

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

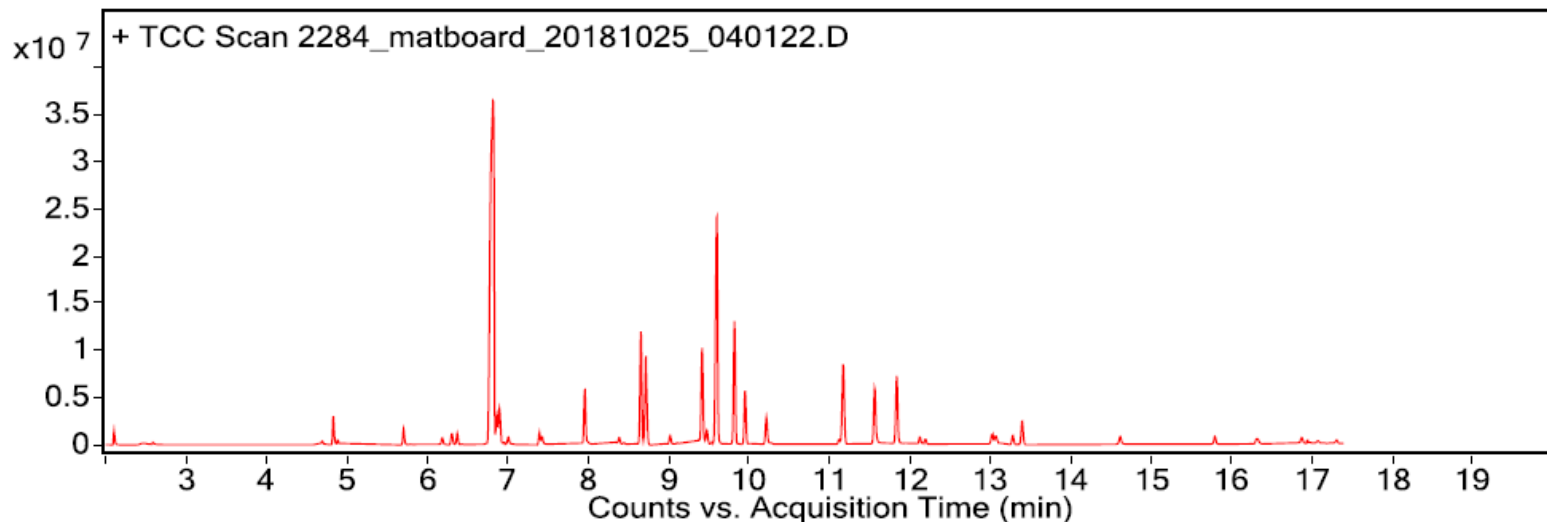
Alkynes – can become reactive when exposed to heat or UV light

Sample: Alpharag Artcare light Collection 100% cotton mat board in Colonial Cream

Date collected: 10/23/2018

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 auto-sampler; Pre-heated at 60°C for 20 minutes; fiber exposure at 60°C for 20 minutes; sample 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 using the Masshunter Qualitative program. Samples > 80% match with a NIST 17.0 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-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
1.530	97.9	C2H4O2	60.0	2145161	64-19-7	Acetic acid
2.100	93.7	C2H8O2Si	92.0	1755661	1066-42-8	Silanediol, dimethyl-
2.470	93.5	C6H12O	100.1	1011450	66-25-1	Hexanal
4.690	91.1	C7H12O2	128.1	1209842	141-32-2	2-Propenoic acid, butyl ester
4.830	97.0	C6H14O2	118.1	4084159	111-76-2	Ethanol, 2-butoxy-
5.700	96.0	C7H6O	106.0	2382382	100-52-7	Benzaldehyde
6.190	91.9	C8H18O	130.1	1070988	26952-21-6	Isooctanol
6.310	96.3	C8H24O4Si4	296.1	2013041	556-67-2	Cyclotetrasiloxane, octamethyl-
6.370	97.7	C8H16O	128.1	1677040	124-13-0	Octanal
6.820	84.4	C10H22O	158.2	84932718	112-30-1	1-Decanol
7.010	94.3	C8H18O	130.1	1455550	57803-73-3	(S)-(+)-5-Methyl-1-heptanol
7.430	96.8	C8H18O	130.1	1088204	111-87-5	1-Octanol
7.960	97.9	C9H18O	142.1	9099235	124-19-6	Nonanal
8.390	90.0	C9H20O	144.2	1151429	143-08-8	1-Nonanol
8.660	95.9	C10H20O2	172.1	18217445	103-09-3	Acetic acid, 2-ethylhexyl ester
8.720	94.4	C10H30O5Si5	370.1	12504553	541-02-6	Cyclopentasiloxane, decamethyl-
9.020	98.0	C10H20O	156.2	1342519	15356-70-4	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(./-)-
9.420	95.7	C10H20O	156.2	16833206	937-05-3	Cyclohexanol, 4-(1,1-dimethylethyl)-, cis-
9.480	96.7	C10H20O	156.2	1189997	112-31-2	Decanal
9.600	95.7	C10H20O	156.2	43725068	21862-63-5	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-
9.820	95.3	C11H20O2	184.1	19896221	103-11-7	2-Ethylhexyl acrylate
9.950	91.6	C11H22O2	186.2	8829409	999145-46-3	2-Ethyl-1-hexyl propionate
10.220	93.9	C10H16N2	164.1	5047414	999094-51-6	2,3-Diethyl-2,3-dimethylsuccinonitrile
11.120	89.2	C12H24O2	200.2	982701	25415-84-3	n-Butyric acid 2-ethylhexyl ester
11.170	95.8	C12H30O6Si6	444.1	15483556	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.560	91.5	C12H24O3	216.2	10911369	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.840	93.2	C12H24O3	216.2	12529214	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.120	94.6	C14H30	198.2	1073952	629-59-4	Tetradecane
12.190	93.8	C13H12	168.1	961195	643-58-3	1,1'-Biphenyl, 2-methyl-
13.070	85.2	C14H20O2	220.1	1043781	999234-71-6	2,6-di-butyl-2,5-cyclohexadiene-1,4-dione
13.280	95.2	C13H12	168.1	1549317	644-08-6	1,1'-Biphenyl, 4-methyl-
14.620	85.5	C16H30O4	286.2	1726289	6846-50-0	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-