


<p>JSC TOXICOLOGY AND ENVIRONMENTAL CHEMISTRY GROUP</p> <p>E. Spencer Williams, PhD, DABT Toxicology and Environmental Chemistry NASA JSC/SK4 Houston, TX 77058</p>		<p>Memorandum Number TOX-SW-2020-03</p> <hr/> <p>Voice: (281) 483-8921 Fax: (281) 483-3058 edward.s.williams@nasa.gov</p>
--	---	--

DATE: October 26, 2020

SUBJECT: Toxicological Assessment of ISS Air and Water Quality: October 3, 2019 – February 6, 2020 (Increment 61) Including NG-12 and SpX-19 Ingress

SUMMARY: Based on these data, air quality was acceptable on ISS for this period, and potable water remains acceptable for crew consumption.

AIR QUALITY

Eight archive air samples were collected in mini grab sample containers (mGSCs) on ISS during Increment 61; two each on October 8, November 20, and December 31, 2019, as well as ingress samples for NG-12 (November 4, 2019) and SpX-19 (December 8, 2019). These samples were returned on SpX-19. Additionally, three sets of formaldehyde badges were deployed during Increment 61. The badges were deployed in the US Lab and the Russian Service Module (SM) on October 8, November 20, and December 31, 2019. All Increment 61 formaldehyde badges were returned on Soyuz 61. A summary of the results from the Increment 61 samples is provided in Table 1.

Table 1. Analytical summary of ISS air analyses (Increment 61)

Return Flight	Sample Location	Sample Date	Freon 218 (mg/m ³)	Alcohols ^a (mg/m ³)	T-Value ^b (units)	Formaldehyde (µg/m ³) ^c
SpaceX-19	US Lab	10/8/2019	24	6.1	0.1	37
SpaceX-19	JPM	10/8/2019	25	6.3	0.2	16 ^e
SpaceX-19	NG-12 ingress	11/4/2019	11	3.7	0.1 (0.1)	--
SpaceX-19	US Lab	11/20/2019	146	6.2	0.1	28
SpaceX-19	Columbus	11/20/2019	161	5.8	0.1	21 ^e
SpaceX-19	SpX-19 ingress	12/8/2019	52	2.8	0.2 (0.1)	--
SpaceX-19	US Lab	12/31/2019	177	7.6	0.2	27
SpaceX-19	SM	12/31/2019	85	3.9	0.2	19
<i>Guideline</i>			---	<5	<1 ^d	<120

^a Includes acetone

^b Sum of the ratios of the measured concentrations and the corresponding 180-day SMAC for each compound; parenthesis indicate value based on 7-day SMACs and applicable to first ingress

^c All formaldehyde badges were returned on Soyuz 61S.

^d T-value <1 used to evaluate routine monthly sampling; <3 used to evaluate first ingress

^e These formaldehyde samples were collected in the Russian SM

Data tables containing measured concentrations and corresponding T-values based on appropriate Spacecraft Maximum Allowable Concentrations (SMACs) for compounds present at levels above the laboratory reporting limit are attached to this report. Complete data tables, which include compounds assessed but not detected, are available upon request. Pressure readings for the mGSCs indicate that all Increment 61 samples were considered acceptable, but pressure readings were slightly low (2-3 psia) for the mGSC samples collected in the US Lab and Columbus on November 20, 2019. Consequently, the results from these samples have slightly higher reporting limits. The mean relative recoveries of the three surrogate standards from the mGSC samples returned on SpX-19 were all within acceptable limits.

On-orbit, the Air Quality Monitors (AQMs) automatically collect and analyze samples every 73 hours, which results in 2-3 sampling sessions per unit per week. Monthly average concentrations as well as the Increment average concentrations for compounds measured on the AQMs are presented in Table 2. AQM2 failed in June 2019 and was returned to the ground for diagnosis and troubleshooting. As a result, AQM data from October 2019 are lacking for compounds that can only be measured on AQM 2. Data from AQM1 were used to estimate concentrations of acetaldehyde and ethanol during this period. A replacement AQM2 was delivered on NG-11 in November 2019.

Table 2. Average monthly concentrations (mg/m³) of AQM target compounds

Compound	October Average	November Average	December Average	January Average	February Average	Increment Average
2-Propanol	MI	MI	MI	MI	MI	MI
Acetone	0.30	0.29	0.24	0.23	0.20	0.25
Acrolein	ND	ND	ND	ND	ND	ND
Benzene	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND
Decamethylcyclotrasiloxane#	ND	ND	ND	ND	ND	ND
Hexanal	ND	ND	ND	ND	ND	ND
Hexane	ND	ND	ND	ND	ND	ND
mp-Xylenes#	ND	ND	ND	ND	ND	ND
Methanol	0.22	0.22	0.23	0.23	0.23	0.23
o-Xylene#	ND	ND	ND	ND	ND	ND
Octamethylcyclotetrasiloxane#	ND	ND	ND	ND	ND	ND
Toluene#	ND	ND	ND	ND	ND	ND
2-Butanone	--	ND	ND	ND	ND	ND
Acetaldehyde	TRACE	0.17	TRACE	TRACE	TRACE	TRACE
Dichloromethane	--	ND	ND	ND	ND	ND
Ethanol	5.1	4.8	5.7	5.6	4.4	5.1
Ethyl Acetate	--	ND	ND	ND	ND	ND
Hexamethylcyclotrisiloxane#	ND	ND	ND	TRACE	ND	ND
n-Butanol	--	ND	ND	ND	ND	ND
Trimethylsilanol	--	0.02	0.02	0.01	ND	0.01

ND: Not detected; <MDL (Minimum Detection Limit)

TRACE: >MDL, <MQL (Minimum Quantification Limit)

MI: matrix interference

--: Data are not available due to failure of AQM2.

Toxicological Evaluation of ISS Air Quality

Routine air quality monitoring is performed in-flight using the AQMs. Archive air samples (mGSCs and formaldehyde badges) are collected during each Increment and returned for analysis in the Toxicology and Environmental Chemistry (TEC) Air Quality Laboratory. Data from the ground analyses complement the in-flight data and provide a more complete understanding of air quality on the ISS. The routine mGSC samples for this Increment that returned on SpX-19 confirmed air quality was acceptable. **All measured**

values for routine samples (mGSC and AQM) met 180-d T-value guideline criteria ($T < 1$), indicating no concern for crew health. The average, rounded T-value calculated from the nominal Increment 61 mGSC samples was 0.15 (Figure 1). The pressure in samples AQ200087 and -88, taken in the US Lab and Columbus on November 20, 2019, were slightly low (2-3 psia), which increased reporting limits for these samples. The T-values calculated from GSC results (Figure 1; 0.15) and AQM (Figure 2; 0.07) continued to diverge during this Increment. This is likely a result of the loss of analytes from AQM2 in October 2019 and the continuing difficulties in quantifying 2-propanol (isopropanol) due to matrix interference.

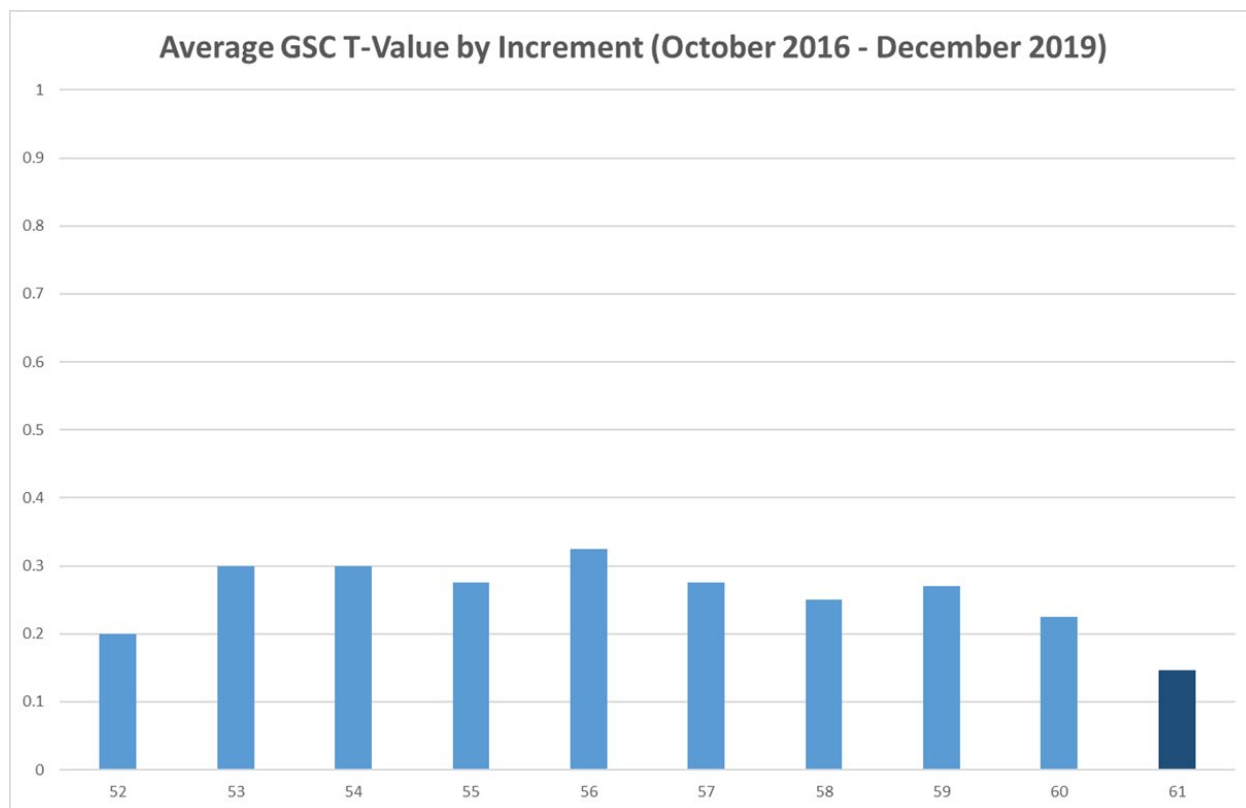


Figure 1. GSC-Derived T-values for Increments 52- 61

Generally, the reported concentrations for the compounds detected during Increment 61 are similar to levels detected during recent Increments. However, levels of Freon 218 (octafluoropropane) increased from 25 mg/m³ in October to 146-151 mg/m³ in November and 85-177 mg/m³ in December 2019. This is likely due to a coolant leak that occurred on October 9, 2019 during CKB maintenance.

All six routine mGSC samples collected during Increment 61 contained a CO₂ concentration below the limit documented in Flight Note F091532D, which requests that the 24-hour average concentration not exceed 3.1 mmHg (7300 mg/m³) on the US segment. While mGSC CO₂ sampling provides a snap-shot of the CO₂ concentration, the major constituent analyzer (MCA) routinely monitors CO₂ levels in the US segment (Figure 3). For this reason, data from the MCA are better suited for evaluation of short and long-term trends in CO₂. Concentrations measured by the MCA fluctuate as a result of multiple factors including the number of crew on ISS, current scrubbing capability, and processes and activities that generate CO₂.

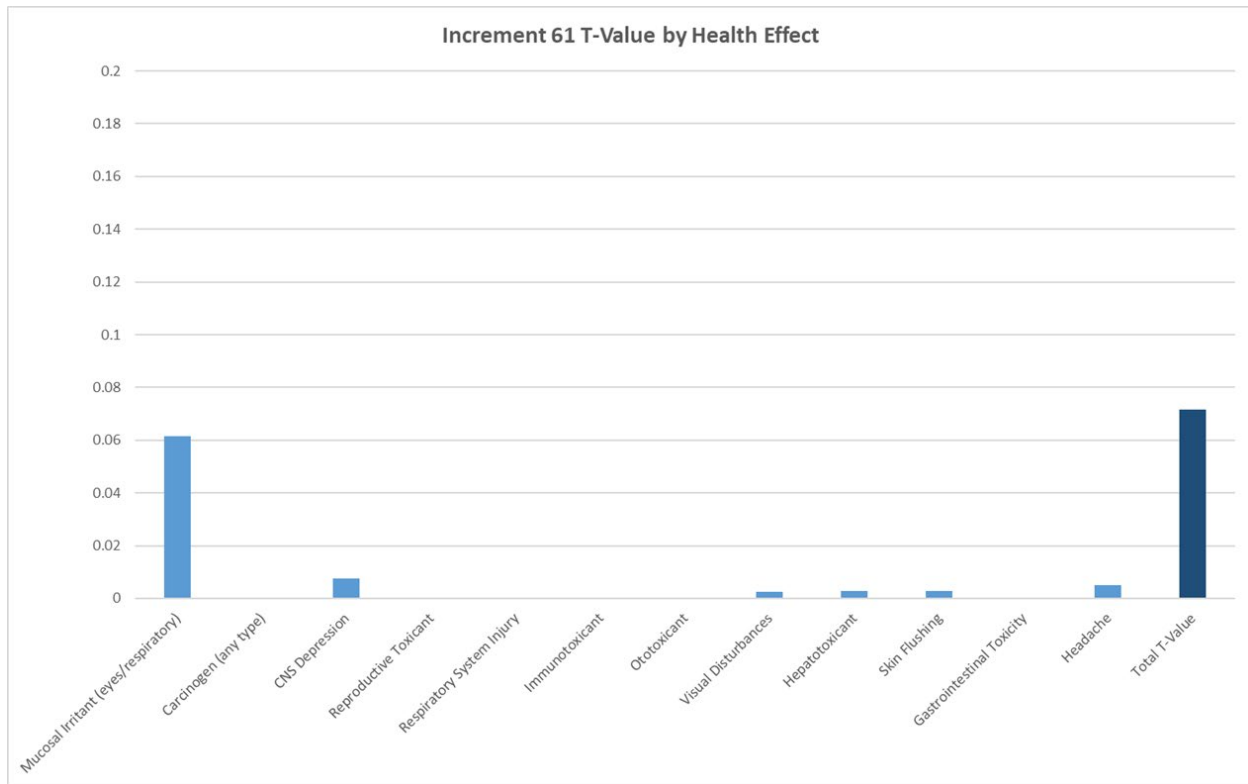


Figure 2. AQM-Derived T-Values by Health Effect for Increment 61

CO₂ data during Increment 61 were obtained from the MCA in Node 3 for the first 5 days of the Increment, and then the Lab MCA provided data for the rest of the Increment. Overall, CO₂ concentrations were well-controlled throughout the Increment (Figure 3). CO₂ levels have historically been maintained between 1.5 and 2 mmHg with 3-person crew and closer to the 3 mmHg limit with 6 crew. The ISS crew was comprised of 6 crew throughout the Increment. The crew performed numerous EVAs during the Increment, resulting in 19 departures above 4 mmHg associated MetOx regeneration events and rapid sampling in the airlock prior to EVA.

Alcohol values in five of the six routine mGSC samples returned on SpaceX-19 exceeded the guideline of <5 mg/m³, which is intended to protect the water recovery system from risk of overloading. The majority of the total alcohol levels in these samples was attributable to ethanol (2.8-5.1 mg/m³ across all samples). These levels of total alcohols have continued from Increment 60 (7.2 mg/m³ total alcohols measured in US Lab in late August 2019). Measured levels do not present a risk to crew health but could adversely impact the lifetime of consumables in the water recovery system. This trend will continue to be monitored.

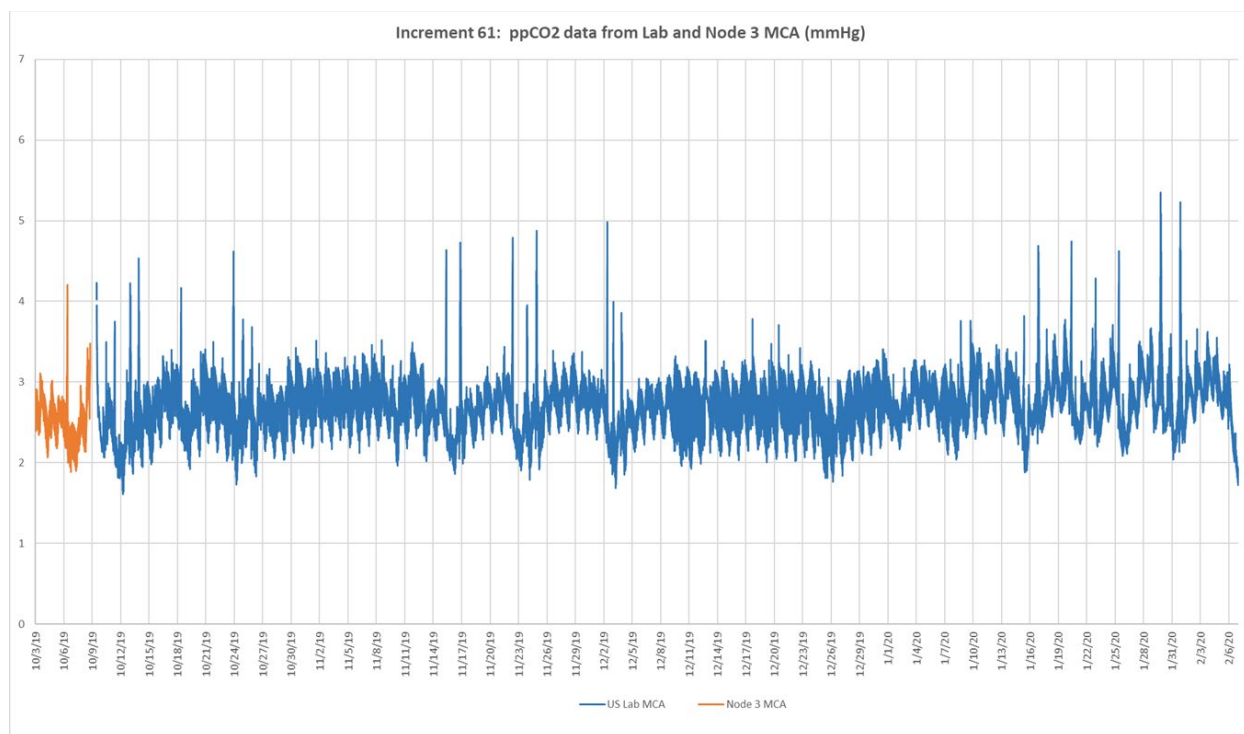


Figure 3. Environmental CO₂ Concentrations on ISS Increment 61 in mmHg

Levels of octafluoropropane (Freon 218) have been falling in ISS air since a release event occurred on October 25, 2018 (peak concentration 865 mg/m³). Samples collected in August (Increment 60) and in October (Increment 61) measured concentrations of octafluoropropane ranging from 21-26 mg/m³. An increase in levels was observed in samples collected in November (146-161 mg/m³ in the US Lab and Columbus modules) and December (85-177 mg/m³ in the US Lab and Russian SM). This increase coincides with a coolant leak from CKB during maintenance activities on October 9, 2019. These concentrations are well below levels of concern for crew health.

Three sets of passive formaldehyde badges were deployed on ISS during Increment 61 (October 8, November 20, and December 31, 2019). Analytical results from these badges indicated that formaldehyde remains in the historical range observed on ISS, and concentrations are well below the SMAC of 120 µg/m³ (Figure 4). The concentrations in the SM ranged from 16-21 µg/m³, and in the US Lab the concentration ranged from 27-37 µg/m³, similar to levels observed earlier in 2019.

NG-12 Ingress

A sample was collected in an mGSC upon ingress into NG-12 on November 4, 2019, approximately 10 minutes after hatch opening. Levels of CO₂ in the ingress sample were 6200 mg/m³ (2.6 mmHg), indicating that significant mixing had occurred with ISS air before the sample was collected. This precludes verification of the T-value projection from offgas testing.

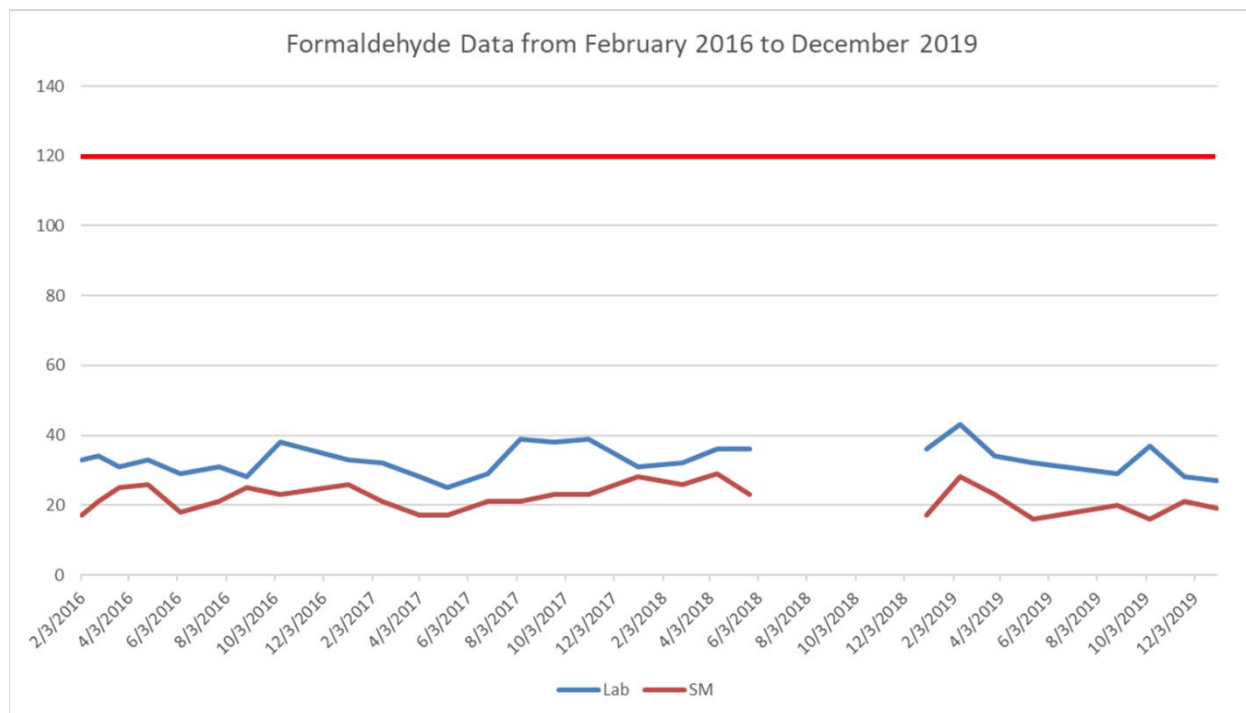


Figure 4: Formaldehyde Concentrations from February 2016 to December 2019

SpaceX-19 Ingress

An additional sample was collected in an mGSC upon ingress into SpaceX-19 on December 8, 2019, approximately 3 minutes after hatch opening. The octafluoropropane concentration in the ingress sample was 52 mg/m³, notably lower than the 145-161 mg/m³ observed on November 20 and the 85-177 mg/m³ observed on December 31, 2019. The presence of Freon 218 in this sample indicates that some mixing did occur before the sample was taken. However, the carbon dioxide concentration in the ingress sample (2900 mg/m³; 1.2 mmHg) seems to indicate a low level of mixing. **The measured T-value for this ingress (0.1, excluding CO₂) is well below levels of concern for crew health.**

WATER QUALITY

Two water samples were collected from the US Potable Water Dispenser (PWD) during Increment 61: ambient water on December 18, 2019, and hot water on January 14, 2020. Samples of WPA wastewater and US condensate were also collected during the Increment. Complete data tables with results for all measured parameters are available upon request. A summary of select analytical results from the Increment 61 samples is provided in Table 3. Expanded summary tables containing organic carbon recoveries and results for all analytes present at concentrations above reporting limits are included as attachments to this report.

Toxicological Evaluation of ISS Water Quality

Routine water quality monitoring is performed in-flight using the total organic carbon analyzer (TOCA). Results from these analyses provide a general indication of overall water quality. Typically, archive water samples are also collected during each Increment and returned for comprehensive analysis in ground laboratories. Data from the ground analyses complement the in-flight data and provide a more complete understanding of water quality on the ISS.

Table 3. Analytical Summary of ISS Water Analyses (Increment 61)

Return Mission	Sample Location	Sample Date	TOC (mg/L)	DMSD (mg/L)	Methyl Sulfone (mg/L)	Conductivity (µS/cm)	Total Iodine (mg/L)
SpaceX-19	WPA Wastewater	12/17/2019	9.4	2.6	0.1	76	NA
SpaceX-19	US Condensate	12/18/2019	44	8.5	0.1	220	NA
Soyuz 59	PWD Ambient	12/18/2019	0.82	<1	0.1	2	<0.05
Soyuz 59	PWD Hot	1/14/2020	0.78	<1	0.1	2	<0.05

NA: not analyzed

Potable Water

Concentrations of all chemicals detected in the potable water samples met the requirements listed in SSP 41000, *System Specification for the International Space Station* and JSC 63414, *Spacecraft Water Exposure Guidelines (SWEGs)*. Total organic carbon (TOC) concentrations from in-flight (PWD TOC and WPA TOC) and ground analyses (Archive TOC) performed between February 2017 and February 2020 are shown in Figure 5. The TOC concentrations in the two potable samples was slightly higher than those measured in Increment 60, but well below both the specification for the US segment (<3 mg/L) and the 100-day SWEG (5 mg/L). The DMSD concentrations remained below 1 mg/L in the potable water samples. Based on results from analyses run on TOCA and from ground-based analysis, the water produced by the Water Processor Assembly (WPA) met the US potability requirement for TOC.

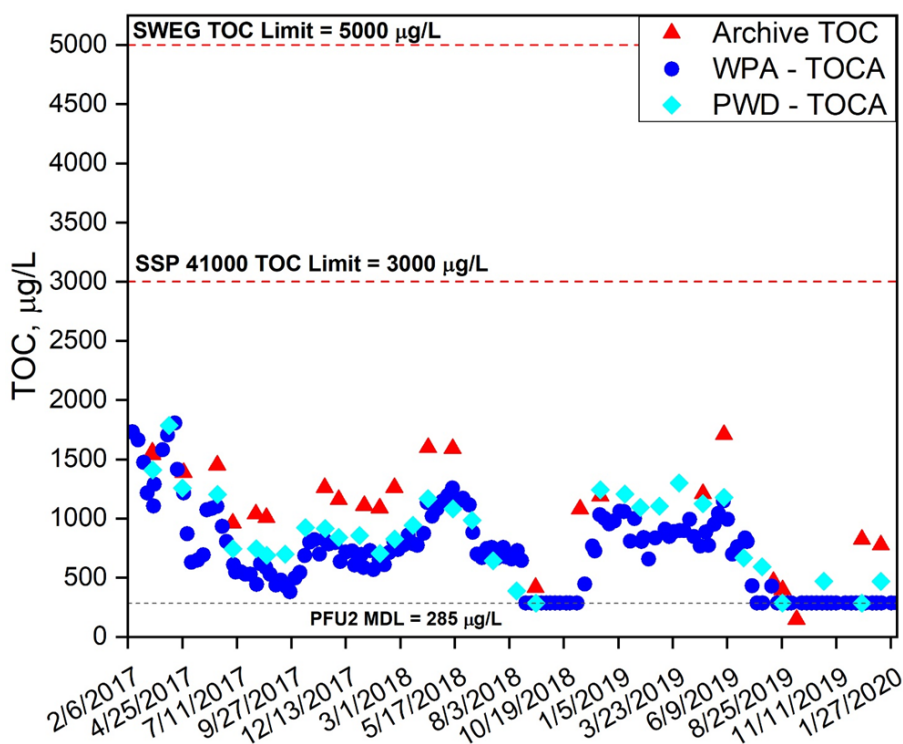


Figure 5. Total Organic Carbon (TOC) trending in US Potable Water

Methyl sulfone was detected in the potable water samples at levels consistent with those observed in Increment 60 and well below the SWEG of 1,500 mg/L. Silicon was detected in both samples (0.27 mg/L) at levels similar to levels from Increment 60 and still lower than results from Increment 59 (0.8-1 mg/L), consistent with the observed decreases in DMSD levels over that period.

Iodine is a biocide used on the US Segment. It is added to the water produced by the WPA but removed prior to crew consumption to avoid potential thyroid dysfunction. The total iodine level in the potable samples collected from the PWD was below the reporting limit (0.05 mg/L), indicating effective removal of iodine in water intended for consumption. For additional information regarding microbial analyses, see the Increment 61 post-flight report generated by the JSC Environmental Microbiology Laboratory.

US Wastewater

A sample of wastewater was collected on December 17, 2019. The TOC concentration was 9.4 mg/L, which is much lower than the historical average of 44.0 mg/L. Organic compounds detected at or above 1 mg/L include methanol (7.6 mg/L), DMSD (2.6 mg/L), and acetone (1.5 mg/L). Organic compound recovery was >100%. The silicon concentration was 1.1 mg/L, which is mostly attributable to DMSD. Nickel (1.5 mg/L) and zinc (0.9 mg/L) were the only metals present at levels above 1 mg/L. Ammonium was present at a concentration of 11.7 mg/L.

US Condensate

A sample of condensate from the US segment was collected on December 18, 2019. The TOC concentration in the sample was 44 mg/L. Organic compounds detected at or above 1 mg/L include ethanol (55.9 mg/L), 2-propanol (9.1 mg/L), DMSD (8.5 mg/L), methanol (7.6 mg/L), acetone (7.3 mg/L), propylene glycol (4.2 mg/L), and ethylene glycol (2.2 mg/L). The organic carbon recovery was >100%. The silicon concentration was 3 mg/L, which can be accounted for by the presence of DMSD. Zinc (1.3 mg/L) was the only metal present at or above 1.0 mg/L.

E. Spencer Williams, PhD DABT
NASA Toxicologist

Valerie E. Ryder, PhD DABT
NASA Toxicologist

Enclosures	Table 1: Analytical concentrations of compounds quantified in the mGSC returned on SpaceX-19
	Table 2A: T-values corresponding to concentrations for routine mGSC samples returned on SpaceX-19, based on 180-day SMACs
	Table 2B: T-values corresponding to concentrations for NG-12 and SpaceX-19 ingress air samples, based on 7-day and 180-day SMACs
	Table 3A: Analytical concentrations of compounds quantified in potable ambient and hot water samples returned on Soyuz 59
	Table 3B: Analytical concentrations of compounds quantified in US wastewater and US condensate returned on SpaceX-19

**TABLE 1
ANALYTICAL RESULTS FOR SPACEX-19 RETURN SAMPLES**

CHEMICAL CONTAMINANT	CONCENTRATION (mg/M3)							
	AQ200084 S/N 2028 LAB 10/8/19 @ 08:37	AQ200085 S/N 2037 JPM 10/8/19 @ 08:20	AQ200086 S/N 2105 NG-12 INGRESS 11/4/19 @ 16:09	AQ200087 S/N 2101 LAB 11/20/19 @ 19:08	AQ200088 S/N 2104 COLUMBUS 11/20/19 @ 19:08	AQ200089 S/N 2102 SPACEX- 19 INGRESS 12/8/19 @ 17:42	AQ200090 S/N 2103 LAB 12/31/19 @ 08:15	AQ200091 S/N 2050 SERVICE MODULE 12/31/19 @ 08:21
	TARGET COMPOUNDS (TO-15) *							
1,1,1,2-Tetrafluoroethane (Norflurane)	0.087	0.094	0.97	<0.20	<0.20	0.33	0.13	0.13
Propene	<0.025	<0.025	<0.025	<0.050	<0.050	<0.025	0.030	0.029
Isobutane	<0.025	<0.025	0.051	<0.075	<0.075	<0.025	<0.025	<0.025
Methanol	0.26	0.29	0.17	0.31	0.29	0.23	0.29	0.29
Acetaldehyde	0.13	0.14	0.10	0.14	0.12	0.045	0.15	0.17
2-Methyl-1-propene	<0.025	<0.025	<0.025	<0.075	<0.075	<0.025	TRACE	<0.025
Ethanol	5.1	5.1	1.4	4.0	3.8	1.5	5.7	2.8
Acetone	0.25	0.29	0.15	0.46	0.39	0.14	0.29	0.24
Pentane	<0.025	<0.025	<0.025	<0.10	<0.10	<0.025	0.20	<0.025
2-Propanol (Isopropanol)	0.47	0.58	2.0	1.3	1.1	0.96	1.3	0.52
Isoprene (2-Methyl-1,3-butadiene)	<0.025	TRACE	<0.025	<0.10	<0.10	<0.025	<0.025	<0.025
Methylene chloride (Dichloromethane)	<0.025	<0.025	0.025	<0.10	<0.10	0.042	<0.025	<0.025
1-Propanol	<0.025	0.045	<0.025	0.23	<0.025	<0.025	TRACE	<0.025
Trimethylsilanol	<0.025	0.057	<0.025	<0.12	<0.12	<0.025	<0.025	0.030
1-Butanol	<0.025	TRACE	<0.025	<0.10	<0.10	<0.025	<0.025	<0.025
Octafluoropropane (Perfluoropropane)	24	25	11	146	161	52	177	85
SPECIAL INTEREST COMPOUND								
The Special Interest Compound was below its reporting limit								
NON-TARGET COMPOUNDS								
All Non-Target Compounds were below their reporting limit								
TOTAL ALCOHOLS PLUS ACETONE	6.1	6.3	3.7	6.2	5.6	2.8	7.6	3.9
TARGET COMPOUNDS (GC) *								
Methane	45	46	20	48	51	20	72	71
Carbon dioxide	5300	5900	6200	5600	5900	2900	6900	6300
Hydrogen	5.0	5.0	1.9	3.7	3.8	2.6	6.0	5.9
Carbon monoxide	0.89	1.0	1.2	<1.5	<1.6	3.2	1.1	1.2

* Quantified using a multi-point calibration

< : Value is less than the laboratory reporting limit.

TRACE: Amount detected is sufficient for compound identification only.

**TABLE 2A
T-VALUES FOR SPACEX-19 RETURN SAMPLES**

CHEMICAL CONTAMINANT	T-VALUE (180-d SMAC)					
	AQ200084 S/N 2028	AQ200085 S/N 2037	AQ200087 S/N 2101	AQ200088 S/N 2104	AQ200090 S/N 2103	AQ200091 S/N 2050
	LAB 10/8/19 @ 08:37	JPM 10/8/19 @ 08:20	LAB 11/20/19 @ 19:08	COLUMBUS 11/20/19 @ 19:08	LAB 12/31/19 @ 08:15	SERVICE MODULE 12/31/19 @ 08:21
TARGET COMPOUNDS (TO-15)						
1,1,1,2-Tetrafluoroethane (Norflurane)	0.000	0.000	0.000	0.000	0.000	0.000
Propene	ND	ND	ND	ND	0.000	0.000
Methanol	0.010	0.011	0.012	0.011	0.011	0.011
Acetaldehyde	0.032	0.035	0.034	0.031	0.038	0.042
2-Methyl-1-propene	ND	ND	ND	ND	0.001	ND
Ethanol	0.003	0.003	0.002	0.002	0.003	0.001
Acetone	0.005	0.006	0.009	0.007	0.005	0.005
Pentane	ND	ND	ND	ND	0.022	ND
2-Propanol (Isopropanol)	0.003	0.004	0.009	0.008	0.009	0.003
Isoprene (2-Methyl-1,3-butadiene)	ND	0.004	ND	ND	ND	ND
1-Propanol	ND	0.001	0.003	ND	0.000	ND
Trimethylsilanol	ND	0.014	0.012	0.018	ND	0.008
1-Butanol	ND	0.000	ND	ND	ND	ND
Octafluoropropane (Perfluoropropane)	0.000	0.000	0.002	0.002	0.002	0.001
SPECIAL INTEREST COMPOUNDS						
The Special Interest Compound was below its reporting limit						
NON-TARGET COMPOUNDS						
All Non-Target compounds were below their reporting limit						
TARGET COMPOUNDS (GC)						
Methane	0.013	0.013	0.014	0.014	0.021	0.020
Hydrogen	0.015	0.015	0.011	0.011	0.018	0.017
Carbon monoxide	0.053	0.057	ND	ND	0.067	0.070
TOTAL T-VALUE	0.133	0.161	0.105	0.103	0.195	0.177

ND : Value is less than the laboratory reporting limit.

Note: Number of decimal places in T-Values do not represent significant figures of measurements.

TABLE 2B
T-VALUES FOR SPACEX-19 RETURN INGRESS SAMPLES

CHEMICAL CONTAMINANT	T-VALUE (7-d & 180-d SMAC)			
	7-d SMAC	180-d SMAC	7-d SMAC	180-d SMAC
	AQ200086 S/N 2105	AQ200086 S/N 2105	AQ200089 S/N 2102	AQ200089 S/N 2102
	NG-12 INGRESS 11/4/19 @ 16:09	NG-12 INGRESS 11/4/19 @ 16:09	SPACEX- 19 INGRESS 12/8/19 @ 17:42	SPACEX- 19 INGRESS 12/8/19 @ 17:42
TARGET COMPOUNDS (TO-15)				
1,1,1,2-Tetrafluoroethane (Norflurane)	0.000	0.000	0.000	0.000
Isobutane	0.000	0.000	ND	ND
Methanol	0.007	0.007	0.009	0.009
Acetaldehyde	0.026	0.026	0.011	0.011
Ethanol	0.001	0.001	0.001	0.001
Acetone	0.003	0.003	0.003	0.003
2-Propanol (Isopropanol)	0.013	0.013	0.006	0.006
Methylene chloride (Dichloromethane)	0.001	0.003	0.001	0.004
Octafluoropropane (Perfluoropropane)	0.000	0.000	0.001	0.001
SPECIAL INTEREST COMPOUND				
The Special Interest Compound was below its reporting limit				
NON-TARGET COMPOUNDS				
All Non-Target Compounds were below their reporting limit				
TARGET COMPOUNDS (GC)				
Methane	0.006	0.006	0.006	0.006
Hydrogen	0.005	0.005	0.008	0.008
Carbon monoxide	0.019	0.069	0.050	0.186
TOTAL T-VALUE	0.079	0.132	0.094	0.233

ND : Value is less than the laboratory reporting limit.

Note: Number of decimal places in T-Values do not represent significant figures of measurements.

Increment 61 Soyuz 59 Water Sample Summary Report - US Segment Water Samples

Table 3A: Analytical concentrations of compounds quantified in potable ambient and hot water samples returned on Soyuz 59

Increment Mission Sample Location Sample Description Sample Date Analysis/Sample ID	Units	Test Conducted by	Potable Water Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	61	
					Soyuz 59	
					WPA PWD Hot Potable water 1/14/2020 WQ200074	WPA PWD Ambient Potable water 12/18/2019 WQ200075
Physical Characteristics						
Conductivity	µS/cm	U.S.			2	2
pH	pH units	U.S.	4.5-8.5	41000	5.71	5.74
Trace Metals ICPMS						
Aluminum	µg/L	U.S.			2	2
Barium	µg/L	U.S.	10,000	SWEG& 41000	< 1	1
Nickel	µg/L	U.S.	300	SWEG& 41000	4	7
Silicon ICPMS						
Silicon	µg/L	U.S.			265	268
Total Organic Carbon-Sievers						
Total Inorganic Carbon (TIC)	mg/L	U.S.			0.91	0.92
Total Organic Carbon (TOC)	mg/L	U.S.	5 / 3	SWEG / 41000	0.78	0.82
Semi-volatile Organics-Targets						
Methyl sulfone	µg/L	U.S.	1,500,000	interim SWEG (06-2017)	51	57
Base and Neutral Extractables-EPA 625 List GCMS						
Diethylphthalate	µg/L	U.S.			37	40
Carboxylates IC						
Amines IC						
Organic Carbon Recovery	percent	U.S.			4.76	4.85
Unaccounted Organic Carbon	mg/L	U.S.			0.74	0.78

NA=Not analyzed
MI=Matrix Interference
N/A=Not applicable
#previously identified as bis(2-Chloroisopropyl) ether

Increment 61 SpaceX-19 Water Sample Summary Report - US Segment Water Samples

Table 3B: Analytical concentrations of compounds quantified in US wastewater and US condensate returned on SpaceX-19

Increment Mission	Sample Location	Sample Description	Sample Date Analysis/Sample ID	Units	Test Conducted by	Potable Water Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	61 SpaceX-19		
								WPA Wastewater ORU	WPA Condensate Sample Port	
								WPA Wastewater	US Condensate	
								12/17/2019 WQ200017	12/18/2019 WQ200018	
Physical Characteristics										
				Conductivity	μS/cm	U.S.		76	220	
				pH	pH units	U.S.	4.5-8.5	41000	7.01	7.64
Anions IC										
				Fluoride	mg/L	U.S.		0.1	0.1	
				Phosphate (as P)	mg/L	U.S.		0.2	< 0.1	
Cations IC										
				Ammonium (as N)	mg/L	U.S.	1	SWEG&41000	11.7	30.8
Minerals ICPMS										
				Calcium	mg/L	U.S.	30	41000	0.03	0.04
				Potassium	mg/L	U.S.	340	41000	0.14	< 0.01
				Sodium	mg/L	U.S.			0.08	< 0.01
Trace Metals ICPMS										
				Aluminum	μg/L	U.S.			13	8
				Boron	μg/L	U.S.			9	18
				Chromium	μg/L	U.S.	230	41000	16	3
				Copper	μg/L	U.S.	1,000	41000	2	1
				Manganese	μg/L	U.S.	300	SWEG&41000	4	3
				Nickel	μg/L	U.S.	300	SWEG&41000	1,470	55
				Silver	μg/L	U.S.	400	SWEG&41000	6	2
				Titanium	μg/L	U.S.			1	< 1
				Zinc	μg/L	U.S.	2,000	SWEG&41000	900	1,320
Silicon ICPMS										
				Silicon	μg/L	U.S.			1,060	3,040
Total Organic Carbon-OI										
				Total Inorganic Carbon (TIC)	mg/L	U.S.			11.2	24.2
				Total Organic Carbon (TOC)	mg/L	U.S.	5 / 3	SWEG / 41000	9.43	43.5

NA=Not analyzed
 MI=Matrix Interference
 N/A=Not applicable
 #previously identified as bis(2-Chloroisopropyl) ether

Increment 61 SpaceX-19 Water Sample Summary Report - US Segment Water Samples

Table 3B: Analytical concentrations of compounds quantified in US wastewater and US condensate returned on SpaceX-19

Increment Mission	Sample Location	Sample Description	Sample Date Analysis/Sample ID	Units	Test Conducted by	Potable Water	Maximum Contaminant Level (MCL)	Maximum Contaminant Level Source	61 SpaceX-19	
									WPA Wastewater ORU	WPA Condensate Sample Port
									WPA Wastewater	US Condensate
									12/17/2019 WQ200017	12/18/2019 WQ200018
Volatile Organics-Special Interest Compounds (Semi-quantitative)										
				µg/L	U.S.				not found	130
Semi-volatile Organics-Targets										
				µg/L	U.S.				55	< 50
				µg/L	U.S.	1,500,000		Interim SWEG (06-2017)	125	128
Acid Extractables-EPA 625 List GCMS										
				µg/L	U.S.				< 250	821
Base and Neutral Extractables-EPA 625 List GCMS										
				µg/L	U.S.				< 50	200
				µg/L	U.S.				97	249
Semi-volatile Organics-Special Interest Compounds (Semi-quantitative)										
				µg/L	U.S.				not found	120
				µg/L	U.S.				not found	80
				µg/L	U.S.				not found	110
				µg/L	U.S.				not found	170
				µg/L	U.S.				51	not found
Alcohols & Acetone GCMS										
				µg/L	U.S.				691	9,080
				µg/L	U.S.	15000		SWEG	1,500	7,320
				µg/L	U.S.				< 400	55,900
				µg/L	U.S.	40,000		SWEG	7,580	7,600
Glycols GCMS										
				µg/L	U.S.	4000		SWEG	7,890	2,190
				µg/L	U.S.	1,700,000		SWEG	< 1000	4,240
Silanol L CRI (Semi-Quantitative-NIST traceable standard not available)										
				µg/L	U.S.	35,000		SWEG	2,600	8,500
Carboxylates IC										
				µg/L	U.S.				< 500	753
Organic Carbon Recovery										
				percent	U.S.				111.24	111.60
Unaccounted Organic Carbon										
				mg/L	U.S.				0.00	0.00

Data Qualifiers: WQ200017-18: Methyl sulfone - Data qualifier: Possible slight high bias.
WQ200018: Benzoic acid - Data qualifier - Possible high bias.

NA=Not analyzed
MI=Matrix Interference
N/A=Not applicable
#previously identified as bis(2-Chloroisopropyl) ether