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

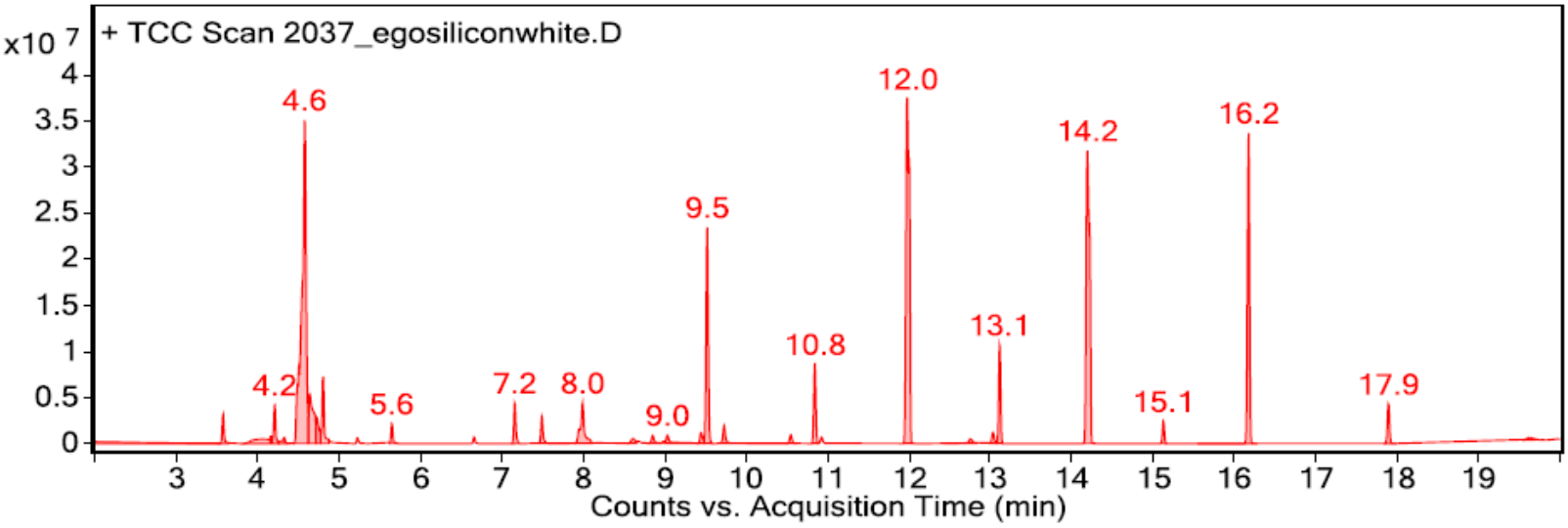
Sample: Ego Silicone 460 White

Oddy test result: Permanent

Date GC-MS collected: 02/09/2018

Technique used: SPME Arrow 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 sample at 60°C for 20 minutes; fiber exposure to sample at 60°C for 20 minutes; fiber injected into 220°C inlet and cryotrapped 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) ~12.8 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) ~13.0 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
1.900	89.6	C2H6O	46.0	6748527	115-10-6	Dimethyl ether
3.600	89.9	C3H7NO	73.1	4910439	127-06-0	2-Propanone, oxime
4.000	90.3	C12H10O4	218.1	2421451	999228-01-8	3-Oxo-1,3-dihydro-1-isobenzofuranyl crotonate
4.200	95.3	C6H16O2Si	148.1	4309952	78-62-6	Silane, diethoxydimethyl-
4.300	93.0	C7H8	92.1	1346839	108-88-3	Benzene, methyl-
4.600	98.3	C5H11NO2	117.1	96335334	7529-22-8	Morpholine, 4-methyl-, 4-oxide
4.600	90.8	C5H11NO	101.1	10624980	109-02-4	Morpholine, 4-methyl-
4.700	95.3	C4H9NO	87.1	6505902	110-91-8	Morpholine
4.800	93.4	C6H18O3Si3	222.1	9936628	541-05-9	Cyclotrisiloxane, hexamethyl-
5.200	86.4	C7H12O2	128.1	1153218	86449-65-2	cis-2-Hydroxymethyl-3-vinyl tetrahydrofuran
5.600	96.2	C7H18O3Si	178.1	3379756	2031-67-6	Silane, triethoxymethyl-
6.700	97.5	C8H22O3Si2	222.1	1158479	18420-09-2	Disiloxane, 1,3-diethoxy-1,1,3,3-tetramethyl-
7.200	96.0	C8H24O4Si4	296.1	7501281	556-67-2	Cyclotetrasiloxane, octamethyl-
7.500	96.7	C10H22	142.2	5020818	124-18-5	Decane
8.000	92.3	C8H18O	130.1	4707153	104-76-7	1-Hexanol, 2-ethyl-
8.000	97.4	C10H16	136.1	7237427	138-86-3	dl-Limonene

8.600	91.3	C8H18O	130.1	1716538	111-87-5	1-Octanol
8.900	90.0	C9H12O	136.1	1931380	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
9.000	94.3	C11H24	156.2	1895477	1120-21-4	Undecane
9.400	94.3	C5H9NO2	115.1	2712078	4394-85-8	N-Formylmorpholine
9.500	95.6	C10H30O5Si5	370.1	41506478	541-02-6	Cyclopentasiloxane, decamethyl-
9.700	95.9	C10H20O2	172.1	3652379	103-09-3	Acetic acid, 2-ethylhexyl ester
10.500	95.8	C12H26	170.2	1669681	112-40-3	Dodecane
10.800	97.5	C12H36O4Si5	384.1	14713840	141-63-9	Pentasiloxane, dodecamethyl-
10.900	95.1	C11H20O2	184.1	1163013	42928-87-0	4-(Prop-2-enoyloxy)octane
12.000	95.9	C12H36O6Si6	444.1	102607290	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.800	90.8	C12H24O3	216.2	1333312	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
13.000	93.9	C12H24O3	216.2	2523733	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.100	94.3	C14H42O5Si6	458.2	13765692	107-52-8	Hexasiloxane, tetradecamethyl-
14.200	82.4	C14H42O7Si7	518.1	93246901	107-50-6	Cycloheptasiloxane, tetradecamethyl-
15.100	88.2	C16H48O6Si7	532.2	3798229	541-01-5	Heptasiloxane, hexadecamethyl-
16.200	87.9	C16H48O8Si8	592.2	60669105	556-68-3	Cyclooctasiloxane, hexadecamethyl-
17.900	84.9	C18H54O9Si9	666.2	7589843	556-71-8	Cyclononasiloxane, octadecamethyl-
19.600	88.8	C30H50	410.4	1408127	7683-64-9	Squalene
20.100	81.5	C30H50	410.4	1722596	7683-64-9	Squalene
20.900	88.9	C24H38O4	390.3	1153572	6422-86-2	1,4-Benzenedicarboxylic acid, bis(2-ethylhexyl) ester
20.900	83.0	C30H50	410.4	1882455	7683-64-9	Squalene
21.200	80.8	C21H36O2	320.3	1731118	36237-72-6	(+)-METHYL 3D,7,11,15-TETRAMETHYLHEXADECA-6-TRANS,10-TRANS-14-TRIENOATE
21.400	81.3	C21H36O2	320.3	1504893	36237-72-6	(+)-METHYL 3D,7,11,15-TETRAMETHYLHEXADECA-6-TRANS,10-TRANS-14-TRIENOATE
21.700	80.4	C21H36O2	320.3	1650242	36237-72-6	(+)-METHYL 3D,7,11,15-TETRAMETHYLHEXADECA-6-TRANS,10-TRANS-14-TRIENOATE
21.900	80.2	C21H36O2	320.3	1916726	36237-72-6	(+)-METHYL 3D,7,11,15-TETRAMETHYLHEXADECA-6-TRANS,10-TRANS-14-TRIENOATE