



Columbia 實驗室分析報告(原文)

## LABORATORY REPORT

December 9, 2008

Ralph Kubitzki  
HGI Industries, Inc.  
2055 High Ridge Road  
Boynton Beach, FL 33426

**RE: Odorox MDU S/N ODHG 000389**

Dear Ralph:

Enclosed are the results of the sample(s) submitted to our laboratory on November 5, 2008. For your reference, these analyses have been assigned our service request number P0803771.

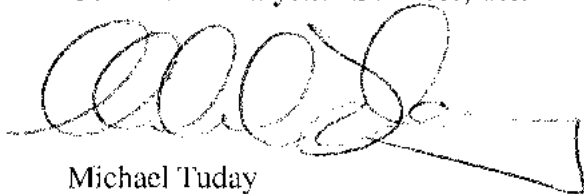
All Analyses were performed according to our laboratory's NELAP-approved quality assurance program. The test results meet requirements of the current NELAP standards, where applicable, and except as noted in the laboratory case narrative provided. For a specific list of NELAP-accredited analytes, refer to the certifications section at [www.caslab.com](http://www.caslab.com). Results are intended to be considered in their entirety and apply only to the samples analyzed and reported herein. Your report contains \_\_\_\_\_ pages.

Columbia Analytical Services, Inc. is certified by the California Department of Health Services, NELAP Laboratory Certificate No. 02115CA; Arizona Department of Health Services, Certificate No. AZ0694; Florida Department of Health, NELAP Certification E871020; New Jersey Department of Environmental Protection, NELAP Laboratory Certification ID #CA009; New York State Department of Health, NELAP NY Lab ID No: 11221; Oregon Environmental Laboratory Accreditation Program, NELAP ID: CA20007; The American Industrial Hygiene Association, Laboratory #101661; Department of the Navy (NFESC); Pennsylvania Registration No. 68-03307; TX Commission of Environmental Quality, NELAP ID T104704413-08-TX. Each of the certifications listed above have an explicit Scope of Accreditation that applies to specific matrices/methods/analytes; therefore, please contact me for information corresponding to a particular certification.

If you have any questions, please call me at (805) 526-7161.

Respectfully submitted,

**Columbia Analytical Services, Inc.**



Michael Tuday  
Director of Research & Development

*The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for utilization of less than the complete report.*

## **HGI Industries**

### **Odorox Mobile Disinfection Unit (M.D.U.) Hydroxyl Air Processor**

The Odorox M.D.U. (Serial No. ODHG 000389) Hydroxyl Air Processor was evaluated to ascertain whether or not the hydroxyl ion generation technology employed in the device causes the formation or significant elevation in the concentration of certain speciated and total volatile organic compounds (VOCs), aldehydes, carbon monoxide (CO) and Ozone (O<sub>3</sub>). A trial consisting of four discreet sampling periods: one 1-hour background evaluation with the device switched off followed by three consecutive 1-hour sampling periods with the device in operation was performed on 18-20 November, 2008.

The test room, an office 11.5' x 11.5' with a 9' ceiling was used to perform the trial. The office is painted drywall, with commercial/office type carpeting and "acoustic" ceiling tile. The test room had both an HVAC register and return. The office contained a particleboard/laminate desk and cabinet, two upholstered office chairs, and desktop computer and twenty-four cardboard archival storage boxes of hardcopy files.

The M.D.U. was placed with its back to a wall such that the unit's exhaust was parallel with the desk four feet away. The air intake to the Odorox M.D.U. was positioned approximately six inches from the only door in the room which was kept closed for the duration of the trial. Inlets to the sampling devices (direct reading ozone monitor, electropolished stainless steel canisters, and aldehyde tube sampling pumps) were placed on top of the desk at a height of 44", in the breathing zone of the investigators.

Aside from the direct reading ozone monitor, two additional types of samples were collected for each sampling period: a whole-air sample collected in an electropolished stainless steel canister (Summa canister) for the measurement of speciated and total volatile organic compounds and carbon monoxide; and a pumped air sample collected on a dinitrophenylhydrazine (DNPH) impregnated silica gel tube for measurement of speciated target aldehydes.

#### Ozone Measurement

The measurement of ozone was performed using a direct reading instrument, a model UV-106 (Serial No. 007) from InDevR 2B Technologies. Ozone is monitored by measuring the absorption of ultraviolet light. The ozone molecule has an absorption maximum at 254 nanometers, coincident with the principal emission wavelength of a low pressure mercury lamp located inside the instrument. Ozone is measured based on the attenuation of light passing through a 15 centimeter long absorption cell fitted with quartz windows. The low pressure mercury lamp is located on one side of the absorption cell, a photodiode at the other. An ozone scrubber provides a null reference. The intensity of light at the photodiode is measured alternatively in air that has passed through the ozone scrubber and air that has not passed through the scrubber. The ozone concentration is calculated from the measurements according to the Beer-Lambert Law.

### Analysis for Volatile Organic Compounds (VOCs)

Whole air samples were collected in precleaned, evacuated and certified 6-liter Summa passivated stainless steel canisters. The Summa canister samples were analyzed for 75 target volatile organic compounds plus additional tentatively identified compounds and total volatile organic compounds (TVOC) according to EPA Method TO-15.

Time integrated samples were collected using calibrated low volume flow controllers over a one hour time period.

The analysis for speciated and total VOCs was performed using an Agilent Model 6890 Series gas chromatograph/ Model 5973 mass selective detector (GC/MSD) interfaced to a Tekmar Model AUTOCAN automated whole-air concentrator.

For the chromatographic separation of VOCs a 60meter x 0.25mm Rxi-1ms bonded phase fused silica column with a 1.0 micron film thickness (Restek Corporation, Bellefonte, PA) was temperature programmed from 40C (hold for 1 minute) to 80C at 5C/minute, then to 160C at 10C/minute, then to 240C at 20C/minute (hold for 5 minutes at 240C).

The mass selective detector was operated in the full scan mode from 33amu to 280amu at 70 electron volts.

The tentatively identified compounds were obtained using a mass spectral library search against an approximately 180,000 entry NIST mass spectral library. In addition to the data system best match algorithm, the analysts employed both intuitive and traditional methods of mass spectral interpretation. Compounds that could not be identified as an exact match were given the most specific generic classification (e.g. a C<sub>9</sub> carboxylic acid, a C<sub>12</sub> branch chain aliphatic hydrocarbon, etc.). The approximate concentrations were calculated to one significant figure assuming a 1:1 response with an appropriate internal standard compound.

### Measurement of Carbon Monoxide

Samples from the Summa passivated stainless steel canisters were analyzed for carbon monoxide by gas chromatography/total combustion analysis/flame ionization detection according to modified EPA Method 25C.

### Measurement of Formaldehyde and other Carbonyl Compounds

Samples were collected for the measurement of formaldehyde and other carbonyl compounds using silica gel tubes, impregnated with a derivatizing reagent, 2,4-dinitrophenylhydrazine (DNPH). Air was drawn through the tubes at using a personal sampling pump at a nominal rate of one liter per minute for 60 minutes.

The DNPH silica gel tubes were analyzed for 13 target aldehydes according to EPA Method TO-11A. A summary of the method is as follows: The carbonyl compounds in the samples

stream react with the 2,4-dinitrophenylhydrazine reagent to form stable aldehyde-hydrazone derivatives. These derivatives are chemically desorbed from the silica gel using acetonitrile. The desorbed acetonitrile extracts are analyzed using high performance liquid chromatography (HPLC) with ultraviolet (UV) detection.

The front (sample) and back (breakthrough) sections of the silica gel tubes were emptied separately into glass vials. Reagent grade acetonitrile was added to the derivatized silica gel sorbent. Each vial was analyzed separately using a Waters Module I Plus high performance liquid chromatograph equipped with an ultraviolet/visible detector operating at a wavelength of 360 nanometers in the ultraviolet range. A Kromasil C18 (5mm x 2.1mm x 3micron) column (Restek Corporation, Bellefonte, PA) was programmed in a linear gradient mode, going from 100% mobile phase A (60/30/10 water/acetonitrile/tetrahydrofuran) to 100% mobile phase B (60/40 acetonitrile/water) in 7.5 minutes at a flow rate of 0.7 milliliters per minute.

### Summary of Results

The results of analysis are given on the attached summary sheets.

Measured ozone results (60 minute averages) for the three hours the MDU was operating were 13.9 ppbV, 13.2 ppbV and 7.0 ppbV (mean concentration = 11.4 ppbV), respectively, compared to the measured background result of 1.3 ppbV. Comparatively, according to the California Air Resources Board, which operates an ambient air monitoring network with a sampling location for Simi Valley-Cochran Street, approximately 8 miles from the CAS laboratory, the average measured outdoor concentration of ozone during the time period of the three hour MDU measurement was 3 ppbV. The outdoor measurement during the time period of the background evaluation was 19 ppbV.

There was no detection of carbon monoxide above the laboratory method reporting limit during the entire trial.

The measured concentration of formaldehyde (mean of 3-hour test = 13 ug/m<sup>3</sup>) was marginally above the background concentration (9.2 ug/m<sup>3</sup>) but within typical indoor levels. Concentrations of acetaldehyde with the MDU switched on were comparable to the measured background level, within experimental error.

Significantly, the concentration of total volatile organic compounds (as toluene) was reduced by greater than 40% over the three hour period with the MDU in operation.

# COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 1 of 1

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox M.D.U. (S/N ODHG 000389)

CAS Project ID: P0803771

**Test Code:** Ozone By Direct Reading Instrument  
**Instrument ID:** UV-106 (InDevR 2B Technologies)  
**Analyst:** K. Chen  
**Matrix:** Continuous Monitor  
**Test Conditions:** Full Fan Speed, Full Processor Power

Date Analyzed: 11/20/2008

## Ozone Results

CAS #	Compound	MDU OFF	MDU ON			MRL
		Bkgd	Hour 1	Hour 2	Hour 3	
		P0803771-009	P0803771-010	P0803771-011	P0803771-012	
		ppmV	ppmV	ppmV	ppmV	ppmV
10028-15-6	Ozone	0.0013	0.0139	0.0132	0.0070	0.001

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

# COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS OF ANALYSIS

Page 1 of 1

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox MDU S/N ODHG 000389

CAS Project ID: P0803771

### Carbon Monoxide

**Test Code:** EPA Method 25C Modified  
**Instrument ID:** HP5890 II/GC1/FID/TCA  
**Analyst:** Zheng Wang/Wade Henton  
**Sampling Media:** 6.0 L Summa Canister(s)  
**Test Notes:**

**Date(s) Collected:** 11/18/08  
**Date Received:** 11/18/08  
**Date Analyzed:** 11/18/08

Client Sample ID	CAS Sample ID	Canister Dilution Factor	Injection Volume ml(s)	Result ppmV	MRL ppmV	Data Qualifier
Odorox MDU Off Background VOC1	P0803771-005	1.65	0.50	ND	8.3	
Odorox MDU On Hour 1 VOC2	P0803771-006	1.64	0.50	ND	8.2	
Odorox MDU On Hour 2 VOC3	P0803771-007	1.60	0.50	ND	8.0	
Odorox MDU On Hour 3 VOC4	P0803771-008	1.61	0.50	ND	8.1	
Method Blank	P081118-MB	1.00	0.50	ND	5.0	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

# COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 1 of 1

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox M.D.U. (S/N ODHG 000389)

CAS Project ID: P0803771

**Test Code:** EPA Method TO-11A  
**Instrument ID:** Waters LC Module 1 Plus/UV\_Vis 360/LC1  
**Analyst:** Hani Cherazaic  
**Matrix:** Silica Gel DNPH Tube  
**Test Notes:**

**Date Collected:** 11/18/08  
**Date Received:** 11/18/08  
**Date Analyzed:** 11/18/08

## Aldehyde Summary Results

CAS #	Compound	MDU OFF	MDU ON		
		Bkgrd µg/m <sup>3</sup>	Hour 1 µg/m <sup>3</sup>	Hour 2 µg/m <sup>3</sup>	Hour 3 µg/m <sup>3</sup>
50-00-0	Formaldehyde	9.2	14	13	12
75-07-0	Acetaldehyde	3.5	4.4	4.0	3.7
123-38-6	Propionaldehyde	ND	ND	ND	ND
4170-30-3	Crotonaldehyde, Total	ND	ND	ND	ND
123-72-8	Butyraldehyde	ND	ND	ND	ND
100-52-7	Benzaldehyde	ND	ND	ND	ND
590-86-3	Isovaleraldehyde	ND	ND	ND	ND
110-62-3	Valeraldehyde	ND	ND	ND	ND
529-20-4	o-Tolualdehyde	ND	ND	ND	ND
620-23-5	m,p-Tolualdehyde	ND	ND	ND	ND
104-87-0	n-Hexaldehyde	ND	ND	ND	ND
66-25-1	n-Hexaldehyde	ND	ND	ND	ND
5779-94-2	2,5-Dimethylbenzaldehyde	ND	ND	ND	ND

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.



# COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS OF ANALYSIS

Page 1 of 1

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox MDU S/N ODIIG 000389

CAS Project ID: P0803771

### TVOC as Toluene

**Test Code:** EPA TO-15  
**Instrument ID:** Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9  
**Analyst:** Elsa Moctezuma  
**Sampling Media:** 6.0 L Summa Canister(s)  
**Test Notes:**

**Date(s) Collected:** 11/18/08  
**Date Received:** 11/18/08  
**Date Analyzed:** 11/18/08

Client Sample ID	CAS Sample ID	Injection Volume Liter(s)	Canister Dilution Factor	Result $\mu\text{g}/\text{m}^3$	Data Qualifier
Odorox MDU Off Background VOC1	P0803771-005	1.00	1.65	150	
Odorox MDU On Hour 1 VOC2	P0803771-006	1.00	1.64	110	
Odorox MDU On Hour 2 VOC3	P0803771-007	1.00	1.60	100	
Odorox MDU On Hour 3 VOC4	P0803771-008	1.00	1.61	89	
Odorox MDU On Hour 3 VOC4	P0803771-008DUP	1.00	1.61	89	
Method Blank	P081118-MB	1.00	1.00	ND	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

Verified By: \_\_\_\_\_ Date: \_\_\_\_\_

## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 1 of 3

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox M.D.U. (S/N ODIIG 000389)

CAS Project ID: P0803771

**Test Code:** EPA TO-15  
**Instrument ID:** Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9  
**Analyst:** Elsa Moctezuma  
**Matrix:** 6.0 L Summa Canister(s)  
**Test Notes:**

**Date Collected:** 11/18/08  
**Date Received:** 11/18/08  
**Date Analyzed:** 11/18/08

## Volatile Organic Compound Summary Results

CAS #	Compound	MDU OFF	MDU ON		
		Bkgrd µg/m <sup>3</sup>	Hour 1 µg/m <sup>3</sup>	Hour 2 µg/m <sup>3</sup>	Hour 3 µg/m <sup>3</sup>
115-07-1	<b>Propene</b>	2.2	1.5	1.4	1.6
75-71-8	<b>Dichlorodifluoromethane (CFC 12)</b>	2.0	1.9	1.9	1.9
74-87-3	Chloromethane	ND	ND	ND	ND
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	ND	ND	ND	ND
75-01-4	Vinyl Chloride	ND	ND	ND	ND
106-99-0	1,3-Butadiene	ND	ND	ND	ND
74-83-9	Bromomethane	ND	ND	ND	ND
75-00-3	Chloroethane	ND	ND	ND	ND
64-17-5	<b>Ethanol</b>	11	ND	ND	8.6
107-02-8	Acrolein	ND	ND	ND	ND
67-64-1	<b>Acetone</b>	37	36	33	32
75-69-4	<b>Trichlorofluoromethane</b>	0.95	0.93	0.93	0.93
67-63-0	2-Propanol (Isopropyl Alcohol)	ND	ND	ND	1.8
107-13-1	Acrylonitrile	ND	ND	ND	ND
75-35-4	1,1-Dichloroethene	ND	ND	ND	ND
75-09-2	<b>Methylene Chloride</b>	5.1	4.2	4.9	4.0
107-05-1	3-Chloro-1-propene (Allyl Chloride)	ND	ND	ND	ND
76-13-1	Trichlorotrifluoroethane	ND	ND	ND	ND
75-15-0	<b>Carbon Disulfide</b>	12	9.4	13	14
156-60-5	trans-1,2-Dichloroethene	ND	ND	ND	ND
75-34-3	1,1-Dichloroethane	ND	ND	ND	ND
1634-04-4	Methyl tert-Butyl Ether	ND	ND	ND	ND
108-05-4	Vinyl Acetate	ND	ND	ND	ND
78-93-3	<b>2-Butanone (MEK)</b>	1.0	1.1	0.99	0.95

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 2 of 3

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox M.D.U. (S/N ODIIG 000389)

CAS Project ID: P0803771

**Test Code:** EPA TO-15  
**Instrument ID:** Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9  
**Analyst:** Elsa Moctezuma  
**Matrix:** 6.0 I. Summa Canister(s)  
**Test Notes:**

**Date Collected:** 11/18/08  
**Date Received:** 11/18/08  
**Date Analyzed:** 11/18/08

## Volatile Organic Compound Summary Results

CAS #	Compound	MDU OFF	MDU ON		
		Bkgrd µg/m <sup>3</sup>	Hour 1 µg/m <sup>3</sup>	Hour 2 µg/m <sup>3</sup>	Hour 3 µg/m <sup>3</sup>
156-59-2	cis-1,2-Dichloroethene	ND	ND	ND	ND
141-78-6	Ethyl Acetate	ND	ND	ND	ND
110-54-3	<b>n-Hexane</b>	<b>12</b>	<b>7.8</b>	<b>6.9</b>	<b>5.9</b>
67-66-3	Chloroform	ND	ND	ND	ND
109-99-9	<b>Tetrahydrofuran (THF)</b>	<b>1.7</b>	<b>7.3</b>	<b>11</b>	<b>7.2</b>
107-06-2	1,2-Dichloroethane	ND	ND	ND	ND
71-55-6	1,1,1-Trichloroethane	ND	ND	ND	ND
71-43-2	<b>Benzene</b>	<b>1.3</b>	<b>0.87</b>	ND	ND
56-23-5	Carbon Tetrachloride	ND	ND	ND	ND
110-82-7	Cyclohexane	ND	ND	ND	ND
78-87-5	1,2-Dichloropropane	ND	ND	ND	ND
75-27-4	Bromodichloromethane	ND	ND	ND	ND
79-01-6	Trichloroethene	ND	ND	ND	ND
123-91-1	1,4-Dioxane	ND	ND	ND	ND
80-62-6	Methyl Methacrylate	ND	ND	ND	ND
142-82-5	n-Heptane	ND	ND	ND	ND
10061-01-5	cis-1,3-Dichloropropene	ND	ND	ND	ND
108-10-1	4-Methyl-2-pentanone	ND	ND	ND	ND
10061-02-6	trans-1,3-Dichloropropene	ND	ND	ND	ND
79-00-5	1,1,2-Trichloroethane	ND	ND	ND	ND
108-88-3	<b>Toluene</b>	<b>4.6</b>	<b>3.4</b>	<b>2.3</b>	<b>1.6</b>
591-78-6	2-Hexanone	ND	ND	ND	ND
124-48-1	Dibromochloromethane	ND	ND	ND	ND
106-93-4	1,2-Dibromoethane	ND	ND	ND	ND
123-86-4	n-Butyl Acetate	ND	ND	ND	ND

ND – Compound was analyzed for, but not detected above the laboratory reporting limit.

## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 3 of 3

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox M.D.U. (S/N ODHG 000389)

CAS Project ID: P0803771

**Test Code:** EPA TO-15  
**Instrument ID:** Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9  
**Analyst:** Elsa Moctezuma  
**Matrix:** 6.0 L. Summa Canister(s)  
**Test Notes:**

**Date Collected:** 11/18/08  
**Date Received:** 11/18/08  
**Date Analyzed:** 11/18/08

## Volatile Organic Compound Summary Results

CAS #	Compound	MDU OFF	MDU ON		
		Bkgrd µg/m <sup>3</sup>	Hour 1 µg/m <sup>3</sup>	Hour 2 µg/m <sup>3</sup>	Hour 3 µg/m <sup>3</sup>
111-65-9	n-Octane	ND	ND	ND	ND
127-18-4	Tetrachloroethene	ND	ND	ND	ND
108-90-7	Chlorobenzene	ND	ND	ND	ND
100-41-4	Ethylbenzene	ND	ND	ND	ND
179601-23-1	<b>m,p-Xylenes</b>	<b>2.8</b>	<b>1.7</b>	ND	ND
75-25-2	Bromoform	ND	ND	ND	ND
100-42-5	Styrene	ND	ND	ND	ND
95-47-6	<b>o-Xylene</b>	<b>0.99</b>	ND	ND	ND
111-84-2	n-Nonane	ND	ND	ND	ND
79-34-5	1,1,2,2-Tetrachloroethane	ND	ND	ND	ND
98-82-8	Cumene	ND	ND	ND	ND
80-56-8	<b>alpha-Pinene</b>	<b>0.83</b>	ND	ND	ND
103-65-1	n-Propylbenzene	ND	ND	ND	ND
622-96-8	4-Ethyltoluene	ND	ND	ND	ND
108-67-8	1,3,5-Trimethylbenzene	ND	ND	ND	ND
95-63-6	<b>1,2,4-Trimethylbenzene</b>	<b>0.90</b>	ND	ND	ND
100-44-7	Benzyl Chloride	ND	ND	ND	ND
541-73-1	1,3-Dichlorobenzene	ND	ND	ND	ND
106-46-7	1,4-Dichlorobenzene	ND	ND	ND	ND
95-50-1	1,2-Dichlorobenzene	ND	ND	ND	ND
5989-27-5	<b>d-Limonene</b>	<b>1.0</b>	ND	ND	ND
96-12-8	1,2-Dibromo-3-chloropropane	ND	ND	ND	ND
120-82-1	1,2,4-Trichlorobenzene	ND	ND	ND	ND
91-20-3	Naphthalene	ND	ND	ND	ND
87-68-3	Hexachlorobutadiene	ND	ND	ND	ND

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.



Columbia 實驗室分析報告(翻譯)

**LABORATORY REPORT**

December 9, 2008

Ralph Kubitzki  
HGI Industries, Inc.  
2055 High Ridge Road  
Boynton Beach, FL 33426

**RE: Odorox MDU S/N ODHG 000389**

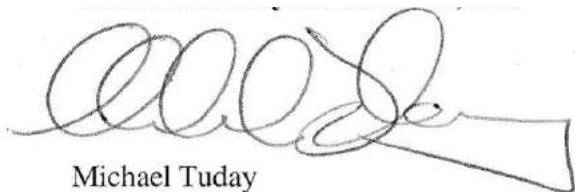
親愛的拉爾夫：

隨函附上 2008 年 11 月 5 日提交實驗室的樣本結果。為提供您參考，這些分析已分配我們的編號 P0803771。

所有分析均根據 NELAP(國家環境實驗認可計畫)批准的品質保證計畫進行。在提供實驗室案例說明中所述，其中應用使用的測試結果符合 NELAP 的標準要求。有關 NELAP 認證特定分析物的清單，請參閱 [www.caslab.com](http://www.caslab.com) 的認證部分。分析全部條件結果，適用於此處分析和報告的樣本。您的報告包含頁面。

哥倫比亞分析服務公司獲得加州衛生局認證，NELAP 實驗室證書號 02115CA;亞利桑那衛生局，證書號 AZ0694；佛羅里達州衛生局，NELAP 認證 E871020；新澤西州環境保護部，NELAP 實驗室認證 ID#CA009；紐約州衛生局，NELAP 紐約實驗室 ID 號：221；俄勒岡州環境實驗室認證計畫，NELAP ID：CA20007；美國工業衛生協會，實驗室#101661；海軍部；賓夕法尼亞註冊號 68-03307；TX 環境品質委員會，NELAP ID T104704413-TX。上面列出的每個認證都有明確的認證範圍，適用於特定的矩陣/方法/分析物;因此，請與我聯繫，瞭解特定認證對應的資訊。

如果您有任何問題，請致電 (805) 526-7161。



Michael Tuday  
Director of Research & Development

*The results of analyses are given in the attached laboratory report. All results are intended to be considered in their entirety, and Columbia Analytical Services, Inc. (CAS) is not responsible for utilization of less than the complete report.*

## HGI Industries

### 移動消毒裝置 (M.D.U.)

#### 羥基空氣處理器

Odorox M.D.U. (序號ODHG 000389) 對羥基空氣處理器進行評估，以確認該裝置中的羥基離子生成技術是否會導致某些特定的揮發性有機化合物 (VOCs)、醛類、一氧化碳 (CO) 和臭氧 (O<sub>3</sub>) 的濃度是否明顯升高。由四個隱蔽採樣週期組成的試驗：於2008年11月18日至20日，在設備運行的情況下，而後關閉設備進行一次1小時的背景評估，然後連續三個1小時的採樣週期。

測試室為一個辦公室 11.5' x 11.5' x 9'。辦公室為乾式牆，有商業/辦公室類型的地毯和"降噪"天花板瓷磚。測試室同時具有暖氣空調。辦公室內有一個刨花板/層壓櫃和櫥櫃，兩把軟墊辦公椅，以及桌上型電腦和 24 個紙板檔案儲存箱。

M.D.U.被放回牆上，使裝置的排氣與四英尺外的桌子平行。Odorox M.D.U.的進氣處位於離房間唯一一扇門約 6 英寸處，在測試期間一直關閉。取樣裝置的入口（直接讀取臭氧監測器、電拋光不銹鋼罐和醛管製造泵）被放置在研究人員的呼吸區域中，高度為 44" 的桌子頂部。

除了直接讀數臭氧監測器外，每個取樣週期還收集了兩種其他樣本：在電拋光不銹鋼罐 (Summa 罐) 中收集的全空氣樣品，用於測量特定揮發性有機物和一氧化碳，和在二硝基苯甲酸酯 (DNPH) 浸漬矽膠管上收集的泵送空氣樣本，用於測量特定的醛類。

### 臭氧測量

臭氧測量使用直接讀取儀器，即 InDevR 2B 技術中的 UV-106 型號 (序號 007)。透過測量紫外線的吸收來監測臭氧。臭氧分子在 254 納米處具有最大吸收，與儀器內的低壓汞燈的主要發射波長重合。臭氧的測量基於穿過裝有石英窗的 15 釐米長吸收單元的光衰減。低壓汞燈位於吸收單元的一側，另一側是光電二極體。臭氧洗滌器提供空參考。光電二極體的光強度在通過臭氧洗滌器的空氣和未通過洗滌器的空氣中交替測量。臭氧濃度是根據比爾 - 朗伯定律計算。

## 揮發性有機化合物（VOC）分析

在預先清潔和認證的 6 升 Summa 鈍化不銹鋼罐中收集整個空氣樣本。根據 EPA 方法 TO-15，對 Summa 罐樣本分析了 75 種特定揮發性有機化合物以及更多其他的化合物和總揮發性有機化合物（TVOC）。

在一個小時內，使用校準的低體積流量控制器收集樣本。

使用安捷倫型號 6890 系列氣體色譜儀/5973 型品質選擇性檢測器（GC/MSD）對特定和總 VOC 進行分析，該探測器與 Tekmar 模型 AUTOC 介面為自動全空氣集中器。

對於 VOC 的色譜分離，將具有 1.0 微米膜厚度的 60 米×0.25 毫米 Rxi-1ms 鍵合相熔融石英柱（Restek Corporation，Bellefonte，PA）從 40°C（保持 1 分鐘）溫度編程至 80°C，SC / 然後以 10°C/分鐘至 160°C，然後以 20°C/分鐘至 240°C（在 240°C 保持 51 分鐘）。

質量選擇檢測器在全掃描 1 節點中運行，從 33amu 到 280amu，電壓為 70 電子伏特。

初步確定的化合物是利用品質光譜庫中大約 180,000 入口 NIST 品質光譜庫獲得的。除了資料系統最佳匹配演算法外，分析人員還採用了直觀和傳統的方法。品質光譜解釋。不能確定為完全符合的化合物被定義為最具體的通用分類（例如，C<sub>9</sub> 碳酸、C<sub>12</sub> 支鏈脂肪烴等）。大致濃度計算為 假設用適當的內標化合物 1：1 定義，將近似濃度計算為一個有效數字。

## 一氧化碳的測量

根據經過改進的 EPA 方法 25C，通過氣相色譜/全燃燒分析/火焰離子檢測，對 summa 鈍化不銹鋼罐的樣品進行一氧化碳分析。

## 甲醛和其他碳化物化合物的測量

使用矽膠管收集甲醛和其他碳基化合物的樣品，，用衍生試劑 2,4-二硝基苯肼（DNPH）浸漬。使用個人取樣泵以每分鐘 1 升的標準速率將空氣抽吸通過管 60 分鐘。

根據 EPA 方法 TO-11A，對 DNPH 矽膠管分析了 13 種特定醛。該方法的摘要如下：樣品中的碳基化合物



與 2，4-二硝基氫化物試劑發生反應，形成穩定的醛-氫化物衍生物。這些衍生物使用乙醯乙醯化物從矽膠中化學脫除。使用高性能液相色譜（HPLC）與紫外線（UV）檢測分析去氧乙醯乙酸酯提取物。

將矽膠管的前（樣品）和後（突破）部分分別倒入玻璃小瓶中。將試劑級乙腈加入衍生化的矽膠吸附劑中。使用配備有紫外/可見檢測器的 Waters Module I Plus 高效液相色譜儀分別分析每個小瓶，所述紫外/可見檢測器在紫外範圍內的波長為 360 納米。將 Kromasil C18（5mm×2.1mm×3micron）柱（Restek Corporation，Bellefonte，PA）以線性梯度模式編程，從 100%流動相 A（60/30 / 10 水/乙腈/四氫呋喃）到 100%移動 B 相（60/40 乙腈/水）在 7.5 分鐘內以 0.7 毫升/分鐘的流速進行。

### 結果摘要

分析結果在所附的摘要表上。

MDU 運行的三小時測量臭氧結果（60 分鐘平均值）分別為 13.9ppbV、13.2 ppbV 和 7.0 ppbV（平均濃度=11.4 ppbV），分別為 13.9 ppbV、13.2 ppbV 和 7.0 ppbV（平均濃度= 11.4 ppbV），與 1.3ppbV 的測量背景結果相比。相比之下，根據加州空氣資源委員會，它運行環境空氣監測網路位於距離 CAS 實驗室約 8 英里的 Simi Valley-Cochran 街的一個地方，平均測量戶外測量在三小時 MDU 測量期間臭氧濃度為 3 ppbV。背景評價期間的室外測量值為 19 ppbV。

在整個試驗過程中，沒有發現一氧化碳超過實驗室方法報告限制。

甲醛的測量濃度（3 小時測試的平均值=13 微克/立方米）略高於背景濃度（9.2 微克/立方米），但處於典型的室內水準。在實驗誤差範圍內，打開 MDU 的乙醛濃度與測得的背景水準相當。

值得注意的是，在 MDU 運行的三小時內，總揮發性有機化合物（如苯二苯）的濃度降低了 40% 以上。

# COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 1 of 1

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox M.D.U. (S/N ODHG 000389)

CAS Project ID: P0803771

**Test Code:** Ozone By Direct Reading Instrument 臭氧直通讀取器  
**Instrument ID:** UV-106 (InDevR 2B Technologies)  
**Analyst:** K. Chen  
**Matrix:** Continuous Monitor 連續監測器  
**Test Conditions:** Full Fan Speed, Full Processor Power 全風扇速度，全處理器功率

Date Analyzed: 11/20/2008

## 臭氧結果

CAS #	Compound	MDU OFF	MDU ON			MRL ppmV
		Bkgrd	Hour 1	Hour 2	Hour 3	
		P0803771-009	P0803771-010	P0803771-011	P0803771-012	
10028-15-6	Ozone 臭氧	0.0013	0.0139	0.0132	0.0070	0.001

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

ND = 化合物進行了分析，但未檢測到超過實驗室報告限制。

## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS OF ANALYSIS

Page 1 of 1

Client: HGI Industries, Inc.  
Client Project ID: Odorox MDU S/N ODHG 000389

CAS Project ID: P0803771

## Carbon Monoxide

一氧化碳

Test Code: EPA Method 25C Modified  
Instrument ID: HP5890 II/GC1/FID/TCA  
Analyst: Zheng Wang/Wade Henton  
Sampling Media: 6.0 L Summa Canister(s)  
Test Notes:

Date(s) Collected: 11/18/08  
Date Received: 11/18/08  
Date Analyzed: 11/18/08

Client Sample ID	CAS Sample ID	罐	注射	Result ppmV	MRL ppmV	Data Qualifier
		稀釋 因子	體積 毫升			
		Canister Dilution Factor	Injection Volume ml(s)			
Odorox MDU Off Background VOC1	P0803771-005	1.65	0.50	ND	8.3	
Odorox MDU On Hour 1 VOC2	P0803771-006	1.64	0.50	ND	8.2	
Odorox MDU On Hour 2 VOC3	P0803771-007	1.60	0.50	ND	8.0	
Odorox MDU On Hour 3 VOC4	P0803771-008	1.61	0.50	ND	8.1	
Method Blank	P081118-MB	1.00	0.50	ND	5.0	

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

MRL = Method Reporting Limit - The minimum quantity of a target analyte that can be confidently determined by the referenced method.

ND = 化合物進行了分析，但未檢測到超過實驗室報告限制。

MRL = 方法報告限制 - 目標（可由引用的方法自信地確定）的最小數量。

## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 1 of 1

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox M.D.U. (S/N ODHG 000389)

CAS Project ID: P0803771

**Test Code:** EPA Method TO-11A  
**Instrument ID:** Waters LC Module I Plus/UV\_Vis 360/LC1  
**Analyst:** Hani Cherazaie  
**Matrix:** Silica Gel DNPH Tube  
**Test Notes:**

**Date Collected:** 11/18/08  
**Date Received:** 11/18/08  
**Date Analyzed:** 11/18/08

## Aldehyde Summary Results

## 醛 總結 結果

CAS #	Compound		MDU OFF	MDU ON		
			Bkgrd µg/m <sup>3</sup>	Hour 1 µg/m <sup>3</sup>	Hour 2 µg/m <sup>3</sup>	Hour 3 µg/m <sup>3</sup>
50-00-0	Formaldehyde	甲醛	9.2	14	13	12
75-07-0	Acetaldehyde	乙醛	3.5	4.4	4.0	3.7
123-38-6	Propionaldehyde	丙醛	ND	ND	ND	ND
4170-30-3	Crotonaldehyde, Total	巴豆醛, 總量	ND	ND	ND	ND
123-72-8	Butyraldehyde	丁醛	ND	ND	ND	ND
100-52-7	Benzaldehyde	苯甲醛	ND	ND	ND	ND
590-86-3	Isovaleraldehyde	異戊醛	ND	ND	ND	ND
110-62-3	Valeraldehyde	戊醛	ND	ND	ND	ND
529-20-4	o-Tolualdehyde	鄰甲基苯甲醛	ND	ND	ND	ND
620-23-5	m,p-Tolualdehyde	間,對-甲基苯甲醛	ND	ND	ND	ND
104-87-0						
66-25-1	n-Hexaldehyde	正己醛	ND	ND	ND	ND
5779-94-2	2,5-Dimethylbenzaldehyde	2,5-二甲基苯甲醛	ND	ND	ND	ND

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

ND = 化合物進行了分析，但未檢測到超過實驗室報告限制。

## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS OF ANALYSIS

Page 1 of 1

Client: HGI Industries, Inc.

Client Project ID: Odorox MDU S/N ODHG 000389

CAS Project ID: P0803771

## TVOC as Toluene

## TVOC 甲苯

Test Code: EPA TO-15

Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9

Analyst: Elsa Moctezuma

Sampling Media: 6.0 L Summa Canister(s)

Test Notes:

注射

罐

體積

稀釋

升

因子

Injection

Canister

Client Sample ID	CAS Sample ID	Injection Volume Liter(s)	Canister Dilution Factor	Result µg/m <sup>3</sup>	Data Qualifier
Odorox MDU Off Background VOC1	P0803771-005	1.00	1.65	150	
Odorox MDU On Hour 1 VOC2	P0803771-006	1.00	1.64	110	
Odorox MDU On Hour 2 VOC3	P0803771-007	1.00	1.60	100	
Odorox MDU On Hour 3 VOC4	P0803771-008	1.00	1.61	89	
Odorox MDU On Hour 3 VOC4	P0803771-008DUP	1.00	1.61	89	
Method Blank	P081118-MB	1.00	1.00	ND	

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ND = 化合物進行了分析，但未檢測到超過實驗室報告限制。

## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 1 of 3

**Client:** HGI Industries, Inc.  
**Client Project ID:** Odorox M.D.U. (S/N ODHG 000389)

CAS Project ID: P0803771

**Test Code:** EPA TO-15  
**Instrument ID:** Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9  
**Analyst:** Elsa Moctezuma  
**Matrix:** 6.0 L Summa Canister(s)  
**Test Notes:**

**Date Collected:** 11/18/08  
**Date Received:** 11/18/08  
**Date Analyzed:** 11/18/08

## Volatile Organic Compound Summary Results

### 揮發性有機化合物總結

CAS #	Compound		MDU OFF	MDU ON		
			Bkgrd µg/m <sup>3</sup>	Hour 1 µg/m <sup>3</sup>	Hour 2 µg/m <sup>3</sup>	Hour 3 µg/m <sup>3</sup>
115-07-1	Propene	丙烯	2.2	1.5	1.4	1.6
75-71-8	Dichlorodifluoromethane (CFC 12)	二氯二氟甲烷(CFC 12)	2.0	1.9	1.9	1.9
74-87-3	Chloromethane	氯甲烷	ND	ND	ND	ND
76-14-2	1,2-Dichloro-1,1,2,2-tetrafluoroethane (CFC 114)	1,2-二氯 - 1,1,2,2-四氟乙烷(CFC 114)	ND	ND	ND	ND
75-01-4	Vinyl Chloride	氯乙烯	ND	ND	ND	ND
106-99-0	1,3-Butadiene	1,3-丁二烯	ND	ND	ND	ND
74-83-9	Bromomethane	溴甲烷	ND	ND	ND	ND
75-00-3	Chloroethane	氯乙烷	ND	ND	ND	ND
64-17-5	Ethanol	乙醇	11	ND	ND	8.6
107-02-8	Acrolein	丙烯醛	ND	ND	ND	ND
67-64-1	Acetone	丙酮	37	36	33	32
75-69-4	Trichlorofluoromethane	三氯氟甲烷	0.95	0.93	0.93	0.93
67-63-0	2-Propanol (Isopropyl Alcohol)	2-丙醇 (異丙醇)	ND	ND	ND	1.8
107-13-1	Acrylonitrile	丙烯腈	ND	ND	ND	ND
75-35-4	1,1-Dichloroethene	1,1-二氯乙烯	ND	ND	ND	ND
75-09-2	Methylene Chloride	二氯甲烷	5.1	4.2	4.9	4.0
107-05-1	3-Chloro-1-propene (Allyl Chloride)	3-氯-1-丙烯(烯丙基氯)	ND	ND	ND	ND
76-13-1	Trichlorotrifluoroethane	三氯三氟乙烷	ND	ND	ND	ND
75-15-0	Carbon Disulfide	二硫化碳	12	9.4	13	14
156-60-5	trans-1,2-Dichloroethene	反式-1,2-二氯乙烯	ND	ND	ND	ND
75-34-3	1,1-Dichloroethane	1,1-二氯乙烷	ND	ND	ND	ND
1634-04-4	Methyl tert-Butyl Ether	甲基叔丁基醚	ND	ND	ND	ND
108-05-4	Vinyl Acetate	乙酸乙烯酯	ND	ND	ND	ND
78-93-3	2-Butanone (MEK)	2-丁酮 (MEK)	1.0	1.1	0.99	0.95

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## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 2 of 3

Client: HGI Industries, Inc.  
 Client Project ID: Odorox M.D.U. (S/N ODHG 000389)

CAS Project ID: P0803771

Test Code: EPA TO-15  
 Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9  
 Analyst: Elsa Moctezuma  
 Matrix: 6.0 L Summa Canister(s)  
 Test Notes:

Date Collected: 11/18/08  
 Date Received: 11/18/08  
 Date Analyzed: 11/18/08

## Volatile Organic Compound Summary Results

### 揮發性有機化合物總結

CAS #	Compound		MDU OFF	MDU ON		
			Bkgrd µg/m <sup>3</sup>	Hour 1 µg/m <sup>3</sup>	Hour 2 µg/m <sup>3</sup>	Hour 3 µg/m <sup>3</sup>
156-59-2	cis-1,2-Dichloroethene	順式-1,2-二氯乙烯	ND	ND	ND	ND
141-78-6	Ethyl Acetate	乙酸乙酯	ND	ND	ND	ND
110-54-3	n-Hexane	正己烷	12	7.8	6.9	5.9
67-66-3	Chloroform	氯仿	ND	ND	ND	ND
109-99-9	Tetrahydrofuran (THF)	四氫呋喃 (THF)	1.7	7.3	11	7.2
107-06-2	1,2-Dichloroethane	1,2-二氯乙烷	ND	ND	ND	ND
71-55-6	1,1,1-Trichloroethane	1,1,1-三氯乙烷	ND	ND	ND	ND
71-43-2	Benzene	苯	1.3	0.87	ND	ND
56-23-5	Carbon Tetrachloride	四氯化碳	ND	ND	ND	ND
110-82-7	Cyclohexane	環己	ND	ND	ND	ND
78-87-5	1,2-Dichloropropane	1,2-二氯丙	ND	ND	ND	ND
75-27-4	Bromodichloromethane	一溴二氯甲烷	ND	ND	ND	ND
79-01-6	Trichloroethene	三氯乙烯	ND	ND	ND	ND
123-91-1	1,4-Dioxane	1,4-二惡烷	ND	ND	ND	ND
80-62-6	Methyl Methacrylate	甲基丙烯酸甲酯	ND	ND	ND	ND
142-82-5	n-Heptane	正庚烷	ND	ND	ND	ND
10061-01-5	cis-1,3-Dichloropropene	順式 1,3-二氯丙烯	ND	ND	ND	ND
108-10-1	4-Methyl-2-pentanone	4-甲基-2-戊酮	ND	ND	ND	ND
10061-02-6	trans-1,3-Dichloropropene	反式 1,3-二氯丙烯	ND	ND	ND	ND
79-00-5	1,1,2-Trichloroethane	1,1,2-三氯乙烷	ND	ND	ND	ND
108-88-3	Toluene	甲苯	4.6	3.4	2.3	1.6
591-78-6	2-Hexanone	2-己	ND	ND	ND	ND
124-48-1	Dibromochloromethane	二溴	ND	ND	ND	ND
106-93-4	1,2-Dibromoethane	1,2-二溴乙烷	ND	ND	ND	ND
123-86-4	n-Butyl Acetate	乙酸正丁酯	ND	ND	ND	ND

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## COLUMBIA ANALYTICAL SERVICES, INC.

## RESULTS SUMMARY

Page 3 of 3

Client: HGI Industries, Inc.  
 Client Project ID: Odorox M.D.U. (S/N ODHG 000389)

CAS Project ID: P0803771

Test Code: EPA TO-15  
 Instrument ID: Tekmar AUTOCAN/Agilent 5973inert/6890N/MS9  
 Analyst: Elsa Moctezuma  
 Matrix: 6.0 L Summa Canister(s)  
 Test Notes:

Date Collected: 11/18/08  
 Date Received: 11/18/08  
 Date Analyzed: 11/18/08

## Volatile Organic Compound Summary Results

### 揮發性有機化合物總結

CAS #	Compound		MDU OFF	MDU ON		
			Bkgrd µg/m <sup>3</sup>	Hour 1 µg/m <sup>3</sup>	Hour 2 µg/m <sup>3</sup>	Hour 3 µg/m <sup>3</sup>
111-65-9	n-Octane	正辛烷	ND	ND	ND	ND
127-18-4	Tetrachloroethene	四氯乙烷	ND	ND	ND	ND
108-90-7	Chlorobenzene	氯苯	ND	ND	ND	ND
100-41-4	Ethylbenzene	乙苯	ND	ND	ND	ND
179601-23-1	<b>m,p-Xylenes</b>	間,對-二甲苯	<b>2.8</b>	<b>1.7</b>	ND	ND
75-25-2	Bromoform	三溴甲烷	ND	ND	ND	ND
100-42-5	Styrene	苯乙烯	ND	ND	ND	ND
95-47-6	<b>o-Xylene</b>	鄰二甲苯	<b>0.99</b>	ND	ND	ND
111-84-2	n-Nonane	正壬烷	ND	ND	ND	ND
79-34-5	1,1,2,2-Tetrachloroethane	1,1,2,2-四氯乙烷	ND	ND	ND	ND
98-82-8	Cumene	異丙苯	ND	ND	ND	ND
80-56-8	<b>alpha-Pinene</b>	$\alpha$ -蒎烯	<b>0.83</b>	ND	ND	ND
103-65-1	n-Propylbenzene	正丙	ND	ND	ND	ND
622-96-8	4-Ethyltoluene	4-乙基甲苯	ND	ND	ND	ND
108-67-8	1,3,5-Trimethylbenzene	1,3,5-三甲苯	ND	ND	ND	ND
95-63-6	<b>1,2,4-Trimethylbenzene</b>	偏三甲苯	<b>0.90</b>	ND	ND	ND
100-44-7	Benzyl Chloride	苄基氯	ND	ND	ND	ND
541-73-1	1,3-Dichlorobenzene	1,3-二氯苯	ND	ND	ND	ND
106-46-7	1,4-Dichlorobenzene	1,4-二氯苯	ND	ND	ND	ND
95-50-1	1,2-Dichlorobenzene	1,2-二氯苯	ND	ND	ND	ND
5989-27-5	<b>d-Limonene</b>	d 檸檬烯	<b>1.0</b>	ND	ND	ND
96-12-8	1,2-Dibromo-3-chloropropane	1,2-二溴-3-氯丙烷	ND	ND	ND	ND
120-82-1	1,2,4-Trichlorobenzene	1,2,4-三氯苯	ND	ND	ND	ND
91-20-3	Naphthalene	萘	ND	ND	ND	ND
87-68-3	Hexachlorobutadiene	六氯丁二烯	ND	ND	ND	ND

ND = Compound was analyzed for, but not detected above the laboratory reporting limit.

ND = 化合物進行了分析，但未檢測到超過實驗室報告限制。