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

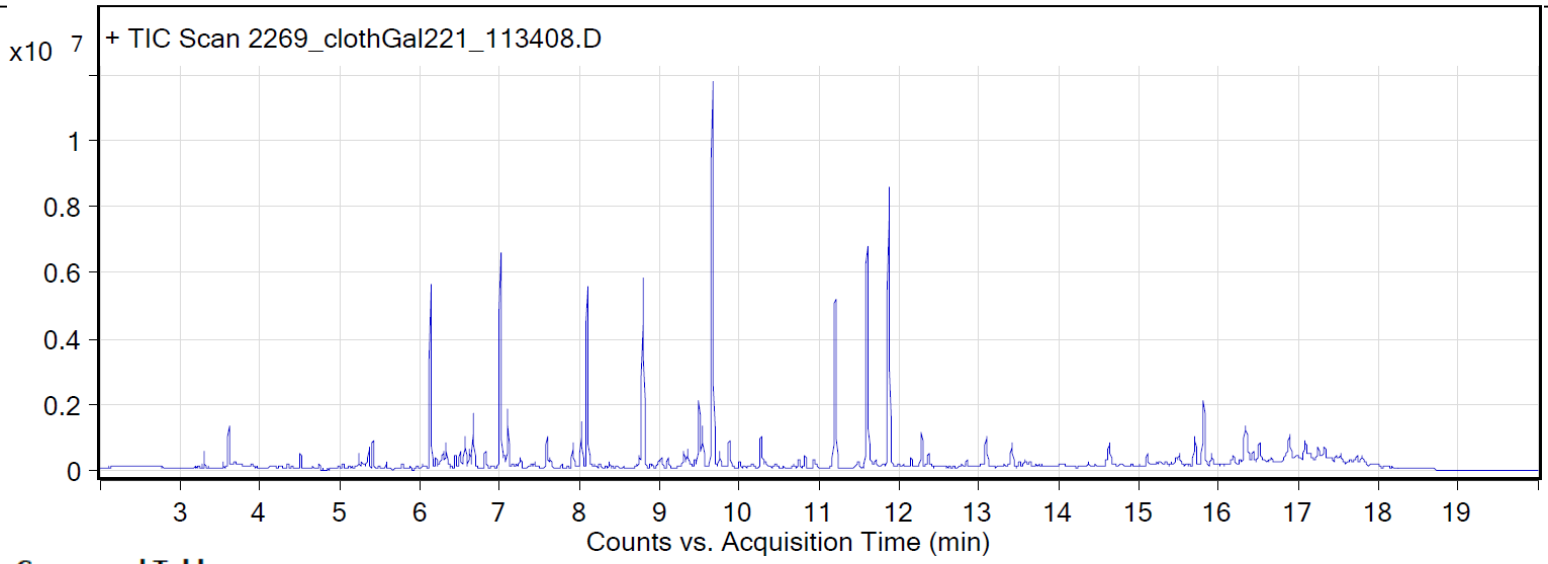
Halogenated compounds – can become reactive with exposure to heat and UV light

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 dense curtain fabric; 100% Silk; Fabric width:140 cm/55 inch/1.53 yard; Weight:70 g/m²
Oddy test result: unsuitable
Date collected: 8/18/2018
Technique used: SPME with a PDMS/Carbon WR 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 cryo-trapped for 2 min at -15°C; GC ramped from 35°C to 250 °C at 10°C/min. Data analyzed in Masshunter Qualitative Analysis. Deconvoluted data with > 85% match with a NIST 17.0 or Wiley 9 library are reported.

VOCs not highlighted are because they were also observed in blanks: (1) 5.3 min: methoxyphenyl oxime; (2) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 11.9 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
3.3	98.38	338072	Acetic acid	C2H4O2
3.61	95.07	820727	Silanediol, dimethyl-	C2H8O2Si
4.5	92.38	520556	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
4.98	87.52	192837	Formic acid, hexyl ester	C7H14O2
5.24	94.84	592986	2-Heptanone	C7H14O
5.27	86.78	247295	Oxime-, methoxy-phenyl-_	C8H9NO2
5.36	94	857240	Heptanal	C7H14O
5.41	96.45	1005606	Ethanol, 2-butoxy-	C6H14O2
5.58	93.57	256653	2,5-Cyclohexadiene-1,4-dione	C6H4O2
6.13	97.84	7052632	Benzaldehyde	C7H6O
6.2	95.43	366900	1-Heptanol	C7H16O
6.45	88.74	553602	5-Hepten-2-one, 6-methyl-	C8H14O
6.5	95.69	635467	2-Octanone	C8H16O
6.56	96.14	1210399	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
6.62	95.5	733576	Decane	C10H22
6.67	96.56	2150246	Octanal	C8H16O
6.82	98.21	743343	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.01	97.22	9026518	1-Hexanol, 2-ethyl-	C8H18O
7.06	93.99	364864	dl-Limonene	C10H16
7.1	93.17	2336383	Benzyl Alcohol	C7H8O
7.25	89.47	383993	Hexane, 1-nitro-	C6H13NO2
7.4	95.54	190979	2(3H)-Furanone, 5-ethyldihydro-	C6H10O2
7.92	92.85	1139395	2-Nonanone	C9H18O
8.02	96.72	2017869	Undecane	C11H24
8.09	97.56	8015564	Nonanal	C9H18O
8.37	92.18	258713	Octanoic acid, methyl ester	C9H18O2
8.75	91.95	497712	Acetic acid, 2-ethylhexyl ester	C10H20O2
8.8	94.36	9009168	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.11	97.27	498865	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	C10H20O

9.31	95.46	755916	Ethanol, 1-(2-butoxyethoxy)-	C8H18O3
9.35	95.01	867118	2-Decanone	C10H20O
9.49	94.05	3079744	Cyclohexanol, 4-(1,1-dimethylethyl)-, cis-	C10H20O
9.51	88.58	417847	1,3-Dimethyl-4,5-imidazolidinedione	C5H8N2O2
9.54	95.65	1867138	Decanal	C10H20O
9.66	95.65	18546003	Cyclohexanol, 4-(1,1-dimethylethyl)-, trans-	C10H20O
9.75	93.55	649725	Ethanol, 2-phenoxy-	C8H10O2
9.87	88.61	1306644	2-Ethylhexyl acrylate	C11H20O2
10	89.01	246799	2-Ethyl-1-hexyl propionate	C11H22O2
10.27	93.54	1609406	2,3-Diethyl-2,3-dimethylsuccinonitrile	C10H16N2
10.44	91.49	262844	1-Decanol	C10H22O
10.83	92.8	576591	Tridecane	C13H28
10.94	91.41	522772	Undecanal	C11H22O
11.2	95.88	8204821	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.6	90.02	10826027	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
11.71	89.08	336207	4-PENTYLBUTAN-4-OLIDE	C9H16O2
11.87	94.19	13422607	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.15	94.76	451396	Tetradecane	C14H30
12.28	97.66	1691146	Dodecanal	C12H24O
12.37	86.92	678846	2,4,7,9-Tetramethyl-5-decyn-4,7-diol	C14H26O2
12.85	87.22	283837	5,9-Undecadien-2-one, 6,10-dimethyl-, (E)-	C13H22O
13.5	91.6	251261	bis(2-Ethylhexyl) ether	C16H34O
13.57	89.43	188829	Phenol, 2,4-bis(1,1-dimethylethyl)-	C14H22O
13.6	88.89	312238	Tetradecane, 2,2-dimethyl-	C16H34
13.64	90.87	206140	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-	C15H24O