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

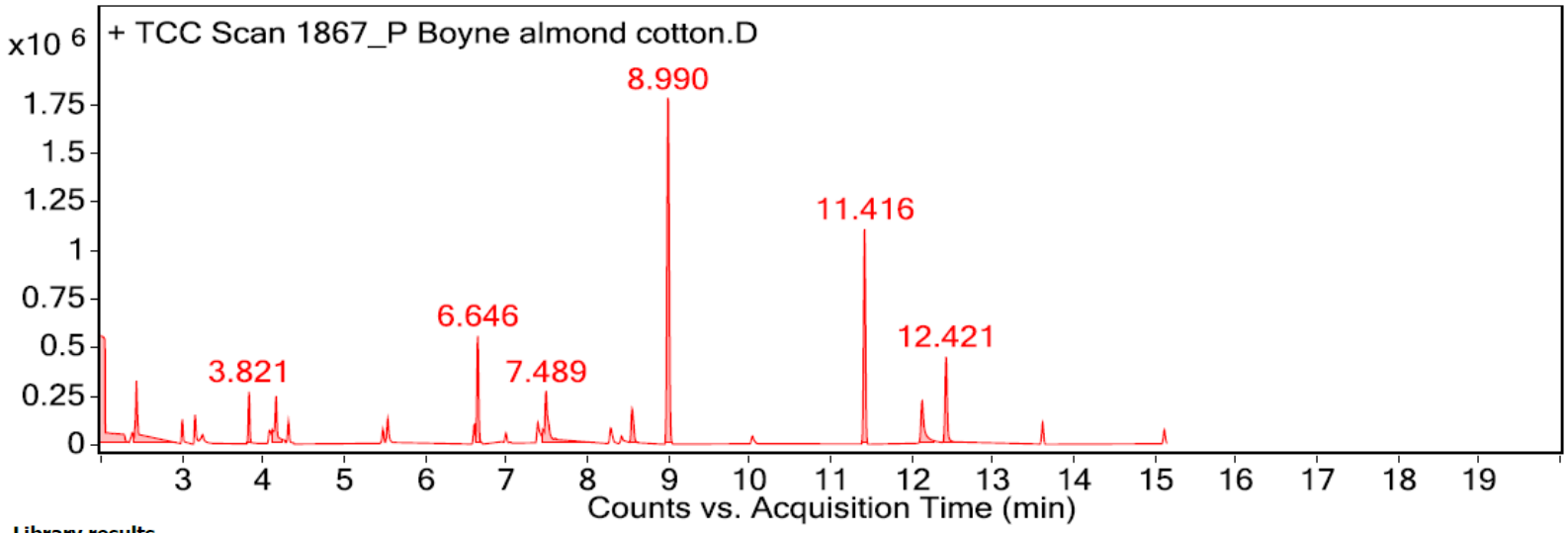
Sample: Philip Boyne broadcloth superba cotton fabric; almond

Oddy test result: Temporary

Date collected: 12/09/2017

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) 12.1 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (2) 12.4 min: 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.432	83.1	C3H6O	58.0	467177	67-64-1	Acetone
2.999	93.1	C4H10O	74.1	165271	71-36-3	1-Butanol
3.157	93.7	C2H8O2Si	92.0	246824	1066-42-8	Silanediol, dimethyl-
3.248	94.0	C6H15N	101.1	153859	121-44-8	Triethylamine
3.822	97.7	C7H8	92.1	365803	108-88-3	Benzene, methyl-
4.076	96.7	C3H7NO	73.1	245917	68-12-2	Formamide, N,N-dimethyl-
4.155	95.5	C6H12O	100.1	257136	66-25-1	Hexanal
4.308	94.5	C6H18O3Si3	222.1	153613	541-05-9	Cyclotrisiloxane, hexamethyl-
5.474	94.6	C7H14O	114.1	118800	111-71-7	Heptanal
5.533	98.0	C6H14O2	118.1	238026	111-76-2	Ethanol, 2-butoxy-
6.601	98.1	C6H6O	94.0	164394	108-95-2	Phenol
6.645	95.8	C8H24O4Si4	296.1	844539	556-67-2	Cyclotetrasiloxane, octamethyl-
6.992	90.3	C8H16O	128.1	96239	124-13-0	Octanal
7.386	90.3	C8H18O	130.1	328530	104-76-7	1-Hexanol, 2-ethyl-
7.486	91.4	C7H8O	108.1	786293	100-51-6	Benzenemethanol
8.285	94.1	C9H12O	136.1	182542	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
8.549	98.4	C9H18O	142.1	373851	124-19-6	Nonanal
8.994	91.8	C10H30O5Si5	370.1	3480871	541-02-6	Cyclopentasiloxane, decamethyl-
10.033	90.4	C4H8O2S	120.0	97225	126-33-0	Thiophene, tetrahydro-, 1,1-dioxide
11.418	91.0	C12H36O6Si6	444.1	1820993	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.127	93.5	C12H24O3	216.2	642146	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.423	93.4	C12H24O3	216.2	842855	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
15.117	90.7	C16H30O4	286.2	128369	74381-40-1	Propanoic acid, 2-methyl-, 1-(1,1-dimethylethyl)-2-methyl-1,3-propanediyl ester