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

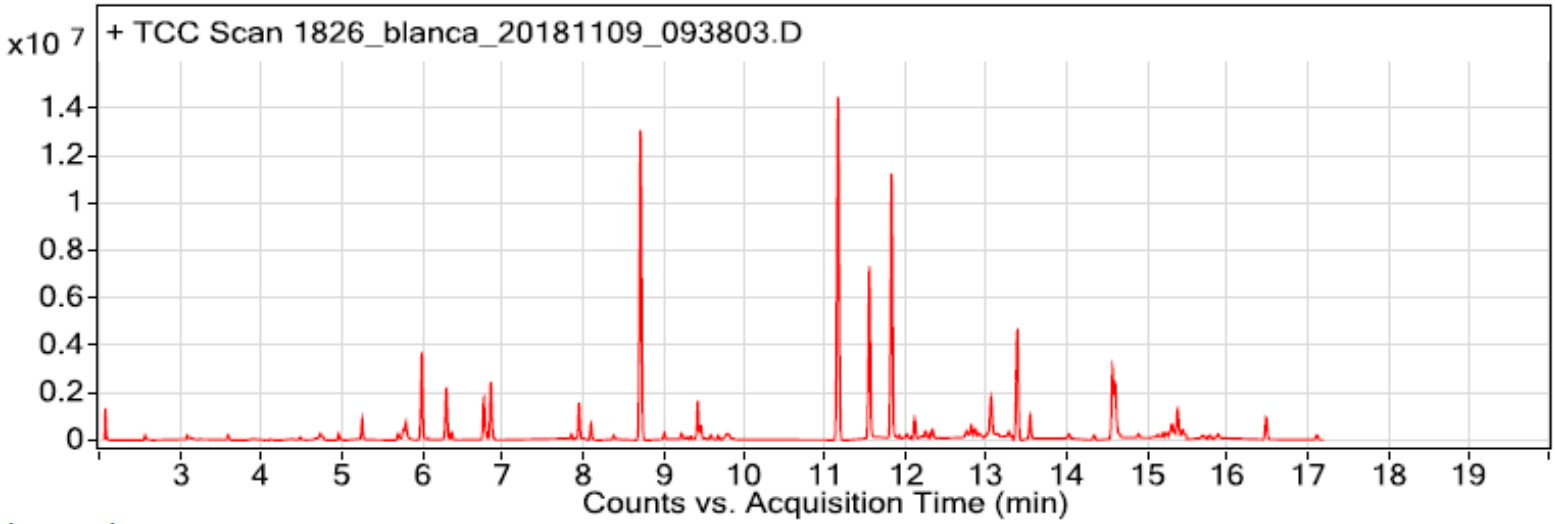
Sample: Perennials canvas weave 600-28 dyed acrylic fabric in blanca

Oddy test result: Permanent

Date collected: 11/09/2018

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 17.0 library are reported.

VOCs not highlighted are because they were also observed in blanks: (1) 4.7 min: methoxy-phenyl-oxime; (2) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (3) 11.8 min: 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.070	93.7	C2H8O2Si	92.0	1190289	1066-42-8	Silanediol, dimethyl-
2.560	94.8	C3H8O2	76.1	299705	57-55-6	1,2-Propanediol
3.590	90.2	C6H18O3Si3	222.1	372729	541-05-9	Cyclotrisiloxane, hexamethyl-
3.900	87.6	C8H10	106.1	285744	106-42-3	Benzene, 1,4-dimethyl-
4.740	84.5	C8H9NO2	151.1	299444	1000222-86-6	Oxime-, methoxy-phenyl-_
4.760	85.5	C8H14O2	142.1	397684	24070-70-0	3-Methylcyclopentyl acetate
4.960	92.9	C4H4O2	84.0	412516	497-23-4	2(5H)-Furanone
5.700	96.7	C7H6O	106.0	338346	100-52-7	Benzaldehyde
5.800	96.3	C4H9ClO2	124.0	1324760	628-89-7	Ethanol, 2-(2-chloroethoxy)-
6.000	89.2	C6H6O	94.0	4650816	108-95-2	Phenol
6.300	95.7	C8H24O4Si4	296.1	3536288	556-67-2	Cyclotetrasiloxane, octamethyl-
6.370	93.0	C8H16O	128.1	461278	124-13-0	Octanal
6.770	96.4	C8H18O	130.1	2616202	104-76-7	1-Hexanol, 2-ethyl-
6.790	93.7	C10H16	136.1	394905	138-86-3	dl-Limonene
6.850	96.2	C7H8O	108.1	3101031	100-51-6	Benzyl Alcohol
7.860	83.8	C13H7F17O2	518.0	403503	27905-45-9	3,3,4,4,5,5,6,6,7,7,8,8,9,9,10,10,10-Heptadecafluorodecyl acrylate #
7.950	97.2	C9H18O	142.1	2313338	124-19-6	Nonanal
8.100	95.0	C8H10O	122.1	1017223	60-12-8	Benzeneethanol
8.710	95.4	C10H30O5Si5	370.1	23183709	541-02-6	Cyclopentasiloxane, decamethyl-
9.010	96.9	C10H20O	156.2	389669	15356-70-4	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-
9.220	94.8	C8H18O3	162.1	449929	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
9.420	85.4	C5H8N2O2	128.1	1670692	999032-99-7	1,3-Dimethyl-4,5-imidazolidinedione
9.460	90.0	C10H20O	156.2	532020	112-31-2	Decanal
9.590	85.7	C5H6N2O3	142.0	373324	5176-82-9	1,3-Dimethyl-2,4,5-trioxoimidazolidine
9.680	93.1	C8H10O2	138.1	317801	122-99-6	Ethanol, 2-phenoxy-
9.810	86.6	C11H20O2	184.1	325950	103-11-7	2-Ethylhexyl acrylate
11.170	96.6	C12H36O6Si6	444.1	27288053	540-97-6	Cyclohexasiloxane, dodecamethyl-

11.560	88.7	C12H24O3	216.2	12310984	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.830	93.8	C12H24O3	216.2	18765382	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.120	94.9	C14H30	198.2	1307333	629-59-4	Tetradecane
12.250	96.1	C12H24O	184.2	456510	112-54-9	Dodecanal
12.340	83.1	C17H28O2	264.2	698406	999360-12-8	(-)-Isolongifolol, acetate
12.760	85.4	C14H28	196.2	560949	2882-98-6	Cyclopentane, nonyl-
12.880	94.3	C10H10O4	194.1	314680	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
13.390	81.7	C14H42O7Si7	518.1	8489610	107-50-6	Cycloheptasiloxane, tetradecamethyl-
13.550	91.1	C14H22O	206.2	1631626	96-76-4	Phenol, 2,4-bis(1,1-dimethylethyl)-
14.040	82.9	C15H30	210.2	373989	2883-02-5	n-Nonylcyclohexane
14.350	89.0	C16H48O6Si7	532.2	380412	541-01-5	Heptasiloxane, hexadecamethyl-
14.580	87.8	C12H14O4	222.1	4231614	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
14.610	95.3	C16H30O4	286.2	4523176	6846-50-0	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-
15.240	82.9	C16H32	224.3	450641	295-65-8	Cyclohexadecane
15.310	93.5	C9H20O	144.2	462980	1000130-68-7	Methyl octyl ether
15.380	88.3	C16H48O8Si8	592.2	2448391	556-68-3	Cyclooctasiloxane, hexadecamethyl-
15.450	80.4	C15H22O2	234.2	459998	999275-15-3	1-(4-ISOPROPYLPHENYL)-2-METHYLPROPYL ACETATE
16.480	85.4	C18H28O2Si3	360.1	1638626	17977-72-9	1,1,3,3,5,5-Hexamethyl-1,5-diphenyl-trisiloxane
17.110	84.0	C18H54O9Si9	666.2	408713	556-71-8	Cyclononasiloxane, octadecamethyl-