

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

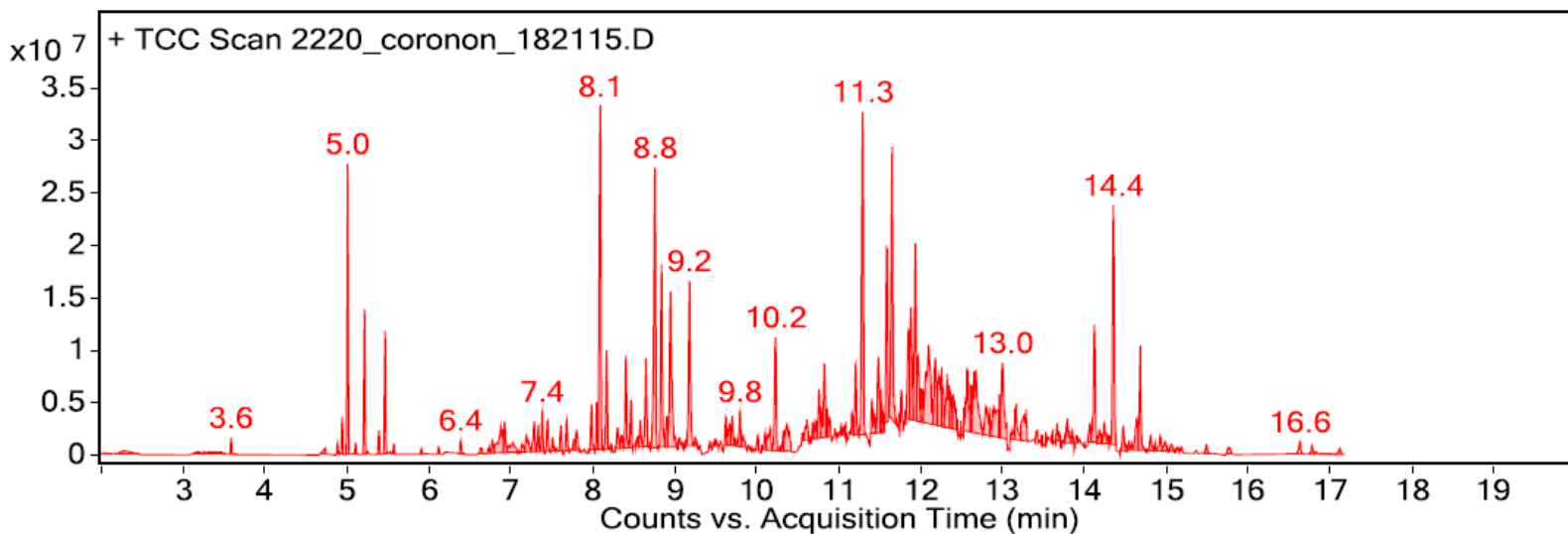
Sample: Coroplast non-archival

Oddy test result: Temporary

Date collected: 06/29/2018

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) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



RT	Score	Formula	MW	Area	CAS #	Name
1.900	83.1	C6H14	86.1	603194	110-54-3	Hexane
2.300	80.0	C6H12	84.1	1431290	96-37-7	Cyclopentane, methyl-
3.200	88.4	C8H16	112.1	2087145	107-39-1	1-Pentene, 2,4,4-trimethyl-
3.600	98.0	C2H4O2	60.0	977133	64-19-7	Acetic acid
4.700	90.6	C5H10O2	102.1	1476316	75-98-9	Propanoic acid, 2,2-dimethyl-
4.900	91.9	C6H18O3Si3	222.1	1078231	541-05-9	Cyclotrisiloxane, hexamethyl-
4.900	95.0	C9H20	128.2	3536989	3074-71-3	Heptane, 2,3-dimethyl-
5.000	95.0	C9H20	128.2	26028094	2213-23-2	Heptane, 2,4-dimethyl-
5.100	83.0	C9H18	126.1	1159957	3074-64-4	2,3-Dimethyl-2-heptene
5.200	89.2	C9H18	126.1	13574834	19549-87-2	2,4-Dimethyl-1-heptene
5.400	96.0	C9H20	128.2	2332234	3074-71-3	Heptane, 2,3-dimethyl-
5.500	94.9	C9H20	128.2	11641863	2216-34-4	Octane, 4-methyl-
5.600	94.4	C10H22	142.2	1165784	2613-61-8	Heptane, 2,4,6-trimethyl-
5.900	80.9	C10H22O	158.2	607148	19780-78-0	4-Ethyl-2-octanol
6.400	95.3	C8H16O	128.1	1721121	6137-06-0	2-Heptanone, 4-methyl-
6.900	85.1	C13H28	184.2	2612179	17312-83-3	Undecane, 5,7-dimethyl-
6.900	81.5	C6H6O	94.0	738095	108-95-2	Phenol
6.900	96.5	C8H24O4Si4	296.1	2614139	556-67-2	Cyclotetrasiloxane, octamethyl-
7.100	80.5	C8H11N	121.1	1359751	1462-84-6	Pyridine, 2,3,6-trimethyl-
7.200	81.8	C13H22ClF3	270.1	1939263	108400-10-8	2-chloro-1,1,1-trifluoro-2-tridecene
7.200	96.6	C7H16O3	148.1	1098194	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.300	87.8	C5H11O2	103.1	1027658	999013-01-3	O-Ethyl-1,3-dioxolanium
7.300	88.6	C10H22	142.2	3598436	15869-93-9	Octane, 3,5-dimethyl-
7.300	93.5	C8H16O	128.1	1766211	124-13-0	Octanal
7.400	90.4	C11H24	156.2	2624251	17302-28-2	Nonane, 2,6-dimethyl-
7.500	90.0	C11H24	156.2	841353	62016-37-9	Octane, 2,4,6-trimethyl-
7.500	82.1	C13H28	184.2	1026300	17312-83-3	Undecane, 5,7-dimethyl-
7.600	94.7	C7H9N	107.1	3367867	100-45-8	4-Cyanocyclohexene

7.700	93.0	C8H18O	130.1	2679871	104-76-7	1-Hexanol, 2-ethyl-
7.800	88.2	C10H16	136.1	1434631	138-86-3	dl-Limonene
7.900	82.7	C9H20O	144.2	541732	3452-97-9	1-Hexanol, 3,5,5-trimethyl-
8.000	93.0	C12H26	170.2	6516437	52670-34-5	Octane, 2,3,6,7-tetramethyl-
8.000	89.3	C13H28	184.2	2948436	62185-53-9	Nonane, 5-(2-methylpropyl)-
8.100	90.9	C11H24	156.2	49587323	17302-23-7	Nonane, 4,5-dimethyl-
8.200	92.1	C13H28	184.2	11556842	17301-32-5	Undecane, 4,7-dimethyl-
8.200	83.0	C15H32	212.3	1180823	31295-56-4	Dodecane, 2,6,11-trimethyl-
8.400	87.1	C13H28	184.2	1323579	17301-24-5	Undecane, 2,7-dimethyl-
8.400	87.9	C12H24	168.2	11384846	112-41-4	1-Dodecene
8.500	88.6	C12H24	168.2	6972977	55170-80-4	1-Decene, 2,4-dimethyl-
8.500	91.3	C12H26	170.2	2581437	1636-43-7	Decane, 5,6-dimethyl-
8.700	92.6	C13H28	184.2	10762588	62185-53-9	Nonane, 5-(2-methylpropyl)-
8.800	92.0	C11H24	156.2	45233176	17302-23-7	Nonane, 4,5-dimethyl-
8.800	88.0	C12H26	170.2	24481901	112-40-3	Dodecane
8.900	92.2	C12H26	170.2	15519318	2980-69-0	Undecane, 4-methyl-
9.000	82.6	C6H12O2	116.1	1692776	98499-03-7	6-Hydroxyhexan-3-one
9.100	87.6	C13H28	184.2	2074655	62185-55-1	Nonane, 4-methyl-5-propyl-
9.200	95.4	C10H30O5Si5	370.1	21081147	541-02-6	Cyclopentasiloxane, decamethyl-
9.300	91.2	C13H28	184.2	1609926	17301-32-5	Undecane, 4,7-dimethyl-
9.400	90.1	C10H20O2	172.1	1550109	103-09-3	Acetic acid, 2-ethylhexyl ester
9.500	82.3	C11H24	156.2	670275	2884-06-2	Nonane, 2,3-dimethyl-
9.600	91.1	C13H28	184.2	1464000	62185-54-0	Nonane, 5-(1-methylpropyl)-
9.700	89.2	C12H26	170.2	1602108	7045-71-8	Undecane, 2-methyl-
9.800	93.5	C13H28	184.2	2569330	17312-77-5	Undecane, 2,3-dimethyl-
10.000	87.7	C8H18O3	162.1	1550930	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
10.100	87.0	C15H25F5O2	332.2	1464556	6222-04-4	Pentafluoropropionic acid, dodecyl ester
10.100	88.5	C10H8	128.1	729894	275-51-4	Azulene
10.200	91.7	C13H28	184.2	1518275	62238-11-3	Decane, 2,3,5-trimethyl-
10.200	95.6	C12H26	170.2	15745285	112-40-3	Dodecane
10.300	94.3	C10H20O	156.2	2809416	112-31-2	Decanal
10.400	83.2	C20H42	282.3	1871531	112-95-8	Eicosane
10.700	89.7	C14H30	198.2	2024091	61141-72-8	Dodecane, 4,6-dimethyl-
10.700	85.9	C7H5NS	135.0	2533238	95-16-9	Benzothiazole
10.800	81.9	C6H14O3	134.1	3843773	25265-71-8	2-Propanol, 1,1'-oxybis-
10.800	91.0	C14H30	198.2	2764969	61141-72-8	Dodecane, 4,6-dimethyl-
10.800	81.0	C10H22O3	190.2	6080645	29911-28-2	2-Propanol, 1-(2-butoxy-1-methylethoxy)-
10.900	82.6	C14H30	198.2	2913920	61141-72-8	Dodecane, 4,6-dimethyl-
11.100	88.3	C13H28	184.2	2587157	17301-29-0	Undecane, 3,7-dimethyl-
11.200	83.0	C12H25Br	248.1	15124510	13187-99-0	2-Bromo dodecane
11.300	90.4	C14H30	198.2	53343916	61141-72-8	Dodecane, 4,6-dimethyl-
11.300	83.5	C5H11Br	150.0	1203550	1809-10-5	Pentane, 3-bromo-
11.400	90.1	C14H30	198.2	9520985	61141-72-8	Dodecane, 4,6-dimethyl-
11.500	89.5	C16H34	226.3	8704434	544-76-3	Hexadecane
11.500	91.7	C10H14O	150.1	5038698	585-34-2	Phenol, 3-(1,1-dimethylethyl)-
11.600	92.1	C12H36O6Si6	444.1	26018292	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.700	89.8	C12H26O	186.2	23208983	3913-02-8	1-Octanol, 2-butyl-
11.700	86.7	C16H34	226.3	2959851	544-76-3	Hexadecane
11.800	90.2	C11H24O	172.2	9529159	91337-07-4	2-Isopropyl-5-methyl-1-heptanol
11.900	83.3	C12H25I	296.1	16064276	4292-19-7	Dodecane, 1-iodo-
11.900	90.2	C15H32	212.3	34467734	629-62-9	pentadecane
12.000	82.6	C16H34	226.3	6632191	4390-04-9	Nonane, 2,2,4,4,6,8,8-heptamethyl-
12.100	86.0	C9H20	128.2	23493916	16747-30-1	Hexane, 2,4,4-trimethyl-
12.200	87.4	C23H48	324.4	20534435	638-67-5	Tricosane
12.200	87.3	C18H38	254.3	8612292	3892-00-0	Pentadecane, 2,6,10-trimethyl-
12.300	86.5	C18H38O3S	334.3	11823291	999541-21-3	Sulfurous acid, decyl 2-ethylhexyl ester
12.400	82.7	C9H20O	144.2	4436638	62238-03-3	Butane, 1-butoxy-2-methyl-
12.500	85.6	C12H26	170.2	4276869	55258-15-6	Hexane, 2,2,3,4,5,5-Hexamethyl-, (DL)-
12.600	92.5	C16H34	226.3	10157571	4390-04-9	Nonane, 2,2,4,4,6,8,8-heptamethyl-
12.600	86.7	C23H48	324.4	9531350	638-67-5	Tricosane
12.600	87.0	C16H34	226.3	5997986	4390-04-9	Nonane, 2,2,4,4,6,8,8-heptamethyl-
12.700	83.1	C12H24O3	216.2	15193058	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.700	81.3	C7H13NO	127.1	8635884	999032-62-8	1,2,2-Trimethylpropyl Isocyanate
12.800	86.8	C13H28	184.2	14846151	17312-82-2	Undecane, 4,6-dimethyl-
12.900	82.8	C12H24	168.2	1823886	112-41-4	1-Dodecene

13.000	93.1	C14H30	198.2	16431561	629-59-4	Tetradecane
13.200	87.7	C12H26	170.2	7741827	112-40-3	Dodecane
13.300	86.4	C17H36	240.3	3840237	629-78-7	Heptadecane
13.400	86.1	C11H24	156.2	4185696	1120-21-4	Undecane
13.500	82.6	C11H24	156.2	3351538	1120-21-4	Undecane
13.500	82.1	C11H24	156.2	1917810	1120-21-4	Undecane
13.600	87.2	C20H42	282.3	3642491	112-95-8	Eicosane
13.600	85.5	C24H50	338.4	2583716	646-31-1	Tetracosane
13.700	84.7	C14H28	196.2	3545847	2882-98-6	Cyclopentane, nonyl-
13.700	80.1	C14H14O	198.1	1329815	4237-44-9	Phenol, 2-(1-phenylethyl)-
13.800	80.3	C14H42O7Si7	518.1	3845083	107-50-6	Cycloheptasiloxane, tetradecamethyl-
13.800	85.9	C19H40O3S	348.3	2297145	999571-16-6	Sulfurous acid, 2-ethylhexyl undecyl ester
13.900	85.0	C14H20O2	220.1	1546763	719-22-2	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)-
14.100	86.0	C13H28	184.2	4490205	17301-30-3	Undecane, 3,8-dimethyl-
14.100	89.3	C16H34	226.3	16943615	544-76-3	Hexadecane
14.200	86.1	C30H58O4	482.4	1376884	2432-89-5	Decanedioic acid, didecyl ester
14.200	89.4	C16H34	226.3	1802770	544-76-3	Hexadecane
14.300	80.9	C33H68	464.5	1483325	630-05-7	Tritriacontane
14.500	86.7	C20H42O	298.3	4093574	1000406-38-4	Dodecyl octyl ether
14.500	85.5	C19H40	268.3	797014	629-92-5	Nonadecane
14.600	82.5	C23H48	324.4	2391682	638-67-5	Tricosane
14.700	89.1	C16H34	226.3	8677463	544-76-3	Hexadecane
14.800	89.6	C20H42	282.3	2762484	504-44-9	Hexadecane, 2,6,11,15-tetramethyl-
14.900	90.2	C20H42	282.3	3502798	638-36-8	Hexadecane, 2,6,10,14-tetramethyl-
15.000	86.0	C15H30	210.2	594332	2883-02-5	n-Nonylcyclohexane
15.100	91.8	C20H42	282.3	1876141	638-36-8	Hexadecane, 2,6,10,14-tetramethyl-
15.100	87.3	C16H34	226.3	990625	2882-96-4	Pentadecane, 3-methyl-
15.200	87.8	C15H32	212.3	831137	629-62-9	pentadecane
15.500	89.4	C16H34	226.3	1310988	3891-99-4	2,6,10-Trimethyltridecane
15.800	89.9	C16H48O8Si8	592.2	943476	556-68-3	Cyclooctasiloxane, hexadecamethyl-
15.800	85.1	C17H26O2	262.2	827522	14035-34-8	2,6-Bis(1,1-dimethylethyl)-4-(1-oxopropyl)phenol
16.600	88.9	C20H42	282.3	2184224	638-36-8	Hexadecane, 2,6,10,14-tetramethyl-
16.800	94.1	C15H22O2	234.2	1235292	5444-75-7	Benzoic acid, 2-ethylhexyl ester
17.100	86.7	C20H42	282.3	1094418	638-36-8	Hexadecane, 2,6,10,14-tetramethyl-