the efficiency of onboard water processors and aid in the development of ISS water processing and monitoring technology.

Determine the chemical composition of Mir and Shuttle humidity condensate.

Provide inflight testing of water collection hardware being developed to collect water samples on ISS.

Background/History

Historically, water provided for crew consumption during U.S. space missions has either been launched from the ground or produced as a byproduct of fuel cell operation. Reclamation and purification of spacecraft wastewaters, as practiced on the Russian Space Station Mir, will be required for supplying crewmembers of the International Space Station with potable and hygiene water.

This experiment has flown under the Human Life Sciences Discipline during the Mir 18/NASA 1, Mir 19, Mir 20/STS-74, and Mir 21/NASA 2/STS-79 missions. In addition, this activity was performed under the Space Medicine Program during the Mir 22/NASA 3/STS-81, Mir 23/NASA 4/STS-84, Mir 24/NASA 5/STS-86, and Mir 25/NASA 6/STS-89 missions.

METHODS/RESEARCH OPERATIONS

Method/Protocol

Protocol

During inflight water sampling sessions on board Mir, the water experiment kit was unstowed from its storage location. The water experiment kit contained the disinfectant wipes, potable water samplers, waste bags, chemical sample bags, and storage bags needed for water sampling. Prepackaged disinfectant wipes containing benzalkonium chloride were retrieved from the kit and used to disinfect the Mir galley-hot, galley-cold, and SVO-ZV water ports. After disinfection, a potable water sampler was connected to the port. A waste bag was then connected to the potable water sampler. Using the waste bag, 50 ml of water was collected and discarded. The chemical sample bag was then attached and 700 ml of water were collected. The sample bag was placed in a self sealing storage bag and stowed for return on the Shuttle. These procedures were used to collect galley-hot, galley-cold, and SVO-ZV (ground-supplied) water for postflight chemical analysis for this investigation. Following the collection of the chemical samples, microbiological samples were obtained for a separate experiment. In addition, humidity condensate samples were also collected for this experiment.

Postflight chemical analysis of samples occurred at Johnson Space Center (JSC) and the Institute for

Biomedical Problems (IBMP). Following recovery of the samples on the ground, the samples were allocated (See Table 2) for distribution to the water analysis laboratories at JSC and IBMP. Parameters tested at JSC included total carbon (total inorganic carbon, purgeable organic carbon, nonpurgeable organic carbon and total organic carbon), specific organics (alcohols, organic acids, semivolatiles, volatiles, nonvolatiles, formaldehyde), and silver. Parameters tested by IBMP included conductivity, pH, color, chemical oxygen demand, total solids, calcium, magnesium, total hardness, and silver.

Functional Objectives

FO1. Preflight collection of ground-supplied water at RSC Energia, Korolov, Russia

FO2. Water Sampling Hardware Setup

FO3. Inflight collection of hot, cold, and SVO-ZV (stored) water

FO4. Inflight collection of humidity condensate

FO5. Inflight collection of partially processed humidity condensate

FO6. Postflight analysis of samples

Hardware Items

Major hardware items used in flight for this experiment:

HW1. Water Experiment Kit - NASA provided

HW2. Disinfectant/Antiseptic Wipes - NASA provided

HW3. Potable Water Samplers (with Mir port adapter interfaces) - NASA provided

HW4. .Waste bags and Chemical Sample, Postflight Analysis Bags - NASA provided

HW5. Self Sealing Storage Bags - NASA provided

HW6. Atmospheric Condensate Sampler - RSA provided

Major hardware items used postflight for this experiment:

HW7. HP 5890 Gas Chromatograph (GC) with HP5971A Mass Spectrometer (MS)- NASA provided

HW8. Waters Quanta 4000 Capillary Electrophoresis System - NASA provided

HW9. OI 700 Carbon Analyzer - NASA provided

HW10. Sievers Model 800 Total Organic Carbon Analyzer - NASA and RSA provided

HW11. HP 7694 Headspace sampler with a HP 5890 GC and 5972 Mass Selective Detector - NASA provided

HW12. HP 5989 Mass Spectrometer (MS) with a 1090 Liquid Chromatograph with Particle beam & Thermospray interfaces - NASA provided

HW13. pH meter - RSA and NASA provided

HW14. Conductivity meter - RSA provided

RESULTS

List of Pre-, In-, and Postflight Anomalies

Preflight Anomalies

Not applicable to this experiment

Inflight Anomalies

One SVO-ZV sample scheduled to be collected during the mission, was not received upon the return of STS-91.

Postflight Anomalies

None

Completeness/Quality of Data

Eleven samples were received upon the return of STS-91. In addition, one sample was received from the return of Soyuz and the Mir 25 crew to Russia. All samples received are listed in Table 2.

DISCUSSION

Status of Data Analysis

Chemical analyses of the water samples have been completed except for a few parameters for one sample returned on Soyuz.

Preliminary Research Findings

Regenerated Water

Four recycled water samples were collected during Mir 25, two in April, one in May, and one in June. Two of these samples were collected in conjunction with the changeout of the BKO multifiltration unit of the Condensate Recovery System (CRS). Analytical results for these samples are reported in Table 4.

Physical Parameters - Conductivity in the Mir 25 regenerated water samples ranged from 19.1 to 314 μS/cm, compared with 5.8–1130 μS/cm in samples collected from Mir 18 through Mir 24 [2,3]. Turbidity in three of the Mir 25 samples exceeded the U.S. maximum

contaminant limit of 1 NTU specified in the Joint U.S./Russian Potable Water Specifications for International Space Station (Table 3). Turbidity in these samples ranged from 1.65 to 7.31 NTU; turbidity in samples collected from Mir 18 to Mir 24 ranged from 0.6 to 7.0 NTU [2,3]. The pH range was consistent in samples collected during Mir 18 through Mir 25, and ranged from 2.56 to 10.0 for all samples analyzed [2,3].

All of the Mir 25 recycled water samples analyzed measured 10 degrees of color. For odor, ratings of 0 (on a 5-point scale) were assigned to the Mir 25 samples indicating that no odor was detected in these samples.

Chemical oxygen demand values for the Mir 25 samples ranged from 3 to 15 mg/L, compared with 3-105 mg/L for the all samples collected from Mir 18 through Mir 24 samples. The Mir 25 values were within the 100 mg/L limit outlined in the Russian potable water specifications for the International Space Station (Table 3).

Inorganic Parameters - Ionic species identified in the Mir 25 samples include chloride (ranging from 0.31 to 13 mg/L), sulfate (<0.75 to 27.6 mg/L), calcium (2.74–38.9 mg/L), magnesium (0.21– 9.38 mg/L), potassium (0.03–2.03 mg/L), and sodium (0.13–5.62 mg/L). Metals detected in the Mir 25 recycled water samples include silver, aluminum, barium, chromium, copper, iron, manganese, molybdenum, nickel, lead, and zinc. One sample exceeded the joint U.S./Russian potable water specifications for nickel which is 100 μg/L; this sample had a nickel concentration of 157 μg/L.

Organic Parameters - Nearly 250 organic compounds were tested for in the Mir 25 samples. These compounds were classified as volatile organic compounds, semivolatile organic compounds, carboxylates, alcohols, aldehydes, and urea. Total organic carbon (TOC) also was performed. Volatile organic compounds detected in the Mir 25 samples include chloroform and toluene. Chloroform has been detected previously in Mir samples at levels ranging from none detected to 244 μg/L. Toluene has also previously been detected at levels of up to 12 μg/L.

No semivolatile organic compounds, alcohols, glycols, carboxylates, or amines were detected in samples collected during Mir 25. Formaldehyde levels however, ranged from none detected to 2.8 μg/L. Levels in previous Mir samples ranged from none detected to 63 μg/L.

The mean concentration of TOC in the Mir 25 samples was 5.7 mg/L (range 0.31–7.52 mg/L). The Mir 25 reclaimed water samples did not normally meet the U.S. potable water specification for the International Space Station (0.5 mg/L), although they did meet the Russian specification of 25 mg/L [3].

Accountability of organic carbon was calculated by summing the concentration of organic carbon for each organic compound analyzed and comparing this result to the total organic carbon value. This comparison gives an indication of the theoretical yield of all organic compounds in the sample. With regard to recovery of organic carbon from the Mir 25 samples, an average of 0.5% of the organic content could be identified using present analytical techniques. This percentage is considerably lower than that obtained for the Mir 18- Mir 24 samples, which averaged 12%.

Stored Water

One SVO-ZV sample was collected during this mission. Results of this sample are reported in Table 5. The physical parameters measured for this sample were consistent with values measured in previous Mir samples. The pH for this sample was 7.25, the conductivity measured 322 μS/cm, the turbidity measured 8.32 NTU, and the chemical oxygen demand (COD) value was 12.5 mg O_2/L. Color and taste were not determined and no odor was detected in this sample.

Inorganic compounds detected in this sample were similar to those found in samples collected during Mir 18 - Mir 24. Chloride, nitrate, sulfate, ammonia, calcium, magnesium, potassium, sodium, silver, aluminum, barium, copper, iron, manganese, nickel, and zinc were found in this sample. Only silver was found to exceed the NASA/RSA specification (see Table 3).

Results show that the stored water sample met the Russian requirement of 25 mg/L for Total Organic Carbon (TOC), but exceeded the U.S. maximum contaminant level of 0.5 mg/L for total organic carbon (TOC) (See Table 3). The TOC for this sample was 7.67 mg/L. Stored water samples collected during Mir 18-Mir 24 also, in most cases, exceeded the U.S. maximum contaminant level. Approximately 0.1% of the organic content of the sample could be accounted for, primarily because only one organic compound could be detected using present analytical techniques. Chloroform was detected at 41.89 μg/L.

Humidity Condensate Results

Four humidity condensate samples were collected using Russian supplied hardware. These samples were taken at the inlet of the Condensate Recovery System (CRS). In addition during Mir 25, one other condensate sample was collected after initial processing from the filter reactor using U.S. supplied hardware. This sample is denoted as Filter Reactor Condensate. Surface condensate samples were also taken and will be discussed separately from the humidity condensate. Analytical results for all of the condensate samples are reported in Table 6.

Physical Parameters - Conductivity levels for Mir 25 humidity condensate samples were similar to levels observed during Mir 19 through Mir 24 and ranged from

200-287 μS/cm. These levels are similar to the levels found in condensate samples collected on Space Shuttle missions STS-45 , STS-47, STS-68, STS-89, and STS-91 [1,10]. Turbidity levels ranged from 6.62-9.75 NTU in the Mir 25 samples, compared with 4.19–39.5 NTU for samples collected during Mir 19 through Mir 24 [3]. Turbidity levels in Shuttle condensate samples were much lower, ranging from 1.0–3.1 NTU (mean 1.67 NTU) [1,3,10]. The pH levels were 7.18, 7.17, 6.92, and 7.57 in the condensate samples analyzed. Shuttle pH levels were similar, ranging from 6.41–7.08 [1,3,10].

Inorganic Parameters - Inorganic constituents measured in the Mir 25 humidity condensate samples included anionic species, cationic species, and metals. Ionic species identified in the humidity condensate samples include chloride, ammonia, lithium, potassium, sodium, magnesium, and calcium. Aluminum, barium, cadmium, chromium, copper, iron, manganese, molybdenum, nickel, lead, and zinc were also present in the Mir humidity condensate.

Organic Parameters - Several classes of organic compounds were detected in the condensate samples collected. Volatile organic compounds detected include acetone (from none detected to 4997 μg/L), carbon disulfide (from none detected to 878.2 μg/L), and 1-chlorobutane (from none detected to 44.5 μg/L). All of these compounds also have been found in previous Mir and Shuttle samples [1,3,10].

Approximately thirty different semivolatile organic compounds were present in the Mir humidity condensate samples. Semivolatile organic compounds found in the greatest concentrations were benzyl alcohol (from none detected to 9633 μg/L), caprolactam (from none detected to 2080 μg/L), 2-methylphenol (none detected to 7936 μg/L), N,N, dimethylformamide (466.7 –2720 μg/L), and 2-ethoxyethanol (5.8–125.5 μg/L).

Significant amounts of 1,2-ethanediol (ethylene glycol) were detected in the Mir 25 condensate samples indicating the presence of thermal coolant in the raw condensate during those times. Ethylene glycol levels ranged from 271 to 747 mg/L.

1-Butanol, ethanol, methanol, and 2-propanol were detected in the Mir 25 samples. Formaldehyde levels ranged from 20.9 to 27.1 μg/L. Samples collected during Mir 19 through Mir 24 had similar formaldehyde levels, with concentrations ranging from 2.2–82 μg/L [3]. Significantly higher levels of formaldehyde have been detected in Shuttle condensate samples [2,9]. No carboxylates, amines or urea was detected in any of the samples analyzed. On average, 80% of the organic constituents in the Mir 25 humidity condensate samples could be accounted.

Surface Condensate

Two surface condensate samples were collected from the Kvant 2 module.

Physical Parameters - Conductivity and turbidity levels in these samples were higher than humidity condensate collected at the inlet of the CRS. Conductivity measured 416 and 412 μS/cm in the surface condensate as compared to 200 to 287 μS/cm in the humidity condensate, while turbidity levels were 17.6 and 5.4 NTU as compared to 6.62 to 9.75 NTU. Similar measurements for pH were observed with values ranging from 6.92 to 7.79 pH units for all condensate samples analyzed during Mir 25.

Inorganic Parameters - Chloride, ammonia, calcium, magnesium, potassium, and sodium were detected in the surface condensate samples. In addition, the following metals were also detected at higher levels that previously seen: aluminum, arsenic, cadmium, chromium, iron, and manganese.

Organic Parameters - The organic content of the surface condensate samples was similar to that of the humidity condensate samples. Organic compounds detected in the surface condensate samples include acetone, acetophenone, benzothiazole, 2-butoxyethanol, 3-t-butylphenol, o-cresol, decamethylcyclopentasiloxane, n,n-diethylformamide, diethyl phthalate, n,n-dimethylacetamide, n,n-dimethylformamide, 2-ethylhexanoic acid, 2-ethyl-1-hexanol, 4-ethylphenol, octamethylcyclotetrasiloxane, phenol, phenyl sulfone, tetramethylurea, and thymol. In addition, several alcohols and formaldehyde were also detected in the surface condensate, as well as ethylene glycol and propylene glycol.

Conclusions

The quality of the regenerated and stored waters, met performance requirements as determined through postflight chemical analysis. The analysis of samples has provided important data for assessing the potential risks of consuming recycled water, especially during the off-nominal conditions experienced with the Mir thermal-cooling system. Other conclusions based on the analytical data are as follows:

Turbidity levels in the regenerated water, on occasion, exceeded the U.S. specification for the International Space Station of 1 NTU.

Total organic carbon levels in the regenerated water and the stored water do not meet the U.S. specification of 0.5 mg/L, although they do meet the Russian standard of no more than 25 mg/L.

One sample analyzed from the Mir 25 mission did not meet the U.S./Russian Joint Specifications for

International Space Station for nickel. Nickel was detected at 157 μg/L, whereas the specification is 100 μg/L.

No compounds have been detected at medically significant levels in the regenerated water samples.

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TABLE 1. DATA COLLECTION SESSIONS/FUNCTIONAL OBJECTIVES

Session Name	FO#	HW#	Scheduled Day	Actual Day	Samples/ Parameters
Mir25					
galley-hot water collection	2,3,6	2-5 7-14	MD115	MD77 9 Apr 98	741 ml of water Split: 474 ml US, 267 ml RSA
galley-hot water collection	2,3,6	2-5 7-14	MD50	MD85 23 Apr 98	703 ml of water Split: 472 ml US, 231 ml RSA
humidity condensate collection	4,6	6-14	MD93	MD90 28 Apr 98	139 ml of water Split: 96 ml US, 43 ml RSA
filter reactor condensate collection	5,6	6-14	unscheduled	MD103 11 May 98	201 ml of water Split: 145 ml US, 56 ml RSA
humidity condensate collection	4,6	6-14	MD122	MD103 11 May 98	137 ml of water Split: 99 ml US, 38 ml RSA
galley-hot water collection	2,3,6	2-5 7-14	MD60	MD91 21 May 98	353 ml of water Split: 243 ml US, 110 ml RSA
surface condensate collection	6	2-5 7-14	unscheduled	MD120 28 May 98	72 ml of water Split: 72 ml US, 0 ml RSA
surface condensate collection	6	2-5 7-14	unscheduled	MD120 28 May 98	61 ml of water Split: 61 ml US, 0 ml RSA
galley-hot water collection	2,3,6	2-5 7-14	MD130	MD130 7 Jun 98	385 ml of water Split: 261 ml US, 124 ml RSA
SVO-ZV (ground supplied) water collection	2,3,6	2-5 7-14	MD130	MD130 7 Jun 98	381 ml of water Split: 261 US, 120 ml RSA
humidity condensate collection	4,6	6-14	MD130	MD130 7 Jun 98	165 ml of water Split: 114 ml US, 51 ml RSA
humidity condensate collection (returned on Soyuz)	4,6	6-14	MD199	MD199 15 Aug 98	? ml of water Split: 64 ml US, ? ml RSA

TABLE 2.ALLOCATION OF MIR 25/NASA 7/STS-91 SAMPLES

WAFAL ID	**98-0615-01**	**98-0615-02**	**98-0615-03**	**98-0615-04**	**98-0615-05**	**98-0615-06**
Mission	Mir24	Mir24	Mir24	Mir25	Mir25	Mir25
Sample Description	Regenerated Water	Regenerated Water	Regenerated Water	Regenerated Water	Stored Water	Humidity Condensate
Sample Location	Galley-Hot	Galley-Hot	Galley-Hot	Galley-Hot	SVO-ZV	CRS
Sample Date	**4/9/98 1140**	**4/23/98 1650**	**5/21/98 1530**	**6/7/1998 1836**	**6/7/98 1733**	**4/28/98**
Analysis/Aliquot	ml	ml	ml	ml	ml	ml
pH, cond, Turb	BNA split	BNA split	BNA split	BNA split	BNA split	BNA split
Alcohols	6	6	6	6	6	3
Formaldehyde	10	10	10	10	10	5
Glycols/Nonvolatiles	5	5	5	5	5	5
Anions, Cations	4	4	4	4	4	4
Acids, Amines	4	4	4	4	4	4
Semivolatiles (BNA)	250	250	100	100	100	25
Metals	50	50	50	50	50	10
TOC	131	129	50	68	68	25
Volatiles	14	14	14	14	14	15
NASA Total	474	472	243	261	261	96
RSA Chemical	267	231	110	124	120	43
RSA Micro	0	0	0	0	0	0
RSA TOTAL	267	231	110	124	120	43
Total (mL)	741	703	353	385	381	139

TABLE 2.ALLOCATION OF MIR 25/NASA 7/STS-91 SAMPLES

WAFAL ID	**98-0615-07**	**98-0615-08**	**98-0615-09**	**98-0615-10**	**98-0615-11**	**98-1117-01**
Mission	Mir25	Mir25	Mir25	Mir25	Mir25	Mir 25
Sample Description	Humidity Condensate	Humidity Condensate	Filter Reactor Humidity Condensate	Surface Condensate #	Surface Condensate #	Humidity Condensate
Sample Location	CRS	CRS	CRS	Kvant-2	Kvant-2 Elektron	CRS
Sample Date	**5/11/98**	**6/7/98**	**5/11/98**	**5/28/98 1215**	**5/28/98 1220**	**8/15-18/98**
Analysis/Aliquot	ml	ml	ml	ml	ml	mL
pH, cond, Turb	BNA split	BNA split	BNA split	BNA split	BNA split	BNA Split
Alcohols	3	3	2	3	3	1
Formaldehyde	6	6	6	5	5	5
Glycols/Nonvolatiles	5	6	5	5	3	3
Anions, Cations	4	4	4	4	4	2
Acids, Amines	4	4	4	4	4	2
Semivolatiles (BNA)	26	42	75	25	16	21
Metals	10	10	10	10	10	10
TOC	25	25	25	10	10	5
Volatiles	16	14	14	6	6	15
NASA Total	99	114	145	72	61	64
RSA Chemical	38	51	56	0	0	0
RSA Micro	0	0	0	0	0	0
RSA TOTAL	38	51	56	0	0	0
Total (mL)	137	165	201	72	61	64

CRS = condensate recovery system

TABLE 3. JOINT U.S./RUSSIAN POTABLE WATER SPECIFICATIONS FOR THE MIR SPACE STATION

Water Parameter	U.S. Maximum Contaminant Level (MCL)	Russian Maximum Contaminant Level (MCL)
pH[1]	5.5-9.0 pH units	5.5-9.0 pH units
Color[2]	15 Pt-Co units	20 degrees
Taste[2]	3 TTN	2 points
Odor[2]	3 TON	2 points
Total Dissolved Solids[3]	100-1,000 mg/L	100-1,000 mg/L
Turbidity[2]	1 NTU	1.5 mg/L
Total Gas	5% volume @1 ATM, 20°C	5% volume @1 ATM, 20°C
Ammonia (NH_3^-N)	2 mg/L	2 mg/L
Arsenic	0.01 mg/L	0.01 mg/L
Barium	1 mg/L	1 mg/L
Cadium	0.005 mg/L	0.005 mg/L
Calcium	100 mg/L	100 mg/L
Chlorine-total (includes Cl^-)	250 mg/L	250 mg/L
Chromium	0.1 mg/L	0.1 mg/L
Copper	1 mg/L	1 mg/L
Fluorine	1.5 mg/L	1.5 mg/L
Iodine-total (includes I^-)	15 mg/L	15 mg/L
Iodine-residual[4]	1.0-4.0 mg/L	1.0-4.0 mg/L
Iron	0.3 mg/L	0.3 mg/L
Lead	0.05 mg/L	0.05 mg/L
Magnesium	50 mg/L	50 mg/L
Manganese	0.05 mg/L	0.05 mg/L
Mercury	0.002 mg/L	0.002 mg/L
Nickel	0.1 mg/L	0.1 mg/L
Nitrate (NO_3^-N)	10 mg/L	10 mg/L
Selenium	0.01 mg/L	0.01 mg/L
Silver	0.5 mg/L	0.5 mg/L
Sulfate	250 mg/L	250 mg/L
Zinc	5 mg/L	5 mg/L
Total Hardness (Ca & Mg)	7 meq/L	7 meq/L
Total Bacteria[2]	100 CFU/100 ml	10,000 CFU/100 ml
Coliform Bacteria	<1 CFU/100 ml	<1 CFU/100 ml
Virus	<1 PFU/100 ml	<1 PFU/100 ml
Cyanide	200 μg/L	200 μg/L
Total Phenols	1 μg/L	1 μg/L
Total Organic Carbon (TOC)	500 μg/L	25,000 μg/L
Uncharacterized TOC	100 μg/L	no limit
Oxygen Consumption-COD	no limit	100 mg/L

[1]pH range applies only before iodination

[2]Parameters have different values for U.S. and Russian supplied water because of different analytical methods used

[3]The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L

[4]Range of required level if iodine is used as a biocide

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Conductivity	µS/cm	U.S.			251	243	19.1	314
Conductivity	µS/cm	Russia			217	209	21	224
pH	pH units	U.S.	5.5-9.0	NASA/RSA	6.96	7.00	7.27	6.98
pH	pH units	Russia	5.5-9.0	NASA/RSA	7.6	7.8	7.4	7.4
Turbidity	NTU	U.S.	1	NASA/RSA	1.65	2.74	0.29	7.31
Turbidity	mg/L	Russia	1.5	NASA/RSA	1.5	0	0	0
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	10	10	NA	NA
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	0	0	0	0
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	NA	NA	NA	NA
Total Solids	mg/L	Russia	1.5	NASA/RSA	NA	NA	NA	NA
Total Hardness	meq/L	Russia	7	NASA/RSA	2.2	2.0	NA	2.4
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	12	12.5	3.0	15
Anions (CE/IC)								
Bromide	mg/L	U.S.			< 0.50	< 0.50	< 0.50	< 0.50
Chloride	mg/L	U.S.	200	NASA/RSA	12.4	11.9	0.31	13.0
Fluoride	mg/L	U.S.	1.5	NASA/RSA	0.20	0.17	< 0.10	0.11
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	0.25	0.25	< 0.11	0.62
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			< 0.08	< 0.08	< 0.08	< 0.08
Phosphate as P (PO4-P)	mg/L	U.S.			< 0.24	< 0.24	< 0.24	< 0.24
Sulfate	mg/L	U.S.	250	NASA/RSA	12.0	11.7	< 0.75	27.6
Cations (CE/IC)								
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	0.040	0.036	< 0.002	0.022
Calcium	mg/L	U.S.	100	NASA/RSA	30.8	29.4	2.74	38.9
Lithium	mg/L	U.S.			< 0.002	< 0.002	< 0.002	0.002
Magnesium	mg/L	U.S.	50	NASA/RSA	7.44	7.18	0.214	9.38
Potassium	mg/L	U.S.			1.69	1.66	0.03	2.03
Sodium	mg/L	U.S.			5.62	5.46	0.13	5.49
Minerals								
Ammonium (NH4)	mg/L	Russia	2	NASA/RSA	0.16	0.10	ND	0.21
Calcium	mg/L	Russia	100	NASA/RSA	28	28	NA	NA
Magnesium	mg/L	Russia	50	NASA/RSA	8.5	7.2	NA	NA
Calcium	µg/L	U.S.	100000	NASA/RSA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA	NA	NA	NA
Sodium	µg/L	U.S.			NA	NA	NA	NA
Potassium	µg/L	U.S.			NA	NA	NA	NA
Silver	µg/L	U.S.	500	NASA/RSA	73.2	77.2	8.4	674

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Metals contd.								
Silver ion	µg/L	Russia			80	80	30	40
Aluminum	µg/L	U.S.		NASA	28.2	27.7	2.7	577
Arsenic	µg/L	U.S.	10	NASA	<1	<1	<1	<1
Barium	µg/L	U.S.	1000	NASA	29.7	28.3	<1	41.8
Cadmium	µg/L	U.S.	5	NASA	<1	<1	<1	<1
Chromium	µg/L	U.S.	100	NASA	<5	<5	<5	<5
Cobalt	µg/L	U.S.		NASA	<1	<1	<1	<1
Copper	µg/L	U.S.	1000	NASA	16.7	13.4	5.3	27.0
Iron	µg/L	U.S.	300	NASA	158	149	14.8	265
Mercury	µg/L	U.S.	2	NASA	<0.5	<0.5	<0.5	<0.5
Manganese	µg/L	U.S.	50	NASA	14.3	12.5	1.7	16.5
Molybdenum	µg/L	U.S.		NASA	<1	1.5	<1	<1
Nickel	µg/L	U.S.	100	NASA	39.6	157	26.2	76.8
Lead	µg/L	U.S.	50	NASA	4.7	3.5	<1	5.5
Selenium	µg/L	U.S.	10	NASA	<1	<1	<1	<1
Zinc	µg/L	U.S.	5000	NASA	26.7	40.0	13.7	58.0
Palladium	µg/L	U.S.		NASA	NA	NA	NA	NA
Silicon	µg/L	U.S.		NASA	NA	NA	NA	NA
Tungsten	µg/L	U.S.			NA	NA	NA	NA
Total Organic Carbon								
TIC (OI 1010)	mg/L	U.S.			NA	NA	NA	NA
POC (OI 1010)	mg/L	U.S.			NA	NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.			NA	NA	NA	NA
TOC (OI 1010)	mg/L	U.S.	0.5/25	NASA/RSA	NA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.			25.1	24.0	2.73	28.3
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	7.52	7.35	0.312	7.45
Total Organic Carbon								
TOC (Sievers 800)	mg/L	Russia	0.5/25	NASA/RSA	7.49	7.18	0.467	6.99
Volatile Organics								
Acetaldehyde	µg/L	U.S.			ND	ND	ND	ND
Acetone	µg/L	U.S.			ND	ND	ND	ND
Acryloniltrile	µg/L	U.S.			ND	ND	ND	ND
Allyl chloride	ND	U.S.			ND	ND	ND	ND
Benzene	µg/L	U.S.	5.0	EPA	ND	ND	ND	ND
Bromobenzene	µg/L	U.S.			ND	ND	ND	ND
Bromochloromethane	µg/L	U.S.	50.0	EPA DWEL	ND	ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID Volatile Organics contd.	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Bromodichloromethane	µg/L	U.S.	100	EPA	ND	ND	ND	ND
Bromoform	µg/L	U.S.	100	EPA	ND	ND	ND	ND
Bromomethane	µg/L	U.S.	10	EPA HA	ND	ND	ND	ND
2-Butanone	µg/L	U.S.			ND	ND	ND	ND
n-Butylbenzene	µg/L	U.S.			ND	ND	ND	ND
s-Butylbenzene	µg/L	U.S.			ND	ND	ND	ND
t-Butylbenzene	µg/L	U.S.			ND	ND	ND	ND
Carbon disulfide	µg/L	U.S.			< 20.00	< 20.00	< 20.00	< 20.00
Carbon tetrachloride	µg/L	U.S.	5	EPA	ND	ND	ND	ND
Chloroacetonitrile	µg/L	U.S.			ND	ND	ND	ND
Chlorobenzene	µg/L	U.S.	100	EPA	ND	ND	ND	ND
1-Chlorobutane	µg/L	U.S.			ND	ND	ND	ND
Chloroethane	µg/L	U.S.			ND	ND	ND	ND
Chloroform	µg/L	U.S.	100	EPA	43.33	39.49	ND	44.31
Chloromethane	µg/L	U.S.	3	EPA HA	ND	ND	ND	ND
2-Chlorotoluene	µg/L	U.S.	100	EPA HA	ND	ND	ND	ND
4-Chlorotoluene	µg/L	U.S.	100	EPA HA	ND	ND	ND	ND
Dibromochloromethane	µg/L	U.S.	100	EPA	ND	ND	ND	ND
1,2-Dibromo-3-chloropropane	µg/L	U.S.	0.2	EPA	ND	ND	ND	ND
1,2-Dibromoethane	µg/L	U.S.	0.05	EPA	ND	ND	ND	ND
Dibromomethane	µg/L	U.S.			ND	ND	ND	ND
1,2-Dichlorobenzene	µg/L	U.S.	600	EPA	ND	ND	ND	ND
1,3-Dichlorobenzene	µg/L	U.S.	600	EPA	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND	ND
trans-1,4-dichloro-2-butene	µg/L	U.S.			ND	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPA HA	ND	ND	ND	ND
1,1-Dichloroethane	µg/L	U.S.			ND	ND	ND	ND
1,2-Dichloroethane	µg/L	U.S.	5	EPA	ND	ND	ND	ND
1,1-Dichloroethene	µg/L	U.S.	7	EPA	ND	ND	ND	ND
cis1,2-dichloroethene	µg/L	U.S.	70	EPA	ND	ND	ND	ND
trans-1,2-dichloroethene	µg/L	U.S.	100	EPA	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	U.S.	5	EPA	ND	ND	ND	ND
1,3-Dichloropropane	µg/L	U.S.			ND	ND	ND	ND
2,2-Dichloropropane	µg/L	U.S.			ND	ND	ND	ND
1,2-Dichloropropene	µg/L	U.S.			ND	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	U.S.			ND	ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Volatile Organics contd.								
trans-1,3-Dichloropropene	µg/L	U.S.			ND	ND	ND	ND
Diethyl ether	µg/L	U.S.			ND	ND	ND	ND
Ethylbenzene	µg/L	U.S.			ND	ND	ND	ND
Ethyl methacylate	µg/L	U.S.			ND	ND	ND	ND
Hexachlorobutadiene	µg/L	U.S.			ND	ND	ND	ND
Hexachloroethane	µg/L	U.S.	1	EPA HA	ND	ND	ND	ND
2-Hexanone	µg/L	U.S.			ND	ND	ND	ND
Iodomethane	µg/L	U.S.			ND	ND	ND	ND
Isopropylbenzene	µg/L	U.S.			ND	ND	ND	ND
4-Isopropyltoluene	µg/L	U.S.			ND	ND	ND	ND
Linolool	µg/L	U.S.			ND	ND	ND	ND
Methacrylonitrile	µg/L	U.S.			ND	ND	ND	ND
Methylacrylate	µg/L	U.S.			ND	ND	ND	ND
Methyl-t-butylether	µg/L	U.S.	20	EPA HA	ND	ND	ND	ND
Methylene chloride	µg/L	U.S.	5	EPA	ND	ND	ND	ND
Methylmethacrylate	µg/L	U.S.			ND	ND	ND	ND
4-Methyl-2-pentanone	µg/L	U.S.			ND	ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.			ND	ND	ND	ND
Pentachloroethane	µg/L	U.S.			ND	ND	ND	ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.			ND	ND	ND	ND
Toluene	µg/L	U.S.			ND	ND	2.70	ND
Trichloroethene	µg/L	U.S.	5	EPA	ND	ND	ND	< 4.00
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	< 8.00	ND
o-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND	ND	ND	ND
Extractable Organics								
Acetophenone	µg/L	U.S.			ND	ND	ND	ND
2-Aminonaphthalene	µg/L	U.S.			ND	ND	ND	ND
Aniline	µg/L	U.S.			ND	ND	ND	ND
Azobenzene	µg/L	U.S.			ND	ND	ND	ND
2,2'-Azobis-isobutyronitrile	µg/L	U.S.			ND	ND	ND	ND
Benzaldehyde	µg/L	U.S.			ND	ND	ND	ND
Benzoic acid	µg/L	U.S.			ND	ND	ND	ND
Benzothiazole	µg/L	U.S.			< 4	< 4	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Extractable Organics contd.								
Benzyl alcohol	µg/L	U.S.			ND	ND	ND	ND
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	ND	ND	ND	ND
2-Butoxyethanol	µg/L	U.S.			ND	ND	ND	ND
2-(2-Butoxyethoxy)ethanol	µg/L	U.S.			ND	ND	ND	ND
2-(2-Butoxyethoxy)ethyl acetate	µg/L	U.S.			ND	ND	ND	ND
n-Butylpalmitate	µg/L	U.S.			ND	ND	ND	ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND	ND	ND	ND
N-Butylbenzenesulfonamide	µg/L	U.S.			ND	ND	ND	ND
3-tert-Butylphenol	µg/L	U.S.			ND	ND	ND	ND
Caffeine	µg/L	U.S.			ND	ND	ND	ND
Caprolactam	µg/L	U.S.			ND	ND	ND	ND
tris-2-Chloroethyl phosphate	µg/L	U.S.			ND	ND	ND	ND
o-Cresol (2-Methylphenol)	µg/L	U.S.			ND	ND	ND	ND
Cyclododecane	µg/L	U.S.			ND	ND	ND	ND
Cyclohexanone	µg/L	U.S.			ND	ND	ND	ND
Decamethylcyclopentasiloxane	µg/L	U.S.			ND	ND	ND	ND
1,4 Diacetylbenzene	µg/L	U.S.			ND	ND	ND	ND
1,3- Dichlorobenzene	µg/L	U.S.	600	EPA	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND	ND	ND	ND
Di-n-butylamine	µg/L	U.S.			ND	ND	ND	ND
Diallyl Phthalate	µg/L	U.S.			ND	ND	ND	ND
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	< 4	ND	ND	ND
N,N-Dibutylformamide	µg/L	U.S.			ND	ND	ND	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			ND	ND	ND	ND
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			ND	ND	ND	ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U S.			ND	ND	ND	ND
2,4-Di-t-butylphenol	µg/L	U.S.			ND	ND	ND	ND
Dicyclohexyl	µg/L	U.S.			ND	ND	ND	ND
N,N-Diethylformamide	µg/L	U.S.			ND	ND	ND	ND
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND	ND	ND	ND
Diethylene glycol di-n-butyl ether	µg/L	U.S.			ND	ND	ND	ND
Diethylene glycol monoethyl ether	µg/L	U.S.			ND	ND	ND	ND
Diethyl phthalate	µg/L	U.S.	5000	EPA HA	ND	ND	ND	ND
Diisopropyl Adipate	µg/L	U.S.			ND	ND	ND	ND
N,N-Dimethylacetamide	µg/L	U.S.			ND	ND	ND	ND
N,N-Dimethylbenzylamine	µg/L	U.S.			ND	ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Extractable Organics contd.								
Dimethylcarbamyl chloride	µg/L	U.S.			ND	ND	ND	ND
N,N-Dimethylformamide	µg/L	U.S.			ND	ND	ND	ND
Dimethyl phthalate	µg/L	U.S.			ND	ND	ND	ND
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND	ND	ND	ND
Dipropylene glycol methyl ether	µg/L	U.S.			ND	ND	ND	ND
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND	ND	ND	ND
Dodecanoic acid	µg/L	U.S.			ND	ND	ND	ND
Eicosane	µg/L	U.S.			ND	ND	ND	ND
2-Ethoxyethanol	µg/L	U.S.			ND	ND	ND	ND
2-Ethylhexanoic acid	µg/L	U.S.			ND	ND	ND	ND
2-Ethyl-1-hexanol	µg/L	U.S.			ND	ND	ND	ND
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	ND	ND	ND	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	6	EPA HA	ND	< 4	ND	ND
4-Ethylmorpholine	µg/L	U.S.			ND	ND	ND	ND
4-Ethylphenol	µg/L	U.S.			ND	ND	ND	ND
1-Formylpiperidine	µg/L	U.S.			ND	ND	ND	ND
Heneicosane	µg/L	U.S.			ND	ND	ND	ND
2-Heptanone	µg/L	U.S.			ND	ND	ND	ND
Hexanoic acid	µg/L	U.S.			ND	ND	ND	ND
2-Hexanol	µg/L	U.S.			ND	ND	ND	ND
Hexanamide	µg/L	U.S.			ND	ND	ND	ND
Hydrocinnamic acid	µg/L	U.S.			ND	ND	ND	ND
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND	ND	ND	ND
2-Hydroxybenzothiazole	µg/L	U.S.			< 4	< 4	ND	ND
Indole	µg/L	U.S.			ND	ND	ND	ND
Isophorone	µg/L	U.S.	100	EPA HA	ND	ND	ND	ND
Isophorone	µg/L	U.S.			ND	ND	ND	ND
Limonene	µg/L	U.S.			ND	ND	ND	ND
p-Menth-1-en-8-ol (alpha-Terpineol)	µg/L	U.S.			ND	ND	ND	ND
Menthol	µg/L	U.S.			ND	ND	ND	ND
Menthone	µg/L	U.S.			ND	ND	ND	ND
2-Mercaptobenzothiazole	µg/L	U.S.			ND	ND	ND	ND
2,2'-Methylenebis(6-t-butyl-4-ethylphenol)	µg/L	U.S.			ND	ND	ND	ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND	ND	ND	ND
Methyl-4-hydroxybenzoate	µg/L	U.S.			ND	ND	ND	ND
3-Methylindole	µg/L	U.S.			ND	ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Extractable Organics contd.								
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND	ND	ND	ND
4-Methylphenol	µg/L	U.S.			ND	ND	ND	ND
2-Methylpyrazine	µg/L	U.S.			ND	ND	ND	ND
1-Methyl-2-pyrrolidinone	µg/L	U.S.			ND	ND	ND	ND
Methyl sulfone	µg/L	U.S.			ND	ND	ND	ND
2-Methylthiobenzothiazole	µg/L	U.S.			ND	< 4	ND	ND
Monomethyl phthalate	µg/L	U.S.			ND	ND	ND	ND
Neomenthol	µg/L	U.S.			ND	ND	ND	ND
Nicotine	µg/L	U.S.			ND	ND	ND	ND
Nonadecane	µg/L	U.S.			ND	ND	ND	ND
Octadecanol	µg/L	U.S.			ND	ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L	U.S.			ND	ND	ND	ND
Octanoic Acid	µg/L	U.S.			ND	ND	ND	ND
4-t-Octylphenol	µg/L	U.S.			ND	ND	ND	ND
Oxindole	µg/L	U.S.			ND	ND	ND	ND
Pentacosane	µg/L	U.S.			ND	ND	ND	ND
s-Phenethyl alcohol	µg/L	U.S.			ND	ND	ND	ND
Phenol	µg/L	U.S.	1/4000	NASA/ EPA HA	ND	ND	ND	ND
bis-Phenol A	µg/L	U.S.			ND	ND	ND	ND
Phenoxyacetic acid	µg/L	U.S.			ND	ND	ND	ND
2-Phenoxyethanol	µg/L	U.S.			ND	ND	ND	ND
N-Phenyl-2-naphthylamine	µg/L	U.S.			ND	ND	ND	ND
2-Phenylacetic Acid	µg/L	U.S.			ND	ND	ND	ND
Phenylethyl alcohol	µg/L	U.S.			ND	ND	ND	ND
2-Phenylphenol	µg/L	U.S.			ND	ND	ND	ND
2-Phenyl-2-propanol	µg/L	U.S.			ND	ND	ND	ND
Phenyl sulfone	µg/L	U.S.			ND	ND	ND	ND
Phthalide	µg/L	U.S.			ND	ND	ND	ND
Salicyclic Acid	µg/L	U.S.			ND	ND	ND	ND
Squalene	µg/L	U.S.			ND	ND	ND	ND
1-Tetradecanol	µg/L	U.S.			ND	ND	ND	ND
Tetramethylsuccinonitrile	µg/L	U.S.			ND	ND	ND	ND
Tetramethylthiourea	µg/L	U.S.			< 4	ND	ND	ND
Tetramethylurea	µg/L	U.S.			ND	ND	ND	ND
Thymol	µg/L	U.S.			ND	ND	ND	ND
o-Toluic acid	µg/L	U.S.			ND	ND	ND	ND

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Extractable Organics contd.								
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.			ND	ND	ND	ND
Tricosane	µg/L	U.S.			ND	ND	ND	ND
Tributyl Phosphate	µg/L	U.S.			ND	ND	ND	ND
Triethyl Phosphate	µg/L	U.S.			ND	ND	ND	ND
Triethylamine	µg/L	U.S.			ND	ND	ND	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			ND	ND	ND	ND
Undecanoic Acid	µg/L	U.S.			ND	ND	ND	ND
2-Undecanone	µg/L	U.S.			ND	ND	ND	ND
Urethane	µg/L	U.S.			ND	ND	ND	ND
Vanillin	µg/L	U.S.			ND	ND	ND	ND
Alcohols (DAI/GC/MS)								
1-Butanol	µg/L	U.S.			ND	ND	ND	ND
Ethanol	µg/L	U.S.			ND	ND	ND	ND
Methanol	µg/L	U.S.			ND	ND	ND	ND
1-Methoxy-2-propanol	µg/L	U.S.			ND	ND	ND	ND
2-Methyl-2-butanol	µg/L	U.S.			ND	ND	ND	ND
2-Methyl-2-propanol	µg/L	U.S.			ND	ND	ND	ND
1-Propanol	µg/L	U.S.			ND	ND	ND	ND
2-Propanol	µg/L	U.S.			ND	ND	ND	ND
Alcohols/Acetone								
Acetone	µg/L	Russia			NA	NA	NA	NA
Butanol	µg/L	Russia			NA	NA	NA	NA
Ethanol	µg/L	Russia			NA	NA	NA	NA
Isoamyl alcohol	µg/L	Russia			NA	NA	NA	NA
Methanol	µg/L	Russia			NA	NA	NA	NA
Propanol	µg/L	Russia			NA	NA	NA	NA
Glycols (DAI/GC/MS)								
1,2-Ethanediol	µg/L	U.S.	7000	EPA HA	ND	ND	ND	ND
1,2-Propanediol	µg/L	U.S.			ND	ND	ND	ND
Glycols								
1,2-Ethanediol	µg/L	Russia	7000	EPA HA	NA	NA	NA	NA
1,2-Propanediol	µg/L	Russia			NA	NA	NA	NA
Organic Acids (SPE/GC/MS)								
Acetic acid	µg/L	U.S.			NA	NA	NA	NA
Acetic acid	µg/L	Russia			NA	NA	NA	NA
Lactic acid	µg/L	U.S.			NA	NA	NA	NA
Propionic acid	µg/L	U.S.			NA	NA	NA	NA

TABLE 4. REGENERATED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 galley-hot regenerated water 4/9/98 98-0615-01	Mir 25 galley-hot regenerated water 4/23/98 98-0615-02	Mir 25 galley-hot regenerated water 5/21/98 98-0615-03	Mir 25 galley-hot regenerated water 6/7/98 98-0615-04
Aldehydes								
Acetaldehyde	µg/L	U.S.			NA	NA	NA	NA
Formaldehyde	µg/L	U.S.	1000	EPA HA	2.6	2.8	ND	2.6
Carboxylates (CE)								
Acetate	mg/L	U.S.			<0.12	<0.12	<0.12	<0.25
Butyrate	mg/L	U.S.			NA	NA	NA	NA
Formate	mg/L	U.S.			<0.12	<0.12	<0.12	<0.12
Glycolate	mg/L	U.S.			<0.12	<0.12	<0.12	<0.25
Glyoxylate	mg/L	U.S.			<0.12	<0.12	<0.12	<0.25
Lactate	mg/L	U.S.			<0.12	0.12	<0.12	<0.25
Propionate	mg/L	U.S.			<0.12	<0.12	<0.12	<0.25
Oxalate	mg/L	U.S.			<0.12	<0.12	<0.12	<0.12
Amines (CE)								
Ethylamine	mg/L	U.S.			<0.12	<0.12	<0.12	<0.12
Methylamine	mg/L	U.S.			<0.63	<0.63	<0.12	<0.63
Propylamine	mg/L	U.S.			<0.12	<0.12	<0.12	<0.12
Trimethylamine	mg/L	U.S.			<0.12	<0.12	<0.12	<0.12
Urea	mg/L	U.S.			< 1.0	< 1.0	< 0.4	< 1.0
Organic Carbon Recovery	percent	U.S.			0.11	0.76	1.15	0.08

NA = not analyzed
ND = not detected
DWEL = Drinking Water Equivalent Level
HA = Health Advisory

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir25 SVO-ZV stored water 6/7/98 98-0615-05
Conductivity	µS/cm	U.S.			322
Conductivity	µS/cm	Russia			280
pH	pH units	U.S.	5.5-9.0	NASA/RSA	7.25
pH	pH units	Russia	5.5-9.0	NASA/RSA	7.0
Turbidity	NTU	U.S.	1	NASA/RSA	8.32
Turbidity	mg/L	Russia	1.5	NASA/RSA	0.0
Color True	degrees	Russia	15 Pt-Co units/20	NASA/RSA	NA
Odor at 20°C	grade	Russia	3 TON/2	NASA/RSA	0
Taste at 20°C	grade	Russia	3 TTN/2	NASA/RSA	NA
Total Solids	mg/L	Russia	1.5	NASA/RSA	NA
Total Hardness	meq/L	Russia	7	NASA/RSA	2.3
Chemical Oxygen Demand	mg O_2/L	Russia	no limit/100	NASA/RSA	12.5
Anions (CE/IC)					
Bromide	mg/L	U.S.			<0.50
Chloride	mg/L	U.S.	200	NASA/RSA	13.3
Fluoride	mg/L	U.S.	1.5	NASA/RSA	<0.10
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	10	NASA/RSA	0.67
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.			<0.08
Phosphate as P (PO4-P)	mg/L	U.S.			<0.24
Sulfate	mg/L	U.S.	250	NASA/RSA	29.9
Cations (CE/IC)					
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	2	NASA/RSA	0.016
Calcium	mg/L	U.S.	100	NASA/RSA	40.5
Lithium	mg/L	U.S.			0.002
Magnesium	mg/L	U.S.	50	NASA/RSA	9.81
Potassium	mg/L	U.S.			2.09
Sodium	mg/L	U.S.			5.66
Minerals					
Ammonium (NH4)	mg/L	Russia	2	NASA/RSA	0.26
Calcium	mg/L	Russia	100	NASA/RSA	NA
Magnesium	mg/L	Russia	50	NASA/RSA	NA
Metals					
Calcium	µg/L	U.S.	100000	NASA/RSA	NA
Magnesium	µg/L	U.S.	50000	NASA/RSA	NA
Sodium	µg/L	U.S.			NA
Potassium	µg/L	U.S.			NA
Silver	µg/L	U.S.	500	NASA/RSA	582
Silver ion	µg/L	Russia			130
Aluminum	µg/L	U.S.		NASA	620
Arsenic	µg/L	U.S.	10	NASA	<1
Barium	µg/L	U.S.	1000	NASA	44.1
Cadmium	µg/L	U.S.	5	NASA	<1
Chromium	µg/L	U.S.	100	NASA	<5
Cobalt	µg/L	U.S.		NASA	<1
Copper	µg/L	U.S.	1000	NASA	2.7
Iron	µg/L	U.S.	300	NASA	266
Mercury	µg/L	U.S.	2	NASA	<0.5
Manganese	µg/L	U.S.	50	NASA	18.0
Molybdenum	µg/L	U.S.		NASA	<1
Nickel	µg/L	U.S.	100	NASA	4.7
Lead	µg/L	U.S.	50	NASA	<1
Selenium	µg/L	U.S.	10	NASA	<1
Zinc	µg/L	U.S.	5000	NASA	69.6
Palladium	µg/L	U.S.		NASA	NA
Silicon	µg/L	U.S.		NASA	NA
Tungsten	µg/L	U.S.			NA

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 SVO-ZV stored water 6/7/98 98-0615-05
Total Organic Carbon					
TIC (OI 1010)	mg/L	U.S.			NA
POC (OI 1010)	mg/L	U.S.			NA
NPOC (OI 1010)	mg/L	U.S.			NA
TOC (OI 1010)	mg/L	U.S.	0.5/25	NASA/RSA	NA
TIC (Sievers 800)	mg/L	U.S.			29.30
TOC (Sievers 800)	mg/L	U.S.	0.5/25	NASA/RSA	7.67
Total Organic Carbon					
TOC (Sievers 800)	mg/L	Russia	0.5/25	NASA/RSA	7.45
Volatile Organics					
Acetaldehyde	µg/L	U.S.			ND
Acetone	µg/L	U.S.			ND
Acryloniltrile	µg/L	U.S.			ND
Allyl chloride	ND	U.S.			ND
Benzene	µg/L	U.S.	5.0	EPA	ND
Bromobenzene	µg/L	U.S.			ND
Bromochloromethane	µg/L	U.S.	50.0	EPA DWEL	ND
Bromodichloromethane	µg/L	U.S.	100	EPA	ND
Bromoform	µg/L	U.S.	100	EPA	ND
Bromomethane	µg/L	U.S.	10	EPA HA	ND
2-Butanone	µg/L	U.S.			ND
n-Butylbenzene	µg/L	U.S.			ND
s-Butylbenzene	µg/L	U.S.			ND
t-Butylbenzene	µg/L	U.S.			ND
Carbon disulfide	µg/L	U.S.			< 20.00
Carbon tetrachloride	µg/L	U.S.	5	EPA	ND
Chloroacetonitrile	µg/L	U.S.			ND
Chlorobenzene	µg/L	U.S.	100	EPA	ND
1-Chlorobutane	µg/L	U.S.			ND
Chloroethane	µg/L	U.S.			ND
Chloroform	µg/L	U.S.	100	EPA	41.89
Chloromethane	µg/L	U.S.	3	EPA HA	ND
2-Chlorotoluene	µg/L	U.S.	100	EPA HA	ND
4-Chlorotoluene	µg/L	U.S.	100	EPA HA	ND
Dibromochloromethane	µg/L	U.S.	100	EPA	ND
1,2-Dibromo-3-chloropropane	µg/L	U.S.	0.2	EPA	ND
1,2-Dibromoethane	µg/L	U.S.	0.05	EPA	ND
Dibromomethane	µg/L	U.S.			ND
1,2-Dichlorobenzene	µg/L	U.S.	600	EPA	ND
1,3-Dichlorobenzene	µg/L	U.S.	600	EPA	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND
trans-1,4-dichloro-2-butene	µg/L	U.S.			ND
Dichlorodifluoromethane	µg/L	U.S.	1000	EPA HA	ND
1,1-Dichloroethane	µg/L	U.S.			ND
1,2-Dichloroethane	µg/L	U.S.	5	EPA	ND
1,1-Dichloroethene	µg/L	U.S.	7	EPA	ND
cis1,2-dichloroethene	µg/L	U.S.	70	EPA	ND
trans-1,2-dichloroethene	µg/L	U.S.	100	EPA	ND
1,2-Dichloropropane	µg/L	U.S.	5	EPA	ND
1,3-Dichloropropane	µg/L	U.S.			ND
2,2-Dichloropropane	µg/L	U.S.			ND
1,2-Dichloropropene	µg/L	U.S.			ND
cis-1,3-Dichloropropene	µg/L	U.S.			ND
trans-1,3-Dichloropropene	µg/L	U.S.			ND
Diethyl ether	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir 25 SVO-ZV stored water 6/7/98 98-0615-05
Volatile Organics contd.					
Ethylbenzene	µg/L	U.S.			ND
Ethyl methacylate	µg/L	U.S.			ND
Hexachlorobutadiene	µg/L	U.S.			ND
Hexachloroethane	µg/L	U.S.	1	EPA HA	ND
2-Hexanone	µg/L	U.S.			ND
Iodomethane	µg/L	U.S.			ND
Isopropylbenzene	µg/L	U.S.			ND
4-Isopropyltoluene	µg/L	U.S.			ND
Linolool	µg/L	U.S.			ND
Methacrylonitrile	µg/L	U.S.			ND
Methylacrylate	µg/L	U.S.			ND
Methyl-t-butylether	µg/L	U.S.	20	EPA HA	ND
Methylene chloride	µg/L	U.S.	5	EPA	ND
Methylmethacrylate	µg/L	U.S.			ND
4-Methyl-2-pentanone	µg/L	U.S.			ND
alpha-Methyl styrene	µg/L	U.S.			ND
Pentachloroethane	µg/L	U.S.			ND
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.			ND
Tetrahydrofuran	µg/L	U.S.			ND
Toluene	µg/L	U.S.			ND
Trichloroethene	µg/L	U.S.	5	EPA	ND
m&p-Xylene	µg/L	U.S.	Total Xylenes 10000	EPA	ND
o-Xylene	µg/L	U.S.	Total Xylenes 10000.0	EPA	ND
Extractable Organics					
Acetophenone	µg/L	U.S.			ND
2-Aminonaphthalene	µg/L	U.S.			ND
Aniline	µg/L	U.S.			ND
Azobenzene	µg/L	U.S.			ND
2,2'-Azobis-isobutyronitrile	µg/L	U.S.			ND
Benzaldehyde	µg/L	U.S.			ND
Benzoic acid	µg/L	U.S.			ND
Benzothiazole	µg/L	U.S.			ND
Benzyl alcohol	µg/L	U.S.			ND
Benzyl butyl phthlate	µg/L	U.S.	7000	EPA DWEL	ND
2-Butoxyethanol	µg/L	U.S.			ND
2-(2-Butoxyethoxy)ethanol	µg/L	U.S.			ND
2-(2-Butoxyethoxy)ethyl acetate	µg/L	U.S.			ND
n-Butylpalmitate	µg/L	U.S.			ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.			ND
N-Butylbenzenesultonamide	µg/L	U.S.			ND
3-tert-Butylphenol	µg/L	U.S.			ND
Caffeine	µg/L	U.S.			ND
Caprolactam	µg/L	U.S.			ND
tris-2-Chloroethyl phosphate	µg/L	U.S.			ND
o-Cresol (2-Methylphenol)	µg/L	U.S.			ND
Cyclododecane	µg/L	U.S.			ND
Cyclohexanone	µg/L	U.S.			ND
Decamethylcyclopentasiloxane	µg/L	U.S.			ND
1,4 Diacetylbenzene	µg/L	U.S.			ND
1,3- Dichlorobenzene	µg/L	U.S.	600	EPA	ND
1,4-Dichlorobenzene	µg/L	U.S.	75	EPA	ND
Di-n-butylamine	µg/L	U.S.			ND
Diallyl Phthalate	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir25 SVO-ZV stored water 6/7/98 98-0615-05
Extractable Organics contd.					
Di-n-butyl phthalate	µg/L	U.S.	4000	EPA DWEL	ND
N,N-Dibutylformamide	µg/L	U.S.			ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.			ND
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.			ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.			ND
2,4-Di-t-butylphenol	µg/L	U.S.			ND
Dicyclohexyl	µg/L	U.S.			ND
N,N-Diethylformamide	µg/L	U.S.			ND
N,N-Diethyl-m-toluamide	µg/L	U.S.			ND
Diethylene glycol di-n-butyl ether	µg/L	U.S.			ND
Diethylene glycol monoethyl ether	µg/L	U.S.			ND
Diethyl phthalate	µg/L	U.S.	5000	EPA HA	ND
Diisopropyl Adipate	µg/L	U.S.			ND
N,N-Dimethylacetamide	µg/L	U.S.			ND
N,N-Dimethylbenzylamine	µg/L	U.S.			ND
Dimethylcarbamyl chloride	µg/L	U.S.			ND
N,N-Dimethylformamide	µg/L	U.S.			ND
Dimethyl phthalate	µg/L	U.S.			ND
Dimethylthiocarbamoyl chloride	µg/L	U.S.			ND
Dipropylene glycol methyl ether	µg/L	U.S.			ND
Dodecamethylcyclohexasiloxane	µg/L	U.S.			ND
Dodecanoic acid	µg/L	U.S.			ND
Eicosane	µg/L	U.S.			ND
2-Ethoxyethanol	µg/L	U.S.			ND
2-Ethylhexanoic acid	µg/L	U.S.			ND
2-Ethyl-1-hexanol	µg/L	U.S.			ND
bis-2-Ethylhexyl adipate	µg/L	U.S.	400	EPA	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	6	EPA HA	ND
4-Ethylmorpholine	µg/L	U.S.			ND
4-Ethylphenol	µg/L	U.S.			ND
1-Formylpiperidine	µg/L	U.S.			ND
Heneicosane	µg/L	U.S.			ND
2-Heptanone	µg/L	U.S.			ND
Hexanoic acid	µg/L	U.S.			ND
2-Hexanol	µg/L	U.S.			ND
Hexanamide	µg/L	U.S.			ND
Hydrocinnamic acid	µg/L	U.S.			ND
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.			ND
2-Hydroxybenzothiazole	µg/L	U.S.			<4
Indole	µg/L	U.S.			ND
Isophorone	µg/L	U.S.	100	EPA HA	ND
Isophorone	µg/L	U.S.			ND
Limonene	µg/L	U.S.			ND
p-Menth-1-en-8-ol (alpha-Terpineol)	µg/L	U.S.			ND
Menthol	µg/L	U.S.			ND
Menthone	µg/L	U.S.			ND
2-Mercaptobenzothiazole	µg/L	U.S.			ND
2,2'-Methylenebis(6-t-butyl-4-ethylphenol)	µg/L	U.S.			ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.			ND
Methyl-4-hydroxybenzoate	µg/L	U.S.			ND
3-Methylindole	µg/L	U.S.			ND
2-Methyl-2,4-pentanediol	µg/L	U.S.			ND
4-Methylphenol	µg/L	U.S.			ND
2-Methylpyrazine	µg/L	U.S.			ND
1-Methyl-2-pyrrolidinone	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir25 SVO-ZV stored water 6/7/98 98-0615-05
Extractable Organics contd.					
Methyl sulfone	µg/L	U.S.			ND
2-Methylthiobenzothiazole	µg/L	U.S.			ND
Monomethyl phthalate	µg/L	U.S.			ND
Neomenthol	µg/L	U.S.			ND
Nicotine	µg/L	U.S.			ND
Nonadecane	µg/L	U.S.			ND
Octadecanol	µg/L	U.S.			ND
Octamethylcyclotetrasiloxane	µg/L	U.S.			ND
Octanoic Acid	µg/L	U.S.			ND
4-t-Octylphenol	µg/L	U.S.			ND
Oxindole	µg/L	U.S.			ND
Pentacosane	µg/L	U.S.			ND
s-Phenethyl alcohol	µg/L	U.S.			ND
Phenol	µg/L	U.S.	1/4000	NASA/ EPA HA	ND
bis-Phenol A	µg/L	U.S.			ND
Phenoxyacetic acid	µg/L	U.S.			ND
2-Phenoxyethanol	µg/L	U.S.			ND
N-Phenyl-2-naphthylamine	µg/L	U.S.			ND
2-Phenylacetic Acid	µg/L	U.S.			ND
Phenylethyl alcohol	µg/L	U.S.			ND
2-Phenylphenol	µg/L	U.S.			ND
2-Phenyl-2-propanol	µg/L	U.S.			ND
Phenyl sulfone	µg/L	U.S.			ND
Phthalide	µg/L	U.S.			ND
Salicyclic Acid	µg/L	U.S.			ND
Squalene	µg/L	U.S.			ND
1-Tetradecanol	µg/L	U.S.			ND
Tetramethylsuccinonitrile	µg/L	U.S.			ND
Tetramethylthiourea	µg/L	U.S.			ND
Tetramethylurea	µg/L	U.S.			ND
Thymol	µg/L	U.S.			ND
o-Toluic acid	µg/L	U.S.			ND
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.			ND
Tricosane	µg/L	U.S.			ND
Tributyl Phosphate	µg/L	U.S.			ND
Triethyl Phosphate	µg/L	U.S.			ND
Triethylamine	µg/L	U.S.			ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.			ND
Undecanoic Acid	µg/L	U.S.			ND
2-Undecanone	µg/L	U.S.			ND
Urethane	µg/L	U.S.			ND
Vanillin	µg/L	U.S.			ND
Alcohols (DAI/GC/MS)					
1-Butanol	µg/L	U.S.			ND
Ethanol	µg/L	U.S.			ND
Methanol	µg/L	U.S.			ND
1-Methoxy-2-propanol	µg/L	U.S.			ND
2-Methyl-2-butanol	µg/L	U.S.			ND
2-Methyl-2-propanol	µg/L	U.S.			ND
1-Propanol	µg/L	U.S.			ND
2-Propanol	µg/L	U.S.			ND

TABLE 5. STORED WATER RESULTS

Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	Mir25 SVO-ZV stored water 6/7/98 98-0615-05
Alcohols/Acetone					
Acetone	μg/L	Russia			NA
Butanol	μg/L	Russia			NA
Ethanol	μg/L	Russia			NA
Isoamyl alcohol	μg/L	Russia			NA
Methanol	μg/L	Russia			NA
Propanol	μg/L	Russia			NA
Glycols (DAI/GC/MS)					
1,2-Ethanediol	μg/L	U.S.	7000	EPA HA	ND
1,2-Propanediol	μg/L	U.S.			ND
Glycols					
1,2-Ethanediol	μg/L	Russia	7000	EPA HA	NA
1,2-Propanediol	μg/L	Russia			NA
Organic Acids (SPE/GC/MS)					
Acetic acid	μg/L	U.S.			NA
Acetic acid	μg/L	Russia			NA
Lactic acid	μg/L	U.S.			NA
Propionic acid	μg/L	U.S.			NA
Aldehydes					
Acetaldehyde	μg/L	U.S.			NA
Formaldehyde	μg/L	U.S.	1000	EPA HA	ND
Carboxylates (CE)					
Acetate	mg/L	U.S.			<0.25
Butyrate	mg/L	U.S.			NA
Formate	mg/L	U.S.			<0.12
Glycolate	mg/L	U.S.			<0.25
Glyoxylate	mg/L	U.S.			<0.25
Lactate	mg/L	U.S.			<0.25
Propionate	mg/L	U.S.			<0.25
Oxalate	mg/L	U.S.			<0.12
Amines (CE)					
Ethylamine	mg/L	U.S.			<0.12
Methylamine	mg/L	U.S.			<0.63
Propylamine	mg/L	U.S.			<0.12
Trimethylamine	mg/L	U.S.			<0.12
Urea	mg/L	U.S.			< 1.0
Organic Carbon Recovery	percent	U.S.			0.09

NA = not analyzed
ND = not detected
DWEL = Drinking Water Equivalent Level
HA = Health Advisory

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		Test	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		Conducted	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	Units	by	98-0615-06	98-0615-07	98-0615-08	98-1117-01	98-0615-09	98-0615-10	98-0615-11
Conductivity	µS/cm	U.S.	274	287	272	200	550	416	412
Conductivity	µS/cm	Russia	253	270	253	pending	469	NA	NA
pH	pH units	U.S.	7.18	7.17	6.92	7.57	7.92	7.60	7.79
pH	pH units	Russia	7.3	7.3	7.0	pending	7.6	NA	NA
Turbidity	NTU	U.S.	6.62	8.56	9.75	NA	36.2	17.6	5.41
Turbidity	mg/L	Russia	0.6	0.6	0.6	pending	1.7	NA	NA
Color True	degrees	Russia	NA	NA	NA	pending	NA	NA	NA
Odor at 20°C	grade	Russia	2	2	3	pending	0	NA	NA
Taste at 20°C	grade	Russia	NA	NA	NA	pending	NA	NA	NA
Total Solids	mg/L	Russia	NA	NA	NA	pending	NA	NA	NA
Total Hardness	meq/L	Russia	NA	NA	NA	pending	NA	NA	NA
Chemical Oxygen Demand	mg O_2/L	Russia	520	680	960	pending	60	NA	NA
Anions (CE/IC)									
Bromide	mg/L	U.S.	< 0.50	< 0.50	< 0.50	pending	< 0.50	< 0.50	< 0.50
Chloride	mg/L	U.S.	1.06	0.89	0.38	pending	1.38	7.24	2.46
Fluoride	mg/L	U.S.	< 0.10	< 0.10	< 0.10	pending	< 0.10	< 0.10	< 0.10
Nitrate as Nitrogen (NO3-N)	mg/L	U.S.	< 0.11	< 0.11	< 0.11	pending	< 0.11	< 0.11	< 0.11
Nitrite as Nitrogen (NO2-N)	mg/L	U.S.	< 0.08	< 0.08	< 0.08	pending	< 0.08	< 0.08	< 0.08
Phosphate as P (PO4-P)	mg/L	U.S.	< 0.24	< 0.24	< 0.24	pending	< 0.24	<0.24	<0.24
Sulfate	mg/L	U.S.	< 0.75	< 0.75	< 0.75	pending	< 0.75	< 0.75	< 0.75
Cations (CE/IC)									
Ammonia as Nitrogen (NH3-N)	mg/L	U.S.	29.8	32.4	27.0	pending	27.0	37.3	47.5
Calcium	mg/L	U.S.	0.07	0.04	0.18	pending	50.4	1.56	0.38
Lithium	mg/L	U.S.	0.011	0.010	0.013	pending	0.010	<0.002	<0.002
Magnesium	mg/L	U.S.	0.034	0.024	0.199	pending	1.23	1.90	0.279
Potassium	mg/L	U.S.	0.30	0.22	0.50	pending	0.31	1.71	1.63
Sodium	mg/L	U.S.	0.13	0.09	0.11	pending	0.16	11.0	0.85
Minerals									
Ammonium (NH4)	mg/L	Russia	NA	NA	NA	pending	NA	NA	NA
Calcium	mg/L	Russia	NA	NA	NA	pending	NA	NA	NA
Magnesium	mg/L	Russia	NA	NA	NA	pending	NA	NA	NA
Metals									
Calcium	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Magnesium	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Sodium	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Potassium	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Silver	µg/L	U.S.	<2	<2	42.6	38.5	130	<4	<4

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		Test	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		Conducted	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	Units	by	98-0615-06	98-0615-07	98-0615-08	98-1117-01	98-0615-09		98-0615-11
Metals contd.									
Silver ion	µg/L	Russia	NA	NA	NA	pending	NA	NA	NA
Aluminum	µg/L	U.S.	16.5	20.2	90.7	37.9	10.3	68.4	53.7
Arsenic	µg/L	U.S.	<1	<1	<1	<2	<1	<2	<2
Barium	µg/L	U.S.	13.3	24.8	18.8	51.8	1.4	8.9	6.2
Cadmium	µg/L	U.S.	7.6	7.5	12.0	4.1	<1	590	31.7
Chromium	µg/L	U.S.	<5	5.0	27.8	11.5	<5	<10	<10
Cobalt	µg/L	U.S.	<1	<1	<1	<2	<1	<2	<2
Copper	µg/L	U.S.	<1	1.3	28.0	4.4	2.5	9.9	5.9
Iron	µg/L	U.S.	16.7	33.9	163	40.3	43.9	343	34.3
Mercury	µg/L	U.S.	<0.5	<0.5	<0.5	<2	<0.5	<1.0	<1.0
Manganese	µg/L	U.S.	336	240	206	95.8	18.5	346	47.4
Molybdenum	µg/L	U.S.	5.3	1.1	1.0	3.2	2.2	11100	23.4
Nickel	µg/L	U.S.	123	317	479	11.8	136000	41.6	10.7
Lead	µg/L	U.S.	1.5	<1	2.3	<2	50.7	<2	<2
Selenium	µg/L	U.S.	<1	<1	<1	<2	<1	<2	<2
Zinc	µg/L	U.S.	1440	1420	1260	985	1160	565	212
Palladium	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Silicon	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Tungsten	µg/L	U.S.	1290	NA	NA	NA	NA	NA	NA
Total Organic Carbon									
TIC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
POC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
NPOC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
TOC (OI 1010)	mg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
TIC (Sievers 800)	mg/L	U.S.	37.9	40.1	32.9	31.0	85.3	45.7	38.5
TOC (Sievers 800)	mg/L	U.S.	211	265	372	411	49.1	93.9	239
Total Organic Carbon									
TOC (Sievers 800)	mg/L	Russia	146.7	277	350	pending	79.4	NA	NA
Volatile Organics									
Acetaldehyde	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Acetone	µg/L	U.S.	1715	977.5	4997	ND	ND	161	1570
Acryloniltrile	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Allyl chloride	ND	U.S.	ND	ND	ND	ND	ND	ND	ND
Benzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Bromobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Bromochloromethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		Test	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		Conducted	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	Units	by	98-0615-06	98-0615-07	98-0615-08	98-1117-01	98-0615-09	98-0615-10	98-0615-11
Volatile Organics contd.									
Bromodichloromethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Bromoform	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Bromomethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Butanone	µg/L	U.S.	ND	ND	< 40.00	ND	ND	ND	ND
n-Butylbenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
s-Butylbenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
t-Butylbenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Carbon disulfide	µg/L	U.S.	744.33	878.22	288.95	143.2	< 20.00	ND	ND
Carbon tetrachloride	µg/L	U.S.	ND	ND	ND	<16.00	ND	ND	ND
Chloroacetonitrile	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Chlorobenzene	µg/L	U.S.	< 4.00	< 4.00	< 4.00	ND	ND	ND	ND
1-Chlorobutane	µg/L	U.S.	ND	< 20	44.53	ND	ND	ND	ND
Chloroethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Chloroform	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Chloromethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Chlorotoluene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
4-Chlorotoluene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Dibromochloromethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,2-Dibromo-3-chloropropane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,2-Dibromoethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Dibromomethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
trans-1,4-dichloro-2-butene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Dichlorodifluoromethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
cis1,2-dichloroethene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
trans-1,2-dichloroethene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,3-Dichloropropane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2,2-Dichloropropane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,2-Dichloropropene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		Test	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		Conducted	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	Units	by	98-0615-06	98-0615-07	98-0615-08	98-1117-01	98-0615-09	98-0615-10	98-0615-11
Volatile Organics contd.									
trans-1,3-Dichloropropene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Diethyl ether	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Ethyl methacylate	µg/L	U.S.	ND	ND		ND	ND	ND	ND
Hexachlorobutadiene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Hexachloroethane	µg/L	U.S.	ND	< 20.00	ND	ND	ND	ND	ND
2-Hexanone	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Iodomethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Isopropylbenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
4-Isopropyltoluene	µg/L	U.S.	< 4.00	< 4.00	< 4.00	<4.00	ND	ND	ND
Linolool	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Methacrylonitrile	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Methylacrylate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Methyl-t-butylether	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Methylene chloride	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Methylmethacrylate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
alpha-Methyl styrene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Pentachloroethane	µg/L	U.S.	< 100	< 100	< 100	<100	ND	< 500	< 500
Perfluoro-1,3-dimethylcyclohexane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Tetrahydrofuran	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Toluene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Trichloroethene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
m&p-Xylene	µg/L	U.S.	< 8.00	< 8.00	ND	ND	< 8.00	ND	ND
o-Xylene	µg/L	U.S.	< 4.00	< 4.00	< 4.00	ND	< 4.00	ND	ND
Extractable Organics									
Acetophenone	µg/L	U.S.	24.9	26.3	32.9	ND	ND	ND	30.5
2-Aminonaphthalene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Aniline	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Azobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2,2'-Azobis-isobutyronitrile	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Benzaldehyde	µg/L	U.S.	ND	48.8	212.4	208.6	< 4	ND	ND
Benzoic acid	µg/L	U.S.	ND	51.3	ND	ND	ND	ND	ND
Benzothiazole	µg/L	U.S.	78.1	98.8	103.4	95.2	15.1	ND	70.9
Benzyl alcohol	µg/L	U.S.	ND	2348.9	9633.6	7198.9	ND	ND	ND
Benzyl butyl phthlate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		Test	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		Conducted	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	Units	by	98-0615-06	98-0615-07	98-0615-08	98-1117-01	98-0615-09	98-0615-10	98-0615-11
Extractable Organics contd.									
2-Butoxyethanol	µg/L	U.S.	85.8	101.1	111.1	71.8	ND	ND	52.2
2-(2-Butoxyethoxy)ethanol	µg/L	U.S.	21.9	24.8	32.2	76.8	ND	ND	ND
2-(2-Butoxyethoxy)ethyl acetate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
n-Butylpalmitate	µg/L	U.S.	ND	ND	ND	ND	ND	20.6	ND
Butylated hydroxyanisole (BHA)	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
N-Butylbenzenesulfonamide	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
3-tert-Butylphenol	µg/L	U.S.	229.4	269.8	356.3	478.8	< 12	46.4	380.0
Caffeine	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Caprolactam	µg/L	U.S.	1417.0	857.7	1344.6	2080.8	40.8	ND	ND
tris-2-Chloroethyl phosphate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
o-Cresol (2-Methylphenol)	µg/L	U.S.	ND	2038.2	7936.7	3384.4	<4	ND	439.2
Cyclododecane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Cyclohexanone	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Decamethylcyclopentasiloxane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	320.8
1,4 Diacetylbenzene	µg/L	U.S.	ND	5.6	6.9	ND	ND	ND	ND
1,3- Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Di-n-butylamine	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Diallyl Phthalate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	µg/L	U.S.	ND	< 4	ND	ND	< 4	ND	ND
N,N-Dibutylformamide	µg/L	U.S.	ND	ND	< 4	ND	ND	ND	ND
2,6-Di-t-butyl-1,4-benzoquinone	µg/L	U.S.	31.2	21.2	< 12	ND	ND	ND	ND
3,5-Di-t-butyl-4-hydroxybenzaldehyde	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2,6-Di-t-butyl-4-methylphenol	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2,4-Di-t-butylphenol	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Dicyclohexyl	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
N,N-Diethylformamide	µg/L	U.S.	187.9	215.1	170.6	98.3	ND	ND	126.5
N,N-Diethyl-m-toluamide	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Diethylene glycol di-n-butyl ether	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Diethylene glycol monoethyl ether	µg/L	U.S.	554.9	539.5	278.5	763.8	19.4	ND	152.8
Diethyl phthalate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Diisopropyl Adipate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
N,N-Dimethylacetamide	µg/L	U.S.	602.4	605.3	581.9	261.9	77.7	62.2	313.3
N,N-Dimethylbenzylamine	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Dimethylcarbamyl chloride	µg/L	U.S.	ND	ND	ND	355.8	ND	ND	ND
N,N-Dimethylformamide	µg/L	U.S.	2076.5	2582.1	2495.3	2720.4	607.2	466.7	2626.2

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		Test	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		Conducted	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	Units	by	98-0615-06	98-0615-07	98-0615-08		98-0615-09	98-0615-10	98-0615-11
Extractable Organics contd.									
Dimethyl phthalate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Dimethylthiocarbamoyl chloride	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Dipropylene glycol methyl ether	µg/L	U.S.	274.4	303.2	170.8	61.3	ND	ND	72.9
Dodecamethylcyclohexasiloxane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	91.7
Dodecanoic acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Eicosane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Ethoxyethanol	µg/L	U.S.	2075.4	2106.9	1481.8	1793.8	ND	ND	1362.4
2-Ethylhexanoic acid	µg/L	U.S.	ND	ND	22.9	ND	ND	ND	1441.3
2-Ethyl-1-hexanol	µg/L	U.S.	227.6	304.0	768.2	216.5	< 4	ND	92.4
bis-2-Ethylhexyl adipate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
bis-2-Ethylhexyl phthalate (Dioctyl phthlate)	µg/L	U.S.	ND	55.0	42.9	523.5	ND	ND	ND
4-Ethylmorpholine	µg/L	U.S.	216.5	190.4	132.2	103.4	ND	ND	ND
4-Ethylphenol	µg/L	U.S.	ND	9.2	ND	ND	ND	ND	18.0
1-Formylpiperidine	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Heneicosane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Heptanone	µg/L	U.S.	ND	ND	117.3	ND	ND	ND	ND
Hexanoic acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Hexanol	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Hexanamide	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Hydrocinnamic acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
4-Hydroxy-4-methyl-2-pentanone	µg/L	U.S.	71.7	87.1	107.1	32	6.1	ND	40.8
2-Hydroxybenzothiazole	µg/L	U.S.	65.1	154.7	86.2	154.7	6.6	ND	ND
Indole	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Isophorone	µg/L	U.S.	ND	< 4	< 4	ND	ND	ND	ND
Isophorone	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Limonene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
p-Menth-1-en-8-ol (alpha-Terpineol)	µg/L	U.S.	ND	31.0	50.3	14.6	ND	ND	21.5
Menthol	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Menthone	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Mercaptobenzothiazole	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2,2'-Methylenebis(6-t-butyl-4-ethylphenol)	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
3-Methyl-2-cyclohexen-1-one	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Methyl-4-hydroxybenzoate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
3-Methylindole	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Methyl-2,4-pentanediol	µg/L	U.S.	ND	23.1	15.7	ND	ND	ND	ND
4-Methylphenol	µg/L	U.S.	54.7	98.4	523.1	ND	ND	ND	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		Test	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		Conducted	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	Units	by	98-0615-06	98-0615-07	98-0615-08	98-1117-01	98-0615-09	98-0615-10	98-0615-11
Extractable Organics contd.									
2-Methylpyrazine	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1-Methyl-2-pyrrolidinone	µg/L	U.S.	134.0	143.3	142.3	69.2	10.0	ND	33.1
Methyl sulfone	µg/L	U.S.	46.8	52.1	ND	48.7	52.4	ND	ND
2-Methylthiobenzothiazole	µg/L	U.S.	7.1	34.2	13.6	12.9	ND	ND	ND
Monomethyl phthalate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Neomenthol	µg/L	U.S.	ND	ND	ND	18	ND	ND	21.1
Nicotine	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Nonadecane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Octadecanol	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Octamethylcyclotetrasiloxane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	1781.9
Octanoic Acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
4-t-Octylphenol	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Oxindole	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Pentacosane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
s-Phenethyl alcohol	µg/L	U.S.	14.7	35.2	154.3	ND	ND	ND	ND
Phenol	µg/L	U.S.	5.0	15.4	1197.6	ND	ND	ND	945.1
bis-Phenol A	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Phenoxyacetic acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Phenoxyethanol	µg/L	U.S.	41.8	58.1	48.1	21.8	ND	ND	ND
N-Phenyl-2-naphthylamine	µg/L	U.S.	ND	43.8	ND	ND	22.5	ND	ND
2-Phenylacetic Acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Phenylethyl alcohol	µg/L	U.S.	ND	10.3	39.7	ND	ND	ND	ND
2-Phenylphenol	µg/L	U.S.	ND	ND	5.1	8.3	ND	ND	12.3
2-Phenyl-2-propanol	µg/L	U.S.	181.3	186.5	201.1	118.2	ND	ND	62.1
Phenyl sulfone	µg/L	U.S.	ND	11.3	5.5	ND	ND	ND	ND
Phthalide	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Salicyclic Acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Squalene	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1-Tetradecanol	µg/L	U.S.	ND	< 4	ND	ND	ND	ND	ND
Tetramethylsuccinonitrile	µg/L	U.S.	37.8	44.6	55.4	<4	5.8	ND	32.6
Tetramethylthiourea	µg/L	U.S.	143.2	234.1	84.1	177.4	ND	ND	ND
Tetramethylurea	µg/L	U.S.	96.3	102.6	65.6	137.2	< 4	ND	50.8
Thymol	µg/L	U.S.	161.3	192.1	254.5	333.9	ND	24.6	268.3
o-Toluic acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
1,3,5-Triallyl-1,3,5-triazine-2,4,6(1H,3H,5H)-trione	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25	Mir 25
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		Test	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		Conducted	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	Units	by	98-0615-06	98-0615-07	98-0615-08	98-1117-01	98-0615-09	98-0615-10	98-0615-11
Extractable Organics contd.									
Tricosane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Tributyl Phosphate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Triethyl Phosphate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Triethylamine	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2,2,4-Trimethyl-1,3-pentanediol diisobutyrate	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Undecanoic Acid	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
2-Undecanone	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Urethane	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Vanillin	µg/L	U.S.	ND	ND	ND	ND	ND	ND	ND
Alcohols (DAI/GC/MS)									
1-Butanol	µg/L	U.S.	615	2670	5471	2430	ND	ND	2198
Ethanol	µg/L	U.S.	27052	70790	333518	306430	ND	ND	167208
Methanol	µg/L	U.S.	4255	7353	13939	8140	3315	226	7508
1-Methoxy-2-propanol	µg/L	U.S.	NA	NA	NA	<200	ND	ND	<200
2-Methyl-2-butanol	µg/L	U.S.	ND	ND	ND	<100	ND	ND	<200
2-Methyl-2-propanol	µg/L	U.S.	ND	ND	ND	<100	ND	107	<200
1-Propanol	µg/L	U.S.	ND	ND	439	<100	ND	ND	<200
2-Propanol	µg/L	U.S.	11816	334	1514	<100	ND	ND	<200
Alcohols/Acetone									
Acetone	µg/L	Russia	5200	2700	13800	pending	NA	NA	NA
Butanol	µg/L	Russia	NA	NA	10100	pending	NA	NA	NA
Ethanol	µg/L	Russia	27300	76700	335500	pending	3200	NA	NA
Isoamyl alcohol	µg/L	Russia	NA	NA	NA	pending	NA	NA	NA
Methanol	µg/L	Russia	6600	8700	16100	pending	4000	NA	NA
Propanol	µg/L	Russia	NA	NA	NA	pending	500	NA	NA
Glycols (DAI/GC/MS)									
1,2-Ethanediol	µg/L	U.S.	275300	435000	271000	474000	43500	4830	109000
1,2-Propanediol	µg/L	U.S.	8940	9530	7250	9220	1830	620	6350
Glycols									
1,2-Ethanediol	µg/L	Russia	296100	445700	218500	pending	44600	NA	NA
1,2-Propanediol	µg/L	Russia	NA	NA	NA	pending	NA	NA	NA
Organic Acids (SPE/GC/MS)									
Acetic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Acetic acid	µg/L	Russia	NA	NA	NA	pending		NA	NA
Lactic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Propionic acid	µg/L	U.S.	NA	NA	NA	NA	NA	NA	NA

TABLE 6. HUMIDITY CONDENSATE AND SURFACE CONDENSATE RESTULS

Mission			**Mir 25**	**Mir 25**	**Mir 25**	**Mir 25**	**Mir 25**	**Mir 25**	**Mir 25**
Sample Location			CRS	CRS	CRS	CRS	CRS	Kvant 2	Kvant 2 Electron
Sample Description		**Test**	condensate	condensate	condensate	condensate	filter reactor condensate	surface condensate	surface condensate
Sample Date		**Conducted**	4/28/98	5/11/98	6/7/98	8/15-18/98	5/11/98	5/28/98	5/28/98
Analysis/Sample ID	**Units**	**by**	**98-0615-06**	**98-0615-07**	**98-0615-08**	**98-1117-01**	**98-0615-09**	**98-0615-10**	**98-0615-11**
Aldehydes									
Acetaldehyde	µg/L	U.S.	NA	NA	NA	pending	NA	NA	NA
Formaldehyde	µg/L	U.S.	20.9	22.2	27.1	pending	6.5	22.5	21.0
Carboxylates (CE)									
Acetate	mg/L	U.S.	<0.12	<0.12	34.8	<1.25	<0.63	<1.25	59.8
Butyrate	mg/L	U.S.	NA	NA	NA	NA	NA	NA	NA
Formate	mg/L	U.S.	<0.12	<0.12	<0.63	<0.25	<0.63	<2.5	<0.25
Glycolate	mg/L	U.S.	<0.12	<0.12	5.88	<1.25	<0.63	<1.25	<1.25
Glyoxylate	mg/L	U.S.	<0.12	<0.12	<1.25	<1/25	<0.63	<1.25	<1.25
Lactate	mg/L	U.S.	<0.25	<0.25	<2.5	<1.25	<6.25	<1.25	<1.25
Propionate	mg/L	U.S.	<1.25	<1.25	<2.5	0.70	<2.5	<1.25	<6.25
Oxalate	mg/L	U.S.	<0.12	<0.12	2.96	<0.25	<1.25	<1.25	<0.25
Amines (CE)									
Ethylamine	mg/L	U.S.	<0.06	<0.06	<0.06	<0.12	<0.06	<0.12	<0.12
Methylamine	mg/L	U.S.	<0.06	<0.06	<0.06	<0.12	0.10	<0.12	<0.12
Propylamine	mg/L	U.S.	<0.06	<0.06	<0.06	<0.12	<0.06	<0.12	<0.12
Trimethylamine	mg/L	U.S.	<0.06	<0.06	<0.06	<0.12	<0.06	<0.12	<0.12
Urea	mg/L	U.S.	< 1.0	< 1.0	< 1.0	137	< 1.0	< 1.0	< 1.0
Organic Carbon Recovery	percent	U.S.	66.54	84.67	89.46	pending	39.58	2.94	70.10

NA = not analyzed
ND = not detected

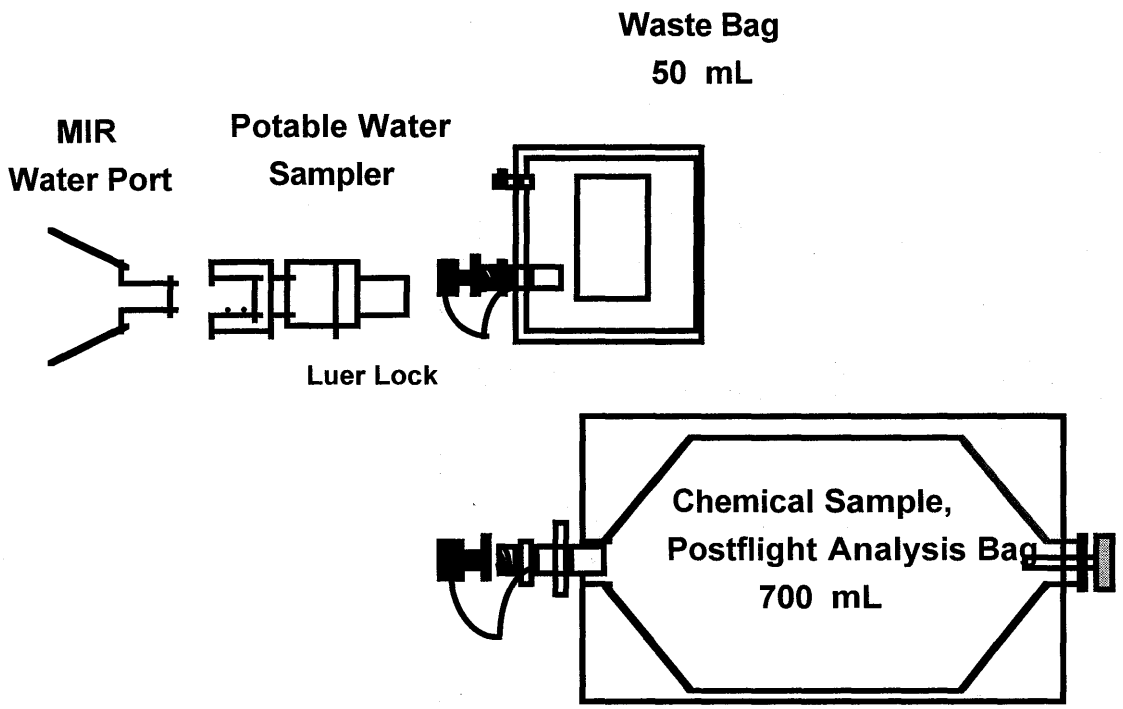

Figure 1. Sample Collection Methodology