Metropolitan Museum of Art
Gas Chromatography- Mass Spectrometry (GC-MS) Results from Material Analysis

This document includes (1) a mass spectrum and (2) the volatile organic compounds (VOCs) emitted from samples using GC-MS analysis. The data is not interpreted; however, several classes of chemicals are highlighted because they are potential risks for artwork in an enclosed environment. A basic key, provided below, indicates those classes. The amount of each chemical identified has not been determined; similarly, it is not known how much of each chemical is necessary to do damage to art. Finally, peaks may be present that are the result of the sample adsorbing chemicals from the air and reemitting them during testing rather than being inherent to the sample. Research is ongoing to determine specifically which chemicals and amounts are required to negatively affect artifacts.

Highlighted data:

Pink – chemicals currently known to be hazardous to art

Green – amines; can raise the pH, are suspected to react with acids and may form crystals in an enclosed environment

Yellow – chemicals of the following type, which *may* be hazardous to art:

Acids – lower the pH, corrosive to metals, degrade organic materials

Aldehydes – can convert to acids with heat or exposure to UV light

Esters – can hydrolyze into acids with heat and humidity

Sulfur-containing compounds – known to tarnish and corrode some metals

Halogenated compounds – can become reactive with exposure to heat and UV light

Nitrogen-containing, not amine – can react with other off-gassed chemicals

Alkynes – can become reactive when exposed to heat or UV light

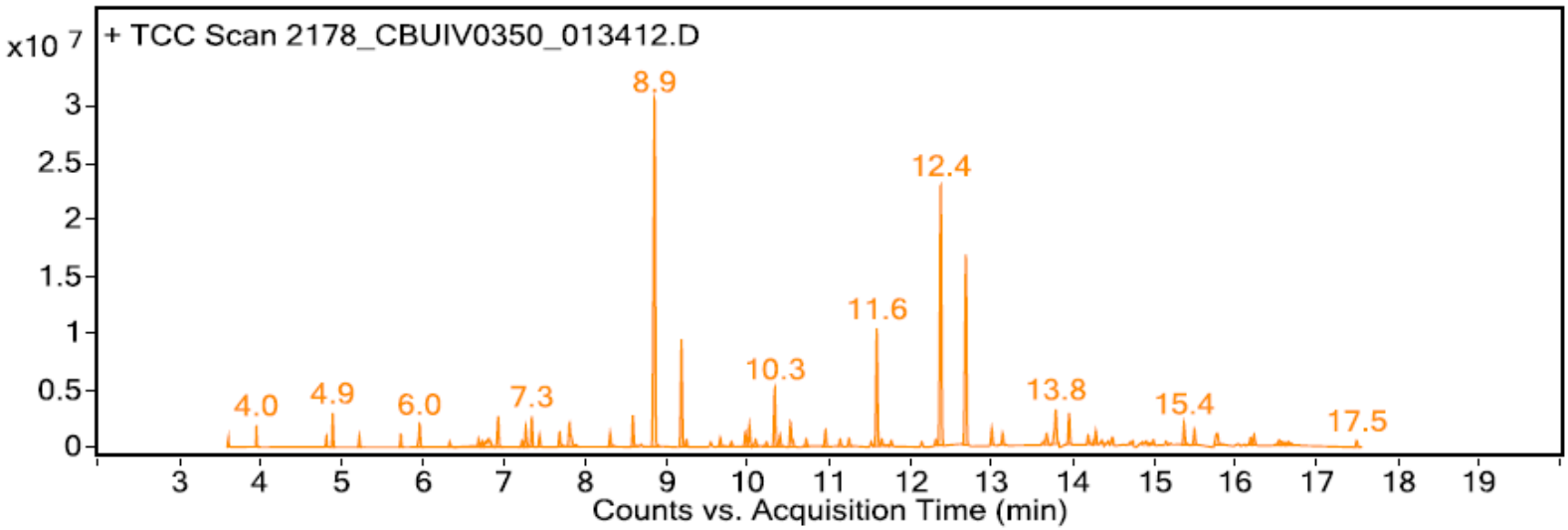
Sample: Creation Baumann Unisono IV 0350 gray cotton fabric

Oddy test result: Temporary

Date collected: 06/26/2018

Technique used: SPME with a PDMS/DVB fiber; Agilent 7890B GC and 5977B MS fitted with a GL Sciences OPTIC-4 multimode inlet and LEAP PAL RTC autosampler; Pre-heated at 60°C for 20 minutes; fiber exposure at 60°C for 20 minutes; sample injected into 220°C inlet and crotrapped for 2 min at -15°C; GC ramped from 40°C to 225 °C at 10°C/min. Data analyzed in masshunter Qualitative. Samples > 80% match with a NIST library are reported.

VOCs not highlighted are because they were also observed in blanks: : (1) 5.7 min: methoxyphenyl oxime; (2) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
3.600	97.9	C2H4O2	60.0	689810	64-19-7	Acetic acid
4.000	93.7	C2H8O2Si	92.0	1316568	1066-42-8	Silanediol, dimethyl-
4.800	97.4	C6H12O	100.1	899197	66-25-1	Hexanal
4.900	92.5	C6H18O3Si3	222.1	2752720	541-05-9	Cyclotrisiloxane, hexamethyl-
5.200	95.3	C6H12O2	116.1	918202	123-42-2	2-Pentanone, 4-hydroxy-4-methyl-
5.700	85.8	C8H9NO2	151.1	1189039	1000222-86-6	Oxime-, methoxy-phenyl-_
6.000	93.4	C6H14O2	118.1	2224043	111-76-2	Ethanol, 2-butoxy-
6.300	94.4	C5H12O3	120.1	576541	111-77-3	Ethanol, 2-(2-methoxyethoxy)-
6.700	86.0	C4H10O3	106.1	1000835	111-46-6	Ethanol, 2,2'-oxybis-
6.800	98.4	C7H6O	106.0	483871	100-52-7	Benzaldehyde
6.900	82.2	C6H6O	94.0	726825	108-95-2	Phenol
6.900	94.3	C8H24O4Si4	296.1	2796940	556-67-2	Cyclotetrasiloxane, octamethyl-
7.300	88.4	C6H14O3	134.1	1106046	111-90-0	Ethanol, 2-(2-ethoxyethoxy)-
7.300	97.9	C8H16O	128.1	2249789	124-13-0	Octanal
7.400	98.2	C7H16O3	148.1	1330734	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.700	93.8	C8H18O	130.1	1848643	104-76-7	1-Hexanol, 2-ethyl-
7.800	95.5	C7H8O	108.1	2599293	100-51-6	Benzyl Alcohol
7.800	90.8	C6H14O2	118.1	816098	6920-22-5	1,2-Hexanediol
7.800	90.7	C5H9NO	99.1	696106	872-50-4	2-Pyrrolidinone, 1-methyl-
8.700	84.4	C9H20O	144.2	482900	999057-76-9	2,6-dimethyl-1-heptanol
8.900	97.4	C9H18O	142.1	47335747	124-19-6	Nonanal
9.200	95.5	C10H30O5Si5	370.1	12043639	541-02-6	Cyclopentasiloxane, decamethyl-

9.200	94.0	C7H12O4	160.1	682922	1119-40-0	Pentanedioic acid, dimethyl ester
9.500	93.9	C8H18O2	146.1	569919	144-19-4	1,3-Pentanediol, 2,2,4-trimethyl-
9.700	93.2	C9H16O	140.1	1070710	18829-56-6	2-Nonenal, (E)-
9.800	87.1	C9H20O	144.2	648022	143-08-8	1-Nonanol
10.000	98.1	C10H20O	156.2	1839962	15356-70-4	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-
10.000	95.7	C8H18O3	162.1	1459565	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
10.100	91.1	C7H14O3	146.1	1030406	5187-23-5	1,3-Dioxane-5-methanol, 5-ethyl-
10.300	97.7	C10H20O	156.2	6695288	112-31-2	Decanal
10.500	93.0	C8H10O2	138.1	2928116	122-99-6	Ethanol, 2-phenoxy-
11.000	93.1	C12H24O2	200.2	2022239	7434-89-1	Hexanoic acid, 2-ethyl-, 2-methylpropyl ester
11.100	95.0	C10H18O	154.1	855011	3913-81-3	2-Decenal, (E)-
11.200	97.6	C10H22O	158.2	985117	112-30-1	1-Decanol
11.500	92.2	C10H14O	150.1	692210	585-34-2	Phenol, 3-(1,1-dimethylethyl)-
11.600	96.0	C12H36O6Si6	444.1	14464467	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.600	95.3	C13H28	184.2	1023433	629-50-5	Tridecane
11.800	96.6	C11H22O	170.2	767823	112-44-7	Undecanal
12.100	94.3	C9H14O6	218.1	636873	102-76-1	Triacetin
12.400	89.4	C12H24O3	216.2	19270506	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.700	93.9	C12H24O3	216.2	25237977	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.000	94.5	C14H30	198.2	2324644	629-59-4	Tetradecane
13.100	97.6	C12H24O	184.2	1636105	112-54-9	Dodecanal
13.700	87.1	C14H28	196.2	844249	2882-98-6	Cyclopentane, nonyl-
13.800	80.2	C14H42O7Si7	518.1	4304382	107-50-6	Cycloheptasiloxane, tetradecamethyl-
14.000	97.0	C12H26O	186.2	3935453	112-53-8	1-Dodecanol
14.200	94.5	C15H30	210.2	1438375	13360-61-7	1-Pentadecene
14.300	93.1	C15H32	212.3	2032672	629-62-9	pentadecane
14.400	95.0	C13H26O	198.2	581298	10486-19-8	Tridecanal
14.700	87.4	C16H48O6Si7	532.2	550571	541-01-5	Heptasiloxane, hexadecamethyl-
14.900	85.2	C20H42O3S	362.3	640788	1000309-13-6	Sulfurous acid, hexyl tetradecyl ester
15.000	93.0	C15H30	210.2	794185	2883-02-5	n-Nonylcyclohexane
15.100	91.8	C16H34	226.3	516510	2882-96-4	Pentadecane, 3-methyl-
15.500	90.5	C16H34	226.3	2034299	3891-99-4	2,6,10-Trimethyltridecane
15.800	90.4	C16H48O8Si8	592.2	1130316	556-68-3	Cyclooctasiloxane, hexadecamethyl-
15.800	90.3	C15H30O2	242.2	1294779	10233-13-3	Dodecanoic acid, 1-methylethyl ester
16.000	81.2	C18H38	254.3	490294	3892-00-0	Pentadecane, 2,6,10-trimethyl-
16.200	92.4	C16H32	224.3	1051715	6785-23-5	Cyclopentane, undecyl-
16.200	92.8	C16H34O	242.3	1425099	629-82-3	Octane, 1,1'-oxybis-
16.600	86.4	C12H26O	186.2	646261	112-53-8	1-Dodecanol
16.700	80.2	C17H36	240.3	900127	629-78-7	Heptadecane
17.500	98.1	C14H12O2	212.1	839244	120-51-4	Benzyl benzoate