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

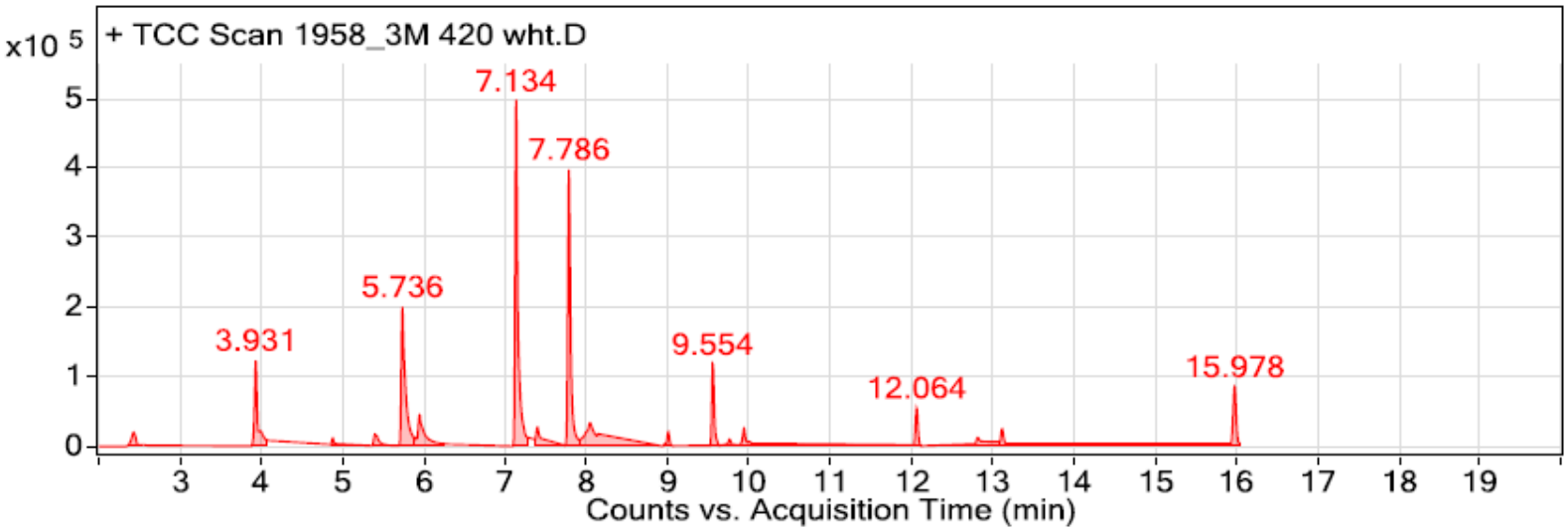
Sample: 3M Scotchweld epoxy adhesive 420; off-white

Oddy test result: Temporary

Date collected: 12/22/2017

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: : (2) 12.8 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 13.1 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.427	92.1	C4H8O	72.1	76332	78-93-3	2-Butanone
3.931	94.9	C7H8	92.1	351071	108-88-3	Benzene, methyl-
4.881	85.1	C8H12	108.1	33949	100-40-3	Cyclohexene, 4-ethenyl-
5.399	93.4	C8H10	106.1	69555	108-38-3	Benzene, 1,3-dimethyl-
5.736	99.3	C8H8	104.1	721056	100-42-5	Styrene
5.948	93.0	C6H14O2	118.1	189471	111-76-2	Ethanol, 2-butoxy-
7.135	95.7	C8H24O4Si4	296.1	1155013	556-67-2	Cyclotetrasiloxane, octamethyl-
7.174	91.2	C10H20	140.2	67314	6069-98-3	Cyclohexane, 1-methyl-4-(1-methylethyl)-, cis-
7.786	94.9	C7H9N	107.1	955091	100-45-8	4-Cyanocyclohexene
8.051	88.9	C9H18O2	158.1	251744	999083-12-4	Octyl ester of formic acid
9.009	96.4	C8H8O2	136.1	46685	93-58-3	Benzoic acid, methyl ester
9.558	88.7	C10H30O5Si5	370.1	249607	541-02-6	Cyclopentasiloxane, decamethyl-
9.762	90.7	C10H20O	156.2	25656	0-00-0	1,2-trans-2,3-trans-Iridan-1-ol
9.940	88.1	C7H6O2	122.0	65336	65-85-0	Benzoic acid
12.067	89.1	C12H36O6Si6	444.1	120208	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.824	87.7	C12H24O3	216.2	58044	74367-33-2	2,2-Dimethyl-1-(2-hydroxy-1-isopropyl)propyl ester of isobutanoic acid
13.119	91.4	C12H24O3	216.2	58250	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
15.980	89.2	C16H30O4	286.2	235296	74381-40-1	Propanoic acid, 2-methyl-, 1-(1,1-dimethylethyl)-2-methyl-1,3-propanediyl ester