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

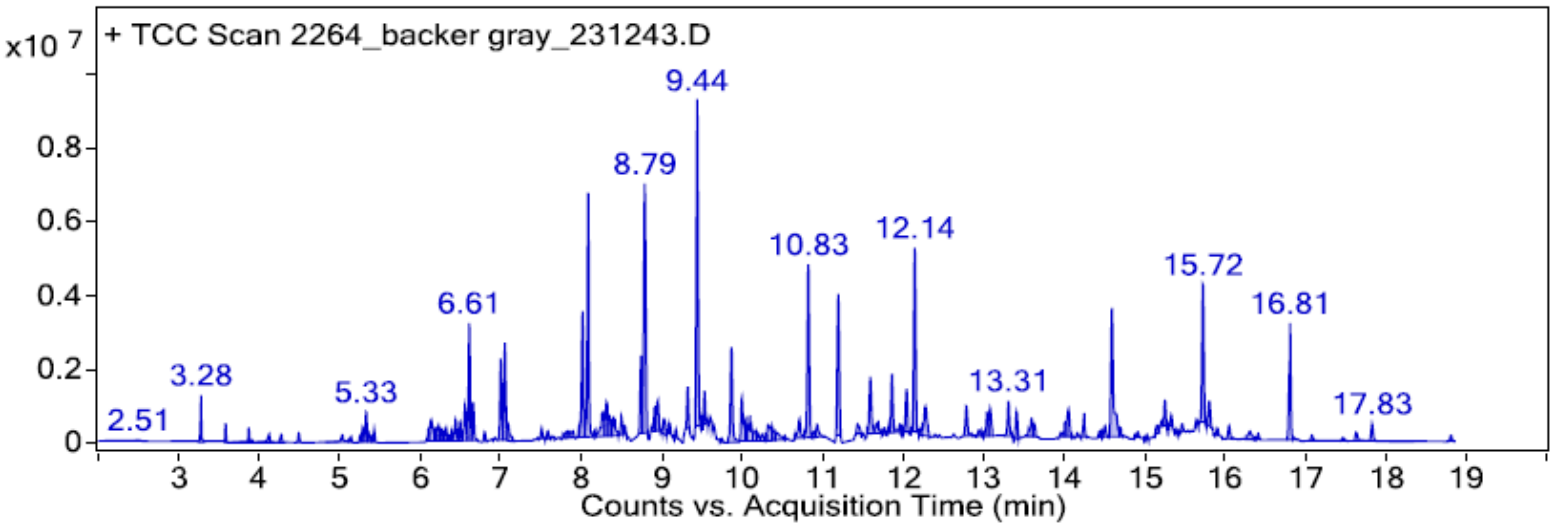
Alkynes – can become reactive when exposed to heat or UV light

Sample: Weatherall Company Inc.; Alcot Plastics backer round rod gray

Date collected: 08/17/2018

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 17.0 library are reported.

VOCs not highlighted are because they were also observed in blanks: : (1) 5.3 min: methoxyphenyl oxime; (2) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 11.9 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.510	94.0	C2H4O2	60.0	411051	64-19-7	Acetic acid
3.280	98.5	C2H4O2	60.0	949293	64-19-7	Acetic acid
3.580	85.6	C2H8O2Si	92.0	453289	1066-42-8	Silanediol, dimethyl-
3.870	94.5	C3H8O2	76.1	360891	57-55-6	1,2-Propanediol
4.120	81.5	C4H8O2	88.1	362269	107-92-6	Butanoic acid
4.280	90.3	C5H10O2	102.1	344063	75-98-9	Propanoic acid, 2,2-dimethyl-
4.490	92.5	C6H18O3Si3	222.1	392356	541-05-9	Cyclotrisiloxane, hexamethyl-
5.140	90.1	C8H18O	130.1	216236	142-96-1	Butane, 1,1'-oxybis-
5.250	83.8	C8H9NO2	151.1	172442	1000222-86-6	Oxime-, methoxy-phenyl-_
5.330	95.4	C9H20	128.2	609957	111-84-2	Nonane
5.410	82.7	C6H14O2	118.1	176485	111-76-2	Ethanol, 2-butoxy-
5.430	90.3	C7H14O2	130.1	260781	590-01-2	Propanoic acid, butyl ester
6.260	86.2	C6H12O2	116.1	718773	142-62-1	Hexanoic acid
6.440	91.8	C8H14O	126.1	531005	110-93-0	5-Hepten-2-one, 6-methyl-
6.500	86.7	C10H20	140.2	446993	872-05-9	1-Decene
6.560	95.0	C8H24O4Si4	296.1	1188997	556-67-2	Cyclotetrasiloxane, octamethyl-
6.570	95.5	C9H12	120.1	449948	0-00-0	unidentified C3-benzene
6.610	96.8	C10H22	142.2	3729671	124-18-5	Decane
6.660	97.1	C8H16O	128.1	770314	124-13-0	Octanal
6.800	93.5	C10H16	136.1	386223	13466-78-9	3-Carene
6.930	93.1	C11H24	156.2	240994	2847-72-5	Decane, 4-methyl-
6.990	88.5	C10H14	134.1	341205	527-84-4	Benzene, 1-methyl-2-(1-methylethyl)-
7.000	95.8	C8H18O	130.1	2873317	104-76-7	1-Hexanol, 2-ethyl-
7.050	97.1	C10H16	136.1	2954881	138-86-3	dl-Limonene
7.510	89.8	C15H32	212.3	271516	31295-56-4	Dodecane, 2,6,11-trimethyl-
7.990	96.1	C8H8O2	136.1	342316	93-58-3	Benzoic acid, methyl ester
8.020	96.9	C11H24	156.2	5211822	1120-21-4	Undecane
8.090	97.6	C9H18O	142.1	5899601	124-19-6	Nonanal
8.270	88.5	C13H28	184.2	1066186	17301-32-5	Undecane, 4,7-dimethyl-
8.320	83.6	C13H22F4	254.2	918096	108377-18-0	1,1,1,2-tetrafluoro-2-tridecene
8.420	91.6	C13H28	184.2	919113	17301-32-5	Undecane, 4,7-dimethyl-

8.500	90.8	C13H28	184.2	320362	17301-33-6	Undecane, 4,8-dimethyl-
8.740	96.0	C10H20O2	172.1	3000869	103-09-3	Acetic acid, 2-ethylhexyl ester
8.790	94.1	C10H30O5Si5	370.1	9079550	541-02-6	Cyclopentasiloxane, decamethyl-
8.950	81.1	C10H20O2	172.1	1229869	112-14-1	Acetic acid, octyl ester
9.030	81.1	C18H38	254.3	787059	26741-18-4	9-methylheptadecane
9.100	86.4	C10H20O	156.2	698270	2216-52-6	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, [1S-(1.alpha.,2.alpha.,5.beta.)]-
9.180	86.4	C10H20O2	172.1	387271	112-14-1	Acetic acid, octyl ester
9.290	89.9	C10H8	128.1	291587	2471-84-3	1H-Indene, 1-methylene-
9.330	96.0	C12H24	168.2	2344111	112-41-4	1-Dodecene
9.440	95.4	C12H26	170.2	15069366	112-40-3	Dodecane
9.530	96.5	C10H20O	156.2	1835229	112-31-2	Decanal
9.560	80.3	C4H8O2S	120.0	263035	126-33-0	Thiophene, tetrahydro-, 1,1-dioxide
9.600	81.2	C12H24O2	200.2	247838	112-17-4	Acetic acid, decyl ester
9.750	92.7	C8H10O2	138.1	201355	122-99-6	Ethanol, 2-phenoxy-
9.870	95.2	C11H20O2	184.1	4100820	103-11-7	2-Ethylhexyl acrylate
10.000	90.3	C11H22O2	186.2	1900371	999145-46-3	2-Ethyl-1-hexyl propionate
10.060	83.6	C12H24	168.2	587984	294-62-2	Cyclododecane
10.320	86.5	C18H38O	270.3	804782	1000406-38-3	Decyl octyl ether
10.430	81.1	C18H38O	270.3	534433	1000406-38-3	Decyl octyl ether
10.710	94.4	C13H26	182.2	1174130	2437-56-1	1-Tridecene
10.820	94.9	C13H28	184.2	7823815	629-50-5	Tridecane
10.930	84.7	C11H22O	170.2	790729	112-44-7	Undecanal
11.200	95.3	C12H36O6Si6	444.1	7511209	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.430	83.7	C13H26	182.2	510029	5617-41-4	Heptylcyclohexane
11.590	91.1	C12H24O3	216.2	1698992	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.760	88.1	C20H42	282.3	508822	13287-24-6	9-methylnonadecane
11.860	92.6	C12H24O3	216.2	3117262	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.040	95.9	C14H28	196.2	2225948	1120-36-1	1-Tetradecene
12.150	95.0	C14H30	198.2	8566636	629-59-4	Tetradecane
12.220	81.1	C16H34	226.3	483476	55045-10-8	Tridecane, 6-propyl-
12.270	96.8	C12H24O	184.2	667772	112-54-9	Dodecanal
12.790	90.5	C14H30O	214.2	1581061	112-72-1	1-Tetradecanol
12.950	90.2	C20H42	282.3	524532	112-95-8	Eicosane
13.310	95.6	C15H30	210.2	1543491	13360-61-7	1-Pentadecene
13.600	88.0	C16H34	226.3	406048	59222-86-5	Tetradecane, 2,2-dimethyl-
13.630	93.0	C15H24O	220.2	285081	128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
13.960	82.4	C13H28	184.2	269283	31081-17-1	Nonane, 2-methyl-5-propyl-
14.060	88.5	C15H30	210.2	823238	2883-02-5	n-Nonylcyclohexane
14.160	87.1	C23H48	324.4	334608	638-67-5	Tricosane
14.250	91.1	C16H34	226.3	432061	2882-96-4	Pentadecane, 3-methyl-
14.440	87.2	C10H20	140.2	316996	489-20-3	Cyclopentane, 1,2-dimethyl-3-(1-methylethyl)-
14.510	92.2	C19H38	266.3	532030	18435-45-5	1-Nonadecene
14.590	90.4	C16H34	226.3	4221927	544-76-3	Hexadecane
14.920	92.6	C15H30O2	242.2	300144	10233-13-3	Dodecanoic acid, 1-methylethyl ester
15.030	98.3	C13H10O	182.1	376437	119-61-9	Methanone, diphenyl-
15.250	91.0	C16H34O	242.3	964367	36653-82-4	1-Hexadecanol
15.330	93.3	C16H34O	242.3	626039	629-82-3	Octane, 1,1'-oxybis-
15.410	84.5	C16H48O8Si8	592.2	231193	556-68-3	Cyclooctasiloxane, hexadecamethyl-
15.730	95.5	C17H36	240.3	2716560	629-78-7	Heptadecane
16.050	91.7	C18H20	236.2	497965	3910-35-8	1H-Indene, 2,3-dihydro-1,1,3-trimethyl-3-phenyl-
16.410	88.9	C17H34	238.3	286677	54105-66-7	Cyclohexane, undecyl-
16.800	93.2	C18H38	254.3	3244239	593-45-3	Octadecane
16.860	80.5	C19H40	268.3	199283	1000360-41-0	5,5-Diethylpentadecane
17.080	91.3	C17H34O2	270.3	239210	110-27-0	Isopropyl myristate
17.630	94.4	C16H34O	242.3	421338	36653-82-4	1-Hexadecanol
17.830	89.8	C19H40	268.3	783822	629-92-5	Nonadecane
18.810	90.7	C24H50	338.4	277630	646-31-1	Tetracosane