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

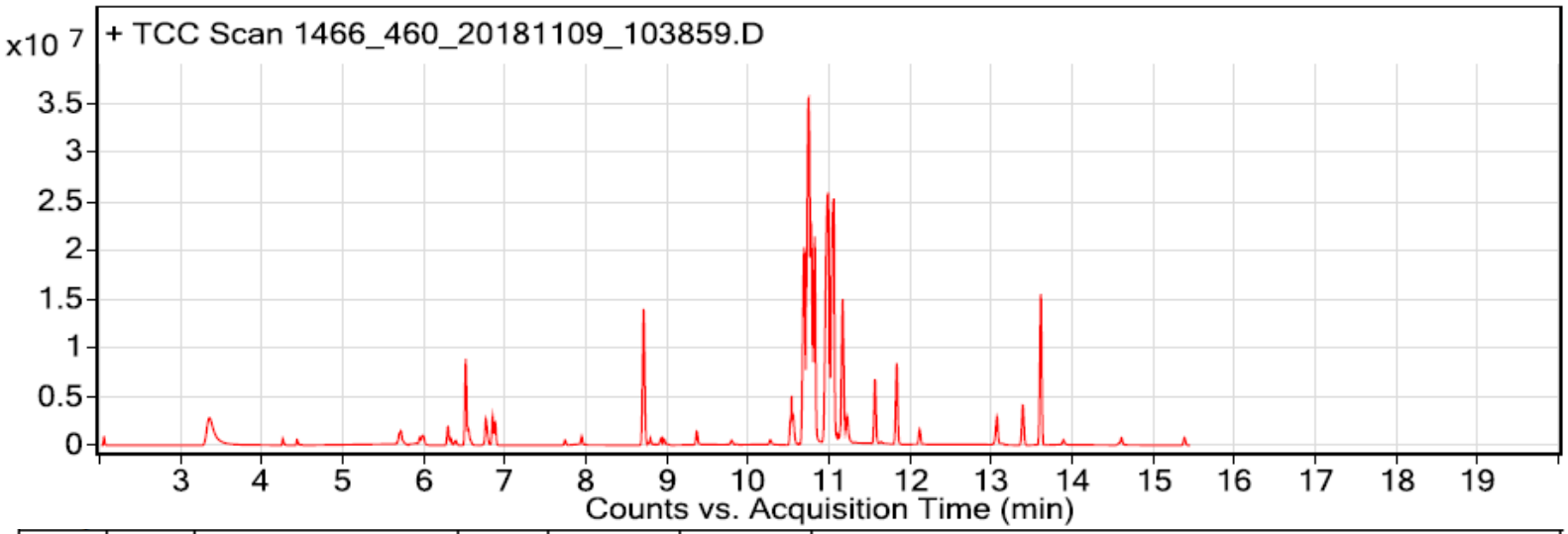
Sample: Renshape 460 light brown colored foamed polyurethane

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 library are reported.

VOCs not highlighted are because they were also observed in blanks: (1) 11.57 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (2) 11.84 min: 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester propanoic acid



RT	Score	Formula	MW	Area	CAS #	Name
2.060	93.7	C2H8O2Si	92.0	923782	1066-42-8	Silanediol, dimethyl-
3.360	94.4	C6H5Cl	112.0	19948777	108-90-7	Benzene, chloro-
4.270	97.8	C5H8O3	116.0	949744	592-20-1	2-Propanone, 1-(acetyloxy)-
4.440	96.4	C5H10O3	118.1	807364	999023-91-7	1-Acetoxy-2-propanol
5.700	96.3	C7H6O	106.0	1868912	100-52-7	Benzaldehyde
5.720	83.5	C4H10O3	106.1	2526435	111-46-6	Ethanol, 2,2'-oxybis-
5.910	85.7	C3H8O3	92.0	1060666	56-81-5	Glycerin
6.300	96.0	C8H24O4Si4	296.1	3183920	556-67-2	Cyclotetrasiloxane, octamethyl-
6.340	95.6	C7H16O3	148.1	940242	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
6.400	88.6	C7H16O3	148.1	931115	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
6.520	96.7	C6H4Cl2	146.0	12294225	541-73-1	Benzene, 1,3-dichloro-
6.550	99.6	C7H16O3	148.1	2686081	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
6.770	97.0	C8H18O	130.1	3566801	104-76-7	1-Hexanol, 2-ethyl-
6.790	95.0	C10H16	136.1	758669	138-86-3	dl-Limonene
6.850	94.6	C7H8O	108.1	2141881	100-51-6	Benzyl Alcohol
6.880	96.3	C6H4Cl2	146.0	3444141	541-73-1	Benzene, 1,3-dichloro-
7.750	96.6	C8H16O3	160.1	786491	112-07-2	2-Butoxyethyl acetate
7.950	97.1	C9H18O	142.1	1443121	124-19-6	Nonanal
8.710	95.6	C10H30O5Si5	370.1	25077277	541-02-6	Cyclopentasiloxane, decamethyl-
8.800	89.4	C9H18O3	174.1	895156	0-00-0	PROPYLENE GLYCOL TRIMER 1
9.370	95.4	C12H26	170.2	2324308	112-40-3	Dodecane
9.800	83.2	C11H24O	172.2	932917	3396-02-9	2-Methyl-2-decanol
10.280	93.9	C13H28	184.2	850784	1560-97-0	Dodecane, 2-methyl-
10.530	87.9	C10H22O4	206.2	4390671	25498-49-1	tri (propylene glycol) monomethyl ether; isomer C
10.560	86.9	C10H22O4	206.2	6275749	25498-49-1	tri (propylene glycol) monomethyl ether; isomer C
10.690	97.2	C10H22O4	206.2	44120346	25498-49-1	tri (propylene glycol) monomethyl ether; isomer D
10.750	80.1	C9H20O4	192.1	30447226	999157-72-2	TRIPROPYLENE GLYCOL 6
10.780	96.3	C10H22O4	206.2	52114203	25498-49-1	tri (propylene glycol) monomethyl ether; isomer B
10.820	96.1	C10H22O4	206.2	38177283	25498-49-1	tri (propylene glycol) monomethyl ether; isomer D

10.820	96.1	C10H22O4	206.2	38177283	25498-49-1	tri (propylene glycol) monomethyl ether; isomer D
10.990	88.4	C10H22O4	206.2	75493068	25498-49-1	tri (propylene glycol) monomethyl ether; isomer E
11.060	88.4	C7H16O3	148.1	65740032	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
11.170	96.6	C12H36O6Si6	444.1	28249756	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.570	89.4	C12H24O3	216.2	11268622	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.840	94.0	C12H24O3	216.2	14204579	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.120	94.5	C14H30	198.2	2560421	629-59-4	Tetradecane
13.070	87.4	C15H24O2	236.2	3992536	10396-80-2	2,6-di(t-butyl)-4-hydroxy-4-methyl-2,5-cyclohexadien-1-one
13.390	81.5	C14H42O7Si7	518.1	7669907	107-50-6	Cycloheptasiloxane, tetradecamethyl-
13.610	97.8	C15H24O	220.2	25985524	128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
13.890	83.1	C16H34	226.3	914224	544-76-3	Hexadecane
14.610	96.2	C16H30O4	286.2	1629301	6846-50-0	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-
15.380	88.9	C16H48O8Si8	592.2	1438328	556-68-3	Cyclooctasiloxane, hexadecamethyl-