

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

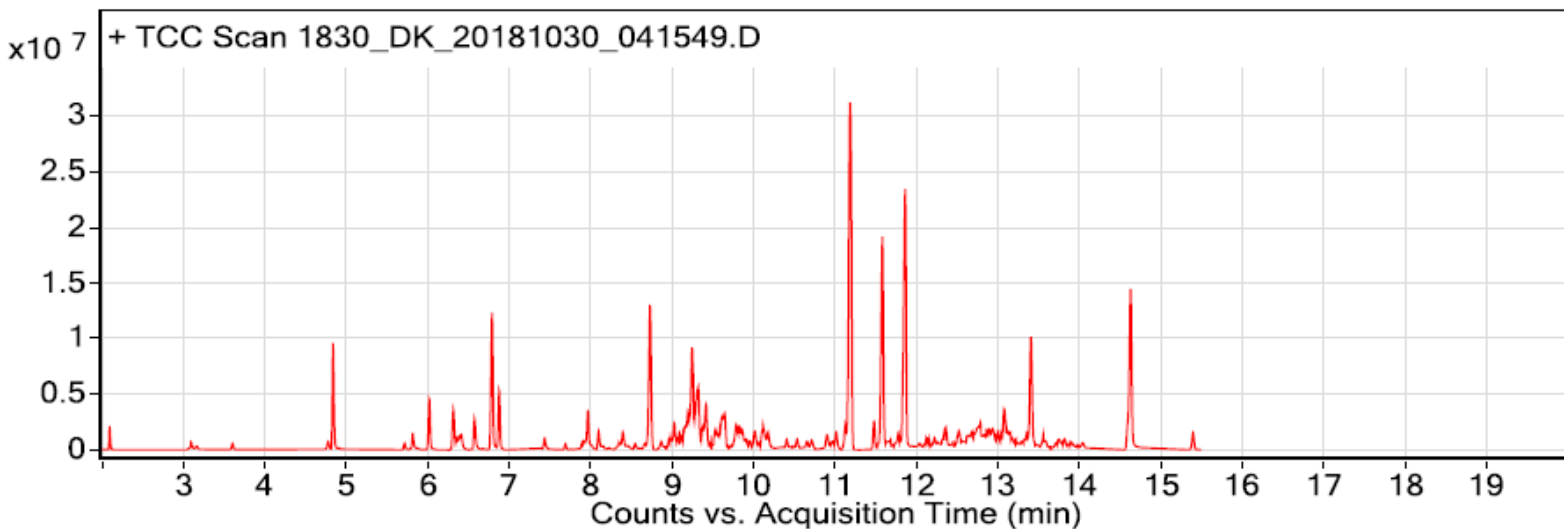
Sample: Dominique Keiffer Satin de Coton, 17161-0 in perle

Oddy test result: Permanent

Date collected: 10/30/2018

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) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (2) 11.8 min: 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
1.510	97.4	C2H4O2	60.0	1042789	64-19-7	Acetic acid
2.090	93.7	C2H8O2Si	92.0	2046167	1066-42-8	Silanediol, dimethyl-
3.600	92.5	C6H18O3Si3	222.1	1011377	541-05-9	Cyclotrisiloxane, hexamethyl-
4.840	96.9	C6H14O2	118.1	7019247	111-76-2	Ethanol, 2-butoxy-
5.710	97.8	C7H6O	106.0	916246	100-52-7	Benzaldehyde
6.020	85.3	C6H6O	94.0	7065321	108-95-2	Phenol
6.310	96.0	C8H24O4Si4	296.1	5967311	556-67-2	Cyclotetrasiloxane, octamethyl-
6.360	93.2	C5H11O2	103.1	991171	999013-01-3	O-Ethyl-1,3-dioxolanium
6.380	93.1	C8H16O	128.1	1235590	124-13-0	Octanal
6.410	88.4	C7H16O3	148.1	1529043	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
6.570	98.4	C7H16O3	148.1	4822087	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
6.790	96.6	C8H18O	130.1	20522832	104-76-7	1-Hexanol, 2-ethyl-
6.880	95.9	C7H8O	108.1	7690914	100-51-6	Benzyl Alcohol
7.430	96.7	C8H18O	130.1	1766160	111-87-5	1-Octanol
7.690	92.8	C9H12O	136.1	784875	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
7.900	84.2	C10H16	136.1	1108046	586-62-9	.ALPHA.-TERPINOLENE
7.970	97.5	C9H18O	142.1	5924496	124-19-6	Nonanal
8.150	85.7	C8H16O2	144.1	768366	149-57-5	Hexanoic acid, 2-ethyl-
8.400	91.7	C9H20O	144.2	1495260	143-08-8	1-Nonanol
8.550	91.0	C9H20O	144.2	811224	110453-78-6	(S)-(+)-6-Methyl-1-octanol
8.660	83.2	C10H20O2	172.1	734934	103-09-3	Acetic acid, 2-ethylhexyl ester
8.700	94.7	C16H12ClN3	281.1	914760	69737-10-6	1-Amino-1-ortho-chlorophenyl-2-(2-quinoxaliny)ethene
8.730	95.5	C10H30O5Si5	370.1	23946722	541-02-6	Cyclopentasiloxane, decamethyl-
8.870	89.6	C11H24O	172.2	1394072	112-42-5	1-Undecanol
8.960	95.9	C9H20O	144.2	1724266	143-08-8	1-Nonanol

9.030	95.8	C10H20O	156.2	2174166	15356-70-4	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(+/-)-
9.120	81.5	C9H20O	144.2	2949553	110453-78-6	(S)-(+)-6-Methyl-1-octanol
9.200	81.0	C14H24O4	256.2	4591859	1000309-30-7	Oxalic acid, cyclohexyl isohexyl ester
9.250	92.8	C8H18O3	162.1	9291863	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
9.420	89.4	C10H20	140.2	7694832	62238-07-7	Cyclopropane, 1-methyl-2-(3-methylpentyl)-
9.640	81.2	C6H8O2	112.1	5132506	765-87-7	1,2-Cyclohexanedione
9.790	82.7	C10H20	140.2	5955337	4737-43-3	Cyclopentane, (1-methylbutyl)-
9.950	90.9	C10H22O2	174.2	1136760	1559-35-9	Ethanol, 2-[(2-ethylhexyl)oxy]-
10.100	92.0	C6H11NO	113.1	1962453	105-60-2	Caprolactam
10.180	86.2	C12H24O2	200.2	1180107	7434-89-1	Hexanoic acid, 2-ethyl-, 2-methylpropyl ester
10.410	96.7	C10H22O	158.2	1257795	112-30-1	1-Decanol
10.530	90.7	C14H30	198.2	1278818	61141-72-8	Dodecane, 4,6-dimethyl-
10.900	85.1	C14H23F5O2	318.2	2434897	1000283-04-0	Pentafluoropropionic acid, undecyl ester
11.010	88.8	C12H26O	186.2	2643606	3913-02-8	1-Octanol, 2-butyl-
11.160	80.7	C19H40	268.3	1476919	629-92-5	Nonadecane
11.190	96.6	C12H36O6Si6	444.1	69628017	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.480	94.4	C7H12O5	176.1	4308670	1000428-18-0	1,3-Diacetin
11.580	89.3	C12H24O3	216.2	35956496	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.780	97.4	C11H24O	172.2	1683268	112-42-5	1-Undecanol
11.860	93.9	C12H24O3	216.2	46079109	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.140	93.9	C14H30	198.2	1270461	629-59-4	Tetradecane
12.220	82.5	C12H26O	186.2	1326942	3913-02-8	1-Octanol, 2-butyl-
12.360	92.1	C14H26O2	226.2	3803895	126-86-3	2,4,7,9-Tetramethyl-5-decyne-4,7-diol
12.520	89.5	C13H20O2	208.1	1367525	128-51-8	Nopyl acetate
12.690	81.6	C16H32	224.3	1713710	629-73-2	1-Hexadecene
12.890	83.5	C10H10O4	194.1	1190544	131-11-3	1,2-Benzenedicarboxylic acid, dimethyl ester
12.940	84.6	C28H58O	410.4	3348846	1000406-38-8	Eicosyl octyl ether
13.170	87.5	C12H26O	186.2	1534570	3913-02-8	1-Octanol, 2-butyl-
13.370	86.6	C19H40	268.3	2103970	629-92-5	Nonadecane
13.410	81.7	C14H42O7Si7	518.1	17916154	107-50-6	Cycloheptasiloxane, tetradecamethyl-
13.570	87.3	C14H22O	206.2	745908	96-76-4	Phenol, 2,4-bis(1,1-dimethylethyl)-
13.590	87.0	C16H34	226.3	1214155	59222-86-5	Tetradecane, 2,2-dimethyl-
13.820	92.7	C19H38	266.3	1551064	18435-45-5	1-Nonadecene
13.910	86.6	C24H50	338.4	1099208	646-31-1	Tetracosane
14.040	82.2	C24H50O	354.4	919636	1000406-38-6	Hexadecyl octyl ether
14.590	94.8	C12H14O4	222.1	3530229	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
15.400	88.7	C16H48O8Si8	592.2	2855205	556-68-3	Cyclooctasiloxane, hexadecamethyl-