

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

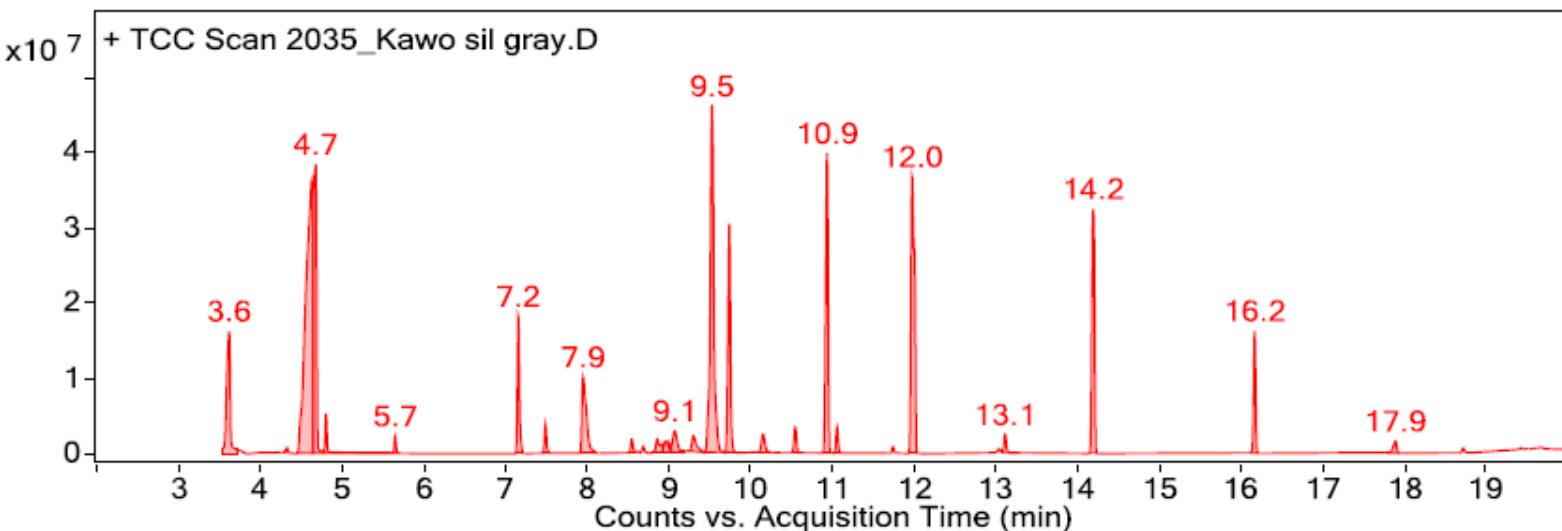
Sample: Kawo Karl Wolpers Colorsil N silicone in RAL 7022 (gray)

Oddy test result: Temporary

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.

VOC not highlighted are because it was also observed in blank: (1) 13.0 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
3.600	89.8	C3H7NO	73.1	49159296	127-06-0	2-Propanone, oxime
4.100	85.5	C7H8	92.1	2751261	108-88-3	Benzene, methyl-
4.300	94.9	C7H8	92.1	1410143	108-88-3	Benzene, methyl-
4.700	91.5	C4H9NO	87.1	104606511	96-29-7	2-Butanone, oxime
4.800	92.5	C6H18O3Si3	222.1	7752916	541-05-9	Cyclotrisiloxane, hexamethyl-
5.700	95.8	C7H18O3Si	178.1	3641762	2031-67-6	Silane, triethoxymethyl-
7.200	97.1	C8H24O4Si4	296.1	32329567	556-67-2	Cyclotetrasiloxane, octamethyl-
7.500	96.8	C10H22	142.2	6706722	124-18-5	Decane
8.000	97.4	C8H18O	130.1	34950832	104-76-7	1-Hexanol, 2-ethyl-
8.000	95.3	C10H16	136.1	2451590	138-86-3	dl-Limonene
8.700	92.7	C9H18O2	158.1	1834621	1000368-94-7	Formic acid, 2-ethylhexyl ester
8.900	92.6	C9H12O	136.1	2134811	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
8.900	80.3	C8H17Br	192.1	1704863	18908-66-2	Heptane, 3-(bromomethyl)-
9.000	88.5	C9H20O	144.2	2795010	3452-97-9	1-Hexanol, 3,5,5-trimethyl-
9.100	90.4	C8H18O	130.1	11869572	6570-88-3	2,3,4-trimethyl-1-pentanol
9.300	86.7	C9H20O	144.2	10056836	143-08-8	1-Nonanol
9.500	88.8	C9H20O	144.2	18551540	143-08-8	1-Nonanol
9.500	96.5	C10H30O5Si5	370.1	94769241	541-02-6	Cyclopentasiloxane, decamethyl-
9.600	92.6	C9H20O	144.2	25058275	143-08-8	1-Nonanol
9.700	94.1	C10H20O2	172.1	63119499	103-09-3	Acetic acid, 2-ethylhexyl ester
10.200	98.2	C9H20O	144.2	7172164	143-08-8	1-Nonanol
10.500	94.6	C12H26	170.2	6872164	112-40-3	Dodecane
10.900	95.5	C11H20O2	184.1	80890757	54774-91-3	2-Propenoic acid, 6-methylheptyl ester
11.100	91.5	C11H22O2	186.2	6107041	999145-46-3	2-Ethyl-1-hexyl propionate
11.700	93.2	C12H28O4Si	264.2	1426969	682-01-9	Silicic acid (H4SiO4), tetrapropyl ester
12.000	95.9	C12H36O6Si6	444.1	108855888	540-97-6	Cyclohexasiloxane, dodecamethyl-
13.000	93.7	C12H24O3	216.2	1482328	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.100	95.9	C13H20O2	208.1	3254911	5888-33-5	2-Propenoic acid, 1,7,7-trimethylbicyclo[2.2.1]hept-2-yl ester, exo-
14.200	82.5	C14H42O7Si7	518.1	73257083	107-50-6	Cycloheptasiloxane, tetradecamethyl-
16.200	88.3	C16H48O8Si8	592.2	27359428	556-68-3	Cyclooctasiloxane, hexadecamethyl-
17.900	84.8	C18H54O9Si9	666.2	4981486	556-71-8	Cyclononasiloxane, octadecamethyl-
18.700	97.7	C16H22O4	278.2	1387544	84-69-5	1,2-Benzenedicarboxylic acid, bis(2-methylpropyl) ester
19.700	81.3	C16H32O2	256.2	1982031	57-10-3	n-Hexadecanoic acid
20.100	88.6	C16H32O2	256.2	1224605	57-10-3	Hexadecanoic acid
22.000	85.3	C18H36O2	284.3	1140261	57-11-4	Octadecanoic acid