

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

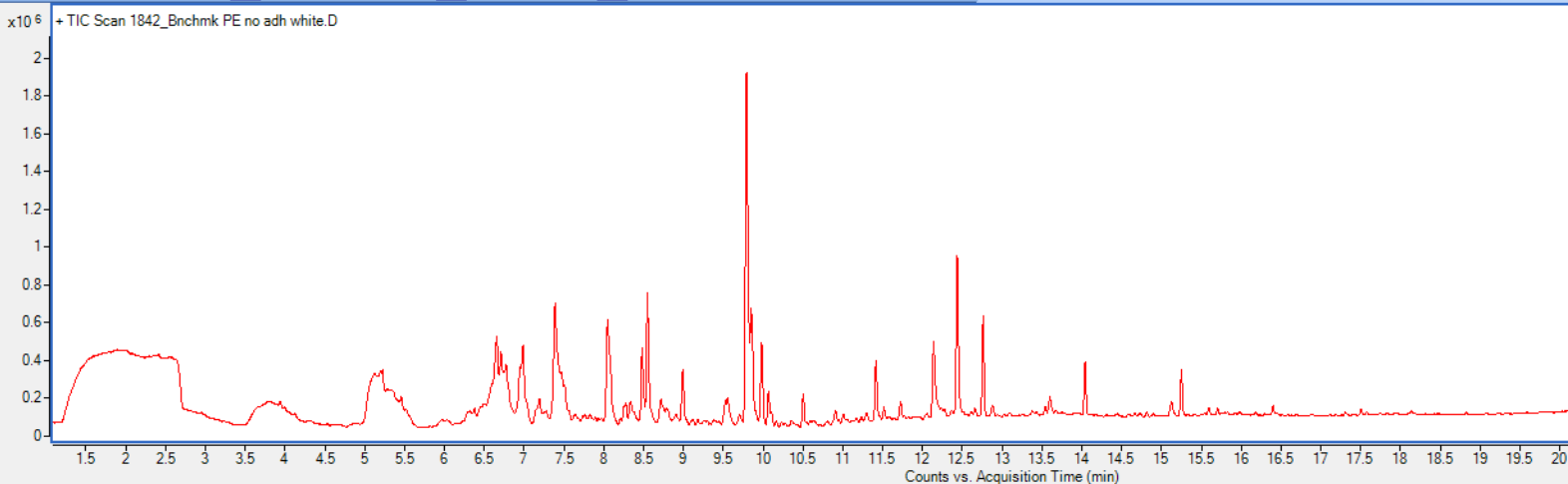
Sample: Benchmark 35-111 white sueded polyethylene fabric – no adhesive backing

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
3.937	85.2	C18H36O2	284.3	385437	57-11-4	Octadecanoic acid
3.997	83.5	C7H12O2	128.1	238938	999033-85-0	6-Oxoheptanal
5.201	87.7	C5H10O2	102.1	765535	109-52-4	Pentanoic acid
5.226	92.3	C7H14O	114.1	1107607	106-35-4	3-Heptanone
5.284	81.5	C8H13NO2	155.1	268099	999077-40-1	N-(tert-Butoxycarbonyl)propargylamine
5.458	81.0	C7H14O	114.1	534488	111-71-7	Heptanal
5.521	90.9	C4H8O2	88.1	208130	999006-03-1	(+)-(3R)-3,4-Epoxybutan-1-ol
6.376	97.1	C7H6O	106.0	523495	100-52-7	Benzaldehyde
6.504	80.4	C9H20	128.2	529183	922-28-1	Heptane, 3,4-dimethyl-
6.592	85.3	C6H6O	94.0	267331	108-95-2	Phenol
6.655	91.1	C6H12O2	116.1	1336282	142-62-1	Hexanoic acid
6.711	96.2	C8H16O	128.1	1262985	106-68-3	3-Octanone
6.778	90.9	C7H14O	114.1	883490	110-43-0	2-Heptanone
6.803	86.2	C8H18O	130.1	319743	999037-47-6	6-Methylheptan-1-ol
6.943	86.6	C12H26	170.2	399168	2980-69-0	Undecane, 4-methyl-
6.984	98.0	C8H16O	128.1	1518287	124-13-0	Octanal
7.194	96.7	C6H4Cl2	146.0	584925	106-46-7	Benzene, 1,4-dichloro-
7.386	96.9	C8H18O	130.1	2578174	104-76-7	1-Hexanol, 2-ethyl-
7.483	93.0	C7H8O	108.1	320475	100-51-6	Benzyl Alcohol
8.048	87.1	C9H18O	142.1	1523512	502-56-7	5-Nonanone
8.282	91.2	C9H12O	136.1	207141	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
8.480	98.5	C11H24	156.2	819493	1120-21-4	Undecane
8.547	96.1	C9H18O	142.1	1416899	124-19-6	Nonanal
8.991	92.1	C10H30O5Si5	370.1	484905	541-02-6	Cyclopentasiloxane, decamethyl-
9.552	91.1	C10H20O	156.2	338535	820-29-1	5-Decanone
9.793	96.6	C8H18O3	162.1	4476552	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
9.855	90.6	C12H24	168.2	983614	112-41-4	1-Dodecene
9.980	96.7	C12H26	170.2	820121	112-40-3	Dodecane
10.067	96.5	C10H20O	156.2	350447	112-31-2	Decanal
10.502	94.3	C7H11NS	141.1	294033	1122-82-3	Cyclohexane, isothiocyanato-

11.411	96.1	C13H28	184.2	458303	629-50-5	Tridecane
12.139	92.8	C12H24O3	216.2	1091329	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.434	93.8	C12H24O3	216.2	1616466	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
12.763	95.2	C14H30	198.2	828283	629-59-4	Tetradecane
14.040	95.4	C15H32	212.3	440514	629-62-9	pentadecane
15.250	94.2	C16H34	226.3	374499	544-76-3	Hexadecane