

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

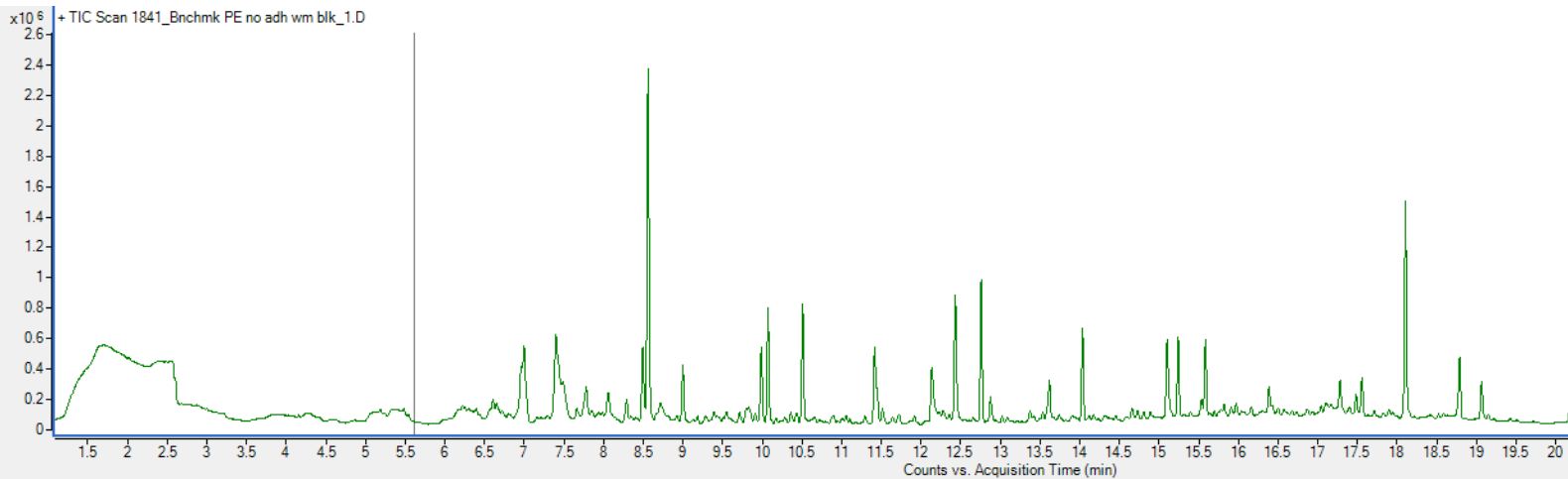
Sample: Benchmark 35-111 sueded polyethylene fabric; warm black; no adhesive backing

Oddy test result: Temporary

Date collected: 12/07/2017

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



Library results

RT	Score	Formula	MW	Area	CAS #	Name
5.481	85.2	C7H14O	114.1	384053	111-71-7	Heptanal
6.225	83.1	C8H14O	126.1	549091	1669-44-9	3-Octen-2-one
6.396	98.2	C7H6O	106.0	496740	100-52-7	Benzaldehyde
6.959	87.9	C11H24	156.2	372220	1120-21-4	Undecane
6.998	96.3	C8H16O	128.1	1709736	124-13-0	Octanal
7.396	97.2	C8H18O	130.1	2075741	104-76-7	1-Hexanol, 2-ethyl-
7.435	83.3	C10H16	136.1	429413	138-86-3	dl-Limonene
7.493	95.5	C7H8O	108.1	753296	100-51-6	Benzyl Alcohol
7.784	88.2	C7H14	98.1	636626	6443-92-1	(Z)-2-Heptene
8.293	91.7	C9H12O	136.1	297293	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
8.491	98.1	C11H24	156.2	887010	1120-21-4	Undecane
8.559	98.5	C9H18O	142.1	4115710	124-19-6	Nonanal
8.717	80.3	C8H10O	122.1	300287	60-12-8	Phenylethyl Alcohol
8.997	91.6	C10H30O5Si5	370.1	568120	541-02-6	Cyclopentasiloxane, decamethyl-
9.986	96.5	C12H26	170.2	826175	112-40-3	Dodecane
10.072	98.3	C10H20O	156.2	1235427	112-31-2	Decanal
10.508	94.9	C7H11NS	141.1	1195167	1122-82-3	Cyclohexane, isothiocyanato-
11.412	86.1	C13H28	184.2	778390	629-50-5	Tridecane
12.136	92.7	C12H24O3	216.2	1106056	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.429	94.1	C12H24O3	216.2	1613771	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
12.759	95.5	C14H30	198.2	1463682	629-59-4	Tetradecane
14.034	95.4	C15H32	212.3	935078	629-62-9	pentadecane
15.099	95.4	C12H14O4	222.1	684609	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
15.241	94.8	C16H34	226.3	825505	544-76-3	Hexadecane
15.582	91.3	C16H48O8Si8	592.2	753728	556-68-3	Cyclooctasiloxane, hexadecamethyl-
16.387	94.8	C20H42	282.3	404939	112-95-8	Eicosane
17.279	83.5	C18H54O9Si9	666.2	498336	556-71-8	OCTADECAMETHYLCYCLONONASILOXANE
17.556	93.2	C14H14O2	214.1	378829	104-66-5	Benzene, 1,1'-[1,2-ethanediylbis(oxy)]bis-
18.104	94.6	C16H22O4	278.2	2153194	17851-53-5	1,2-Benzenedicarboxylic acid, butyl 2-methylpropyl ester
19.063	99.2	C18H24O6	336.2	376652	85-70-1	Phthalic acid, butyl ester, ester with butyl glycolate