POSTFLIGHT 30-DAY OPERATIONAL REPORT
Mir 21/NASA 2/STS 79
E592 Collecting Mir Source and Reclaimed Water
for Postflight Analysis

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30 Day Operational Accomplishments Report

I. 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.

A. 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.

B. Objectives of Experiment

1. 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)
2. Characterize the chemical composition of the ground-resupply water prior to launch and on orbit
3. 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
4. Compare the chemical composition of Mir and Shuttle humidity condensate
5. Provide inflight testing of water collection hardware being developed to collect water samples on ISS
6. Provide a better understanding of the interaction between atmospheric and water contaminants

C. Previous Mission Experiments

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

II. Research Operations

A. List of Pre-, In-, Post-flight 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 inflight were not returned on STS-79.

B. 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 inflight 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).

IV. Discussion

A. 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.

B. 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.

C. 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.

V. Bibliography

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 (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-)
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

1pH range applies only before iodination
2Parameters have different values for U.S. and Russian supplied water because of different analytical methods used
3The 100 mg/L limit applies to the water before mineralization. After mineralization, this parameter will not exceed 1,000 mg/L
4Range of required level if iodine is used as a biocide