

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

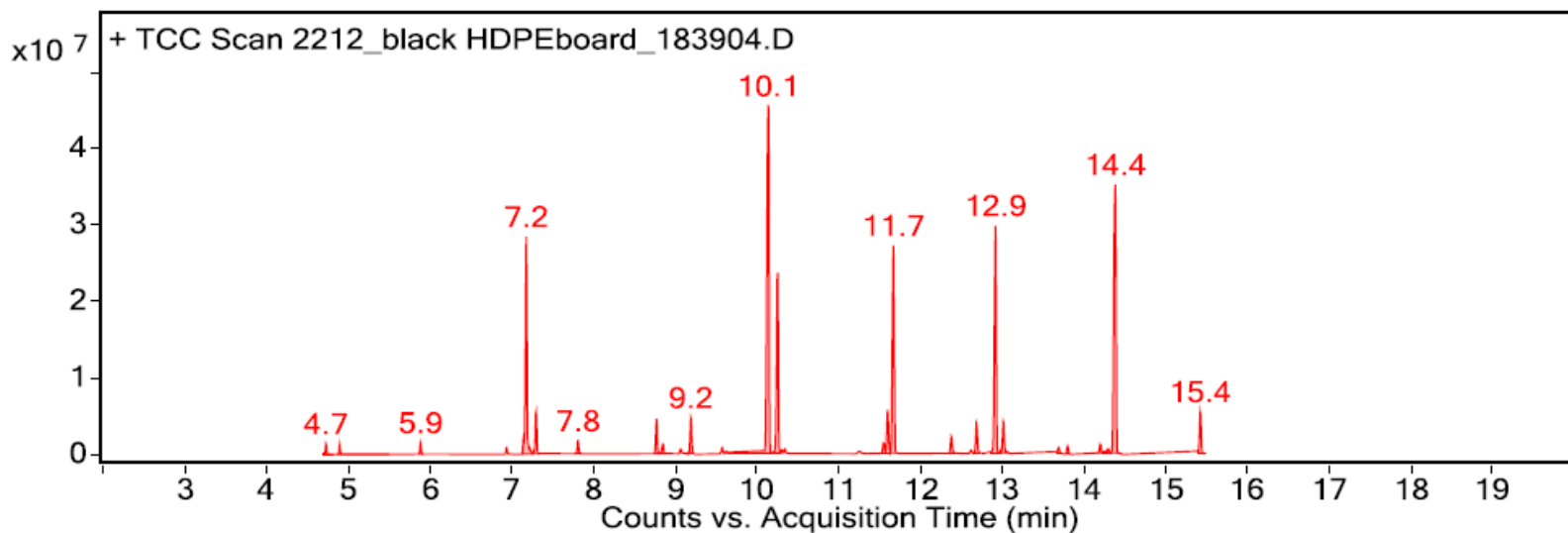
Sample: King Plastic Corporation; King Starboard Marine-grade HDPE (polyethylene) sheet

Oddy test result: Permanent

Date GC-MS collected: 6/20/2018

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) ~12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) ~12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
4.700	96.5	C8H16	112.1	1295535	2511-91-3	Cyclopropane, pentyl-
4.900	92.5	C6H18O3Si3	222.1	1134958	541-05-9	Cyclotrisiloxane, hexamethyl-
5.900	97.8	C8H10	106.1	1640446	0-00-0	unidentified C2-benzene
6.900	94.7	C8H24O4Si4	296.1	1042151	556-67-2	Cyclotetrasiloxane, octamethyl-
7.100	93.2	C8H11N	121.1	2294484	1462-84-6	Pyridine, 2,3,6-trimethyl-
7.200	96.3	C10H20	140.2	34680490	872-05-9	1-Decene
7.200	92.1	C10H20	140.2	1725046	19689-19-1	5-Decene
7.300	94.8	C10H22	142.2	3576985	124-18-5	Decane
7.800	93.0	C7H8O	108.1	2468301	100-51-6	Benzyl Alcohol
8.800	97.2	C11H24	156.2	5832562	1120-21-4	Undecane
8.800	97.7	C9H18O	142.1	1756149	124-19-6	Nonanal
9.100	81.5	C9H17NO	155.1	1023890	10581-38-1	2,2,6,6-tetramethyl-4-oxo-piperidine
9.200	94.3	C10H30O5Si5	370.1	6654574	541-02-6	Cyclopentasiloxane, decamethyl-
9.600	92.8	C12H26	170.2	1193214	1632-70-8	Undecane, 5-methyl-
10.100	96.4	C12H24	168.2	84868298	294-62-2	Cyclododecane
10.300	95.3	C12H26	170.2	34097153	112-40-3	Dodecane
10.300	97.3	C10H20O	156.2	979202	112-31-2	Decanal
11.200	87.9	C11H24O	172.2	868150	18675-24-6	1-Decanol, 2-methyl-

11.500	96.0	C13H26	182.2	2446345	2437-56-1	1-Tridecene
11.600	95.3	C12H36O6Si6	444.1	8134703	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.700	95.0	C13H28	184.2	41850622	629-50-5	Tridecane
12.400	89.8	C12H24O3	216.2	3437033	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.600	84.4	C14H30	198.2	866502	6418-41-3	Tridecane, 3-methyl-
12.700	93.4	C12H24O3	216.2	5781816	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
12.900	95.9	C14H30O	214.2	45619544	112-72-1	1-Tetradecanol
13.000	95.1	C14H30	198.2	6130523	629-59-4	Tetradecane
13.700	93.4	C14H28	196.2	1246668	2882-98-6	Cyclopentane, nonyl-
14.200	95.6	C15H30	210.2	1891484	13360-61-7	1-Pentadecene
14.300	93.7	C15H32	212.3	1141523	629-62-9	pentadecane
15.400	95.9	C16H34O	242.3	7777355	36653-82-4	1-Hexadecanol