

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

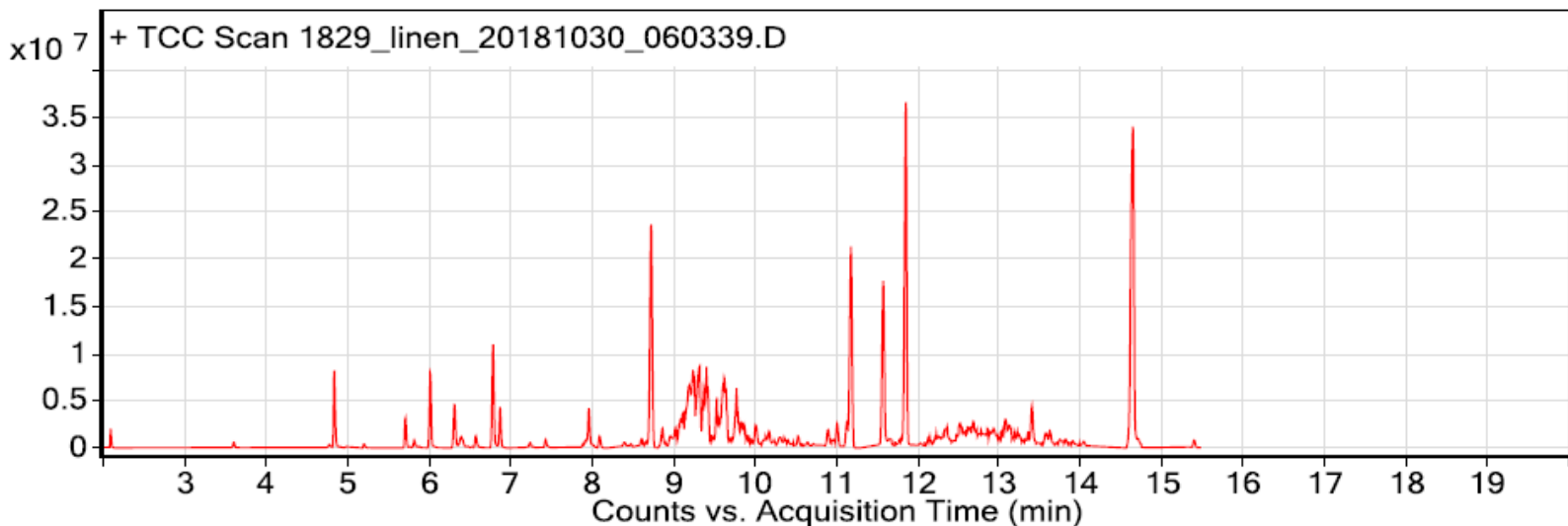
Sample: AKA Castel Pampelonne LC164/746 fabric in linen (color)

Oddy test result: Temporary

Date collected: 10/30/2018

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) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (2) 11.8 min: 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
1.490	97.7	C2H4O2	60.0	694126	64-19-7	Acetic acid
2.090	93.7	C2H8O2Si	92.0	1937925	1066-42-8	Silanediol, dimethyl-
3.600	92.4	C6H18O3Si3	222.1	1103735	541-05-9	Cyclotrisiloxane, hexamethyl-
4.830	96.8	C6H14O2	118.1	6127913	111-76-2	Ethanol, 2-butoxy-
5.200	96.8	C6H10O2	114.1	621631	110-13-4	2,5-Hexanedione
5.710	97.9	C7H6O	106.0	4724914	100-52-7	Benzaldehyde
6.010	87.1	C6H6O	94.0	11969213	108-95-2	Phenol
6.310	95.9	C8H24O4Si4	296.1	7830902	556-67-2	Cyclotetrasiloxane, octamethyl-
6.380	92.8	C8H16O	128.1	988869	124-13-0	Octanal
6.410	87.9	C5H11O2	103.1	972228	999013-01-3	O-Ethyl-1,3-dioxolanium
6.570	98.1	C7H16O3	148.1	2244974	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
6.780	96.6	C8H18O	130.1	17880266	104-76-7	1-Hexanol, 2-ethyl-
6.870	95.9	C7H8O	108.1	6186484	100-51-6	Benzyl Alcohol
7.240	91.6	C11H24	156.2	936552	17302-23-7	Nonane, 4,5-dimethyl-
7.430	96.9	C8H18O	130.1	1404882	111-87-5	1-Octanol
7.890	92.4	C10H18O	154.1	750452	78-70-6	Linalool
7.960	97.4	C9H18O	142.1	7021193	124-19-6	Nonanal
8.400	91.0	C9H20O	144.2	1150466	143-08-8	1-Nonanol
8.660	87.5	C10H20O2	172.1	947890	103-09-3	Acetic acid, 2-ethylhexyl ester
8.710	94.5	C16H11NO2S	281.1	1338148	70453-75-7	2-methoxy[1]benzothieno[2,3-c]quinolin-6(5H)-one
8.730	96.0	C10H30O5Si5	370.1	35039941	541-02-6	Cyclopentasiloxane, decamethyl-
8.860	90.1	C10H20	140.2	3933874	21328-57-4	Cyclooctane, 1,5-dimethyl-
9.020	90.9	C10H20O	156.2	2692525	2216-52-6	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, [1S-(1.alpha.,2.alpha.,5.beta.)]-
9.110	83.1	C9H20O	144.2	5444793	110453-78-6	(S)-(+)-6-Methyl-1-octanol
9.250	85.3	C8H18O3	162.1	6434935	54446-78-5	Ethanol, 1-(2-butoxyethoxy)-
9.310	83.5	C9H12O3	168.1	5779663	999102-94-1	3-Methyl-4-methylene-3-propionylidihydrofuran-2-one
9.320	84.0	C9H18	126.1	16553735	1502-38-1	Cyclooctane, methyl-
9.370	84.0	C8H16	112.1	4965491	3123-93-1	3-Hexene, 2,2-dimethyl-
9.420	89.5	C10H22O	158.2	14470807	106-21-8	1-Octanol, 3,7-dimethyl-

9.480	92.9	C10H200	156.2	1191550	112-31-2	Decanal
9.790	83.0	C10H20	140.2	10006142	4737-43-3	Cyclopentane, (1-methylbutyl)-
9.860	85.5	C8H140	126.1	1561036	4312-99-6	1-Octen-3-one
9.900	85.1	C16H340	242.3	1094990	629-82-3	Octane, 1,1'-oxybis-
9.960	88.7	C11H2202	186.2	1202263	999145-46-3	2-Ethyl-1-hexyl propionate
10.180	88.7	C12H2402	200.2	1520836	7434-89-1	Hexanoic acid, 2-ethyl-, 2-methylpropyl ester
10.320	81.9	C11H22	154.2	1731036	61142-79-8	1-Decene, 8-methyl-
10.410	94.8	C10H220	158.2	1314747	112-30-1	1-Decanol
10.530	89.4	C14H30	198.2	2079749	61141-72-8	Dodecane, 4,6-dimethyl-
10.900	87.3	C11H240	172.2	3728585	91337-07-4	2-Isopropyl-5-methyl-1-heptanol
11.010	88.9	C11H240	172.2	4553482	91337-07-4	2-Isopropyl-5-methyl-1-heptanol
11.160	85.9	C20H42	282.3	2024590	112-95-8	Eicosane
11.180	96.6	C12H36O6Si6	444.1	39997272	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.580	89.4	C12H2403	216.2	33340959	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.780	93.9	C11H240	172.2	1466035	112-42-5	1-Undecanol
11.850	93.9	C12H2403	216.2	39335722	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.130	95.1	C14H30	198.2	1531145	629-59-4	Tetradecane
12.220	80.5	C12H260	186.2	2265275	3913-02-8	1-Octanol, 2-butyl-
12.330	86.1	C14H42O5Si6	458.2	916517	107-52-8	Hexasiloxane, tetradecamethyl-
12.350	81.6	C14H26O2	226.2	1594617	126-86-3	2,4,7,9-Tetramethyl-5-decyne-4,7-diol
12.520	81.7	C16H2402	248.2	1757503	1000383-60-6	Nopyl angelate
12.570	85.2	C14H28	196.2	2516954	1120-36-1	1-Tetradecene
12.680	87.6	C30H58O4	482.4	2116384	2432-89-5	Decanedioic acid, didecyl ester
12.930	87.6	C19H40	268.3	4848291	629-92-5	Nonadecane
13.170	88.1	C14H26O3	242.2	2273134	1000382-54-9	Carbonic acid, undecyl vinyl ester
13.360	80.6	C16H34	226.3	2015246	544-76-3	Hexadecane
13.400	81.2	C14H42O7Si7	518.1	7184571	107-50-6	Cycloheptasiloxane, tetradecamethyl-
13.480	86.5	C15H32	212.3	1129202	3891-98-3	Dodecane, 2,6,10-trimethyl-
13.570	88.3	C14H220	206.2	1468547	96-76-4	Phenol, 2,4-bis(1,1-dimethylethyl)-
13.590	88.6	C16H34	226.3	2355402	59222-86-5	Tetradecane, 2,2-dimethyl-
13.620	94.8	C15H240	220.2	2001799	128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
13.820	91.3	C19H38	266.3	1511619	18435-45-5	1-Nonadecene
13.910	87.8	C15H32	212.3	1327104	31295-56-4	Dodecane, 2,6,11-trimethyl-
14.040	83.2	C28H58O	410.4	1120724	1000406-38-8	Eicosyl octyl ether
14.600	94.8	C12H14O4	222.1	2786625	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
15.400	89.8	C16H48O8Si8	592.2	1579748	556-68-3	Cyclooctasiloxane, hexadecamethyl-