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

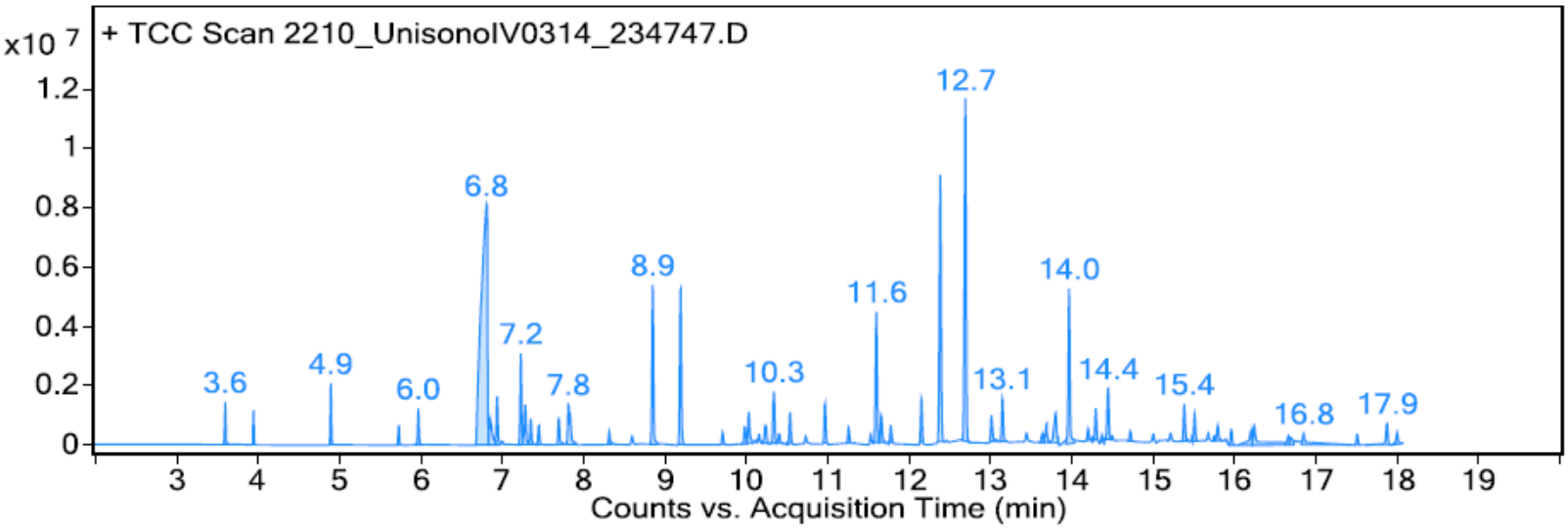
Sample: Creation Baumann Unisono IV 0314 dark blue gray cotton fabric

Oddy test result: Temporary

Date GC-MS collected: 6/20/2018

Technique used: SPME Arrow 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 sample at 60°C for 20 minutes; fiber exposure to sample at 60°C for 20 minutes; fiber injected into 220°C inlet and cryotrapped 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: 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	98.6	C2H4O2	60.0	1277761	64-19-7	Acetic acid
3.900	93.7	C2H8O2Si	92.0	925367	1066-42-8	Silanediol, dimethyl-
4.900	92.5	C6H18O3Si3	222.1	1807678	541-05-9	Cyclotrisiloxane, hexamethyl-
5.700	85.8	C8H9NO2	151.1	673324	1000222-86-6	Oxime-, methoxy-phenyl-_
6.000	94.8	C6H14O2	118.1	1355341	111-76-2	Ethanol, 2-butoxy-
6.800	97.1	C4H10O3	106.1	41195840	111-46-6	Ethanol, 2,2'-oxybis-
6.900	89.6	C8H24O4Si4	296.1	1932883	556-67-2	Cyclotetrasiloxane, octamethyl-
7.200	96.8	C6H14O3Si	162.1	3878870	1000376-38-1	1,3,6-Trioxa-2-silacyclooctane, 2,2,-dimethylsilyl-
7.300	87.4	C7H16O3	148.1	951873	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.400	97.7	C8H16O	128.1	700790	124-13-0	Octanal
7.400	98.2	C7H16O3	148.1	863719	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.700	97.4	C8H18O	130.1	1228010	104-76-7	1-Hexanol, 2-ethyl-
7.800	95.9	C7H8O	108.1	1844787	100-51-6	Benzyl Alcohol
7.800	90.9	C6H14O2	118.1	1083289	6920-22-5	1,2-Hexanediol
8.900	97.8	C9H18O	142.1	6880223	124-19-6	Nonanal
9.200	94.4	C10H30O5Si5	370.1	7340064	541-02-6	Cyclopentasiloxane, decamethyl-
10.000	97.7	C10H20O	156.2	845570	1490-04-6	Cyclohexanol, 5-methyl-2-(1-methylethyl)-

10.000	95.6	C8H18O3	162.1	841114	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
10.200	81.6	C12H26	170.2	920359	112-40-3	Dodecane
10.300	97.5	C10H20O	156.2	2369886	112-31-2	Decanal
10.500	93.2	C8H10O2	138.1	1546939	122-99-6	Ethanol, 2-phenoxy-
11.000	96.2	C12H24O2	200.2	1924468	7434-89-1	Hexanoic acid, 2-ethyl-, 2-methylpropyl ester
11.300	97.9	C10H22O	158.2	813110	112-30-1	1-Decanol
11.500	91.5	C10H14O	150.1	571094	585-34-2	Phenol, 3-(1,1-dimethylethyl)-
11.600	95.3	C12H36O6Si6	444.1	6493558	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.700	94.0	C13H28	184.2	1567782	629-50-5	Tridecane
11.800	97.4	C11H22O	170.2	872960	112-44-7	Undecanal
12.200	93.4	C7H12O5	176.1	2142970	25395-31-7	1,2,3-Propanetriol, diacetate
12.400	89.9	C12H24O3	216.2	12824952	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.700	93.5	C12H24O3	216.2	17320296	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.000	95.6	C14H30	198.2	1464074	629-59-4	Tetradecane
13.100	97.1	C12H24O	184.2	2127295	112-54-9	Dodecanal
13.400	84.5	C22H44O3	356.3	543381	1000383-16-0	Carbonic acid, decyl undecyl ester
13.700	87.5	C14H28	196.2	483207	2882-98-6	Cyclopentane, nonyl-
14.000	97.0	C12H26O	186.2	7016802	112-53-8	1-Dodecanol
14.200	93.9	C15H30	210.2	710463	13360-61-7	1-Pentadecene
14.300	92.3	C17H36O3S	320.2	1662412	999508-28-5	Sulfurous acid, 2-ethylhexyl nonyl ester
14.400	81.2	C15H24O	220.2	475814	999235-71-9	4P-2P
14.400	98.3	C13H26O	198.2	2576207	10486-19-8	Tridecanal
14.700	85.3	C11H24O	172.2	549852	18675-24-6	1-Decanol, 2-methyl-
15.000	92.0	C15H30	210.2	422986	2883-02-5	n-Nonylcyclohexane
15.200	89.1	C13H23F3O2	268.2	457330	999369-51-2	Undecyl trifluoroacetate
15.500	91.9	C16H34	226.3	1332151	544-76-3	Hexadecane
15.700	94.5	C14H28O	212.2	437648	124-25-4	Tetradecanal
16.000	98.0	C13H10O	182.1	756271	119-61-9	Methanone, diphenyl-
16.200	89.4	C16H32	224.3	540778	295-65-8	Cyclohexadecane
16.200	92.5	C9H20O	144.2	787749	1000130-68-7	Methyl octyl ether
16.700	83.5	C17H36	240.3	567369	629-78-7	Heptadecane
16.800	83.6	C12H26	170.2	448356	13475-82-6	Heptane, 2,2,4,6,6-pentamethyl-
17.500	98.0	C14H12O2	212.1	525586	120-51-4	Benzyl benzoate
17.900	95.8	C14H14O2	214.1	1193058	104-66-5	Benzene, 1,1'-[1,2-ethanediylbis(oxy)]bis-
18.000	94.0	C17H34O2	270.3	527495	110-27-0	Isopropyl Myristate