

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

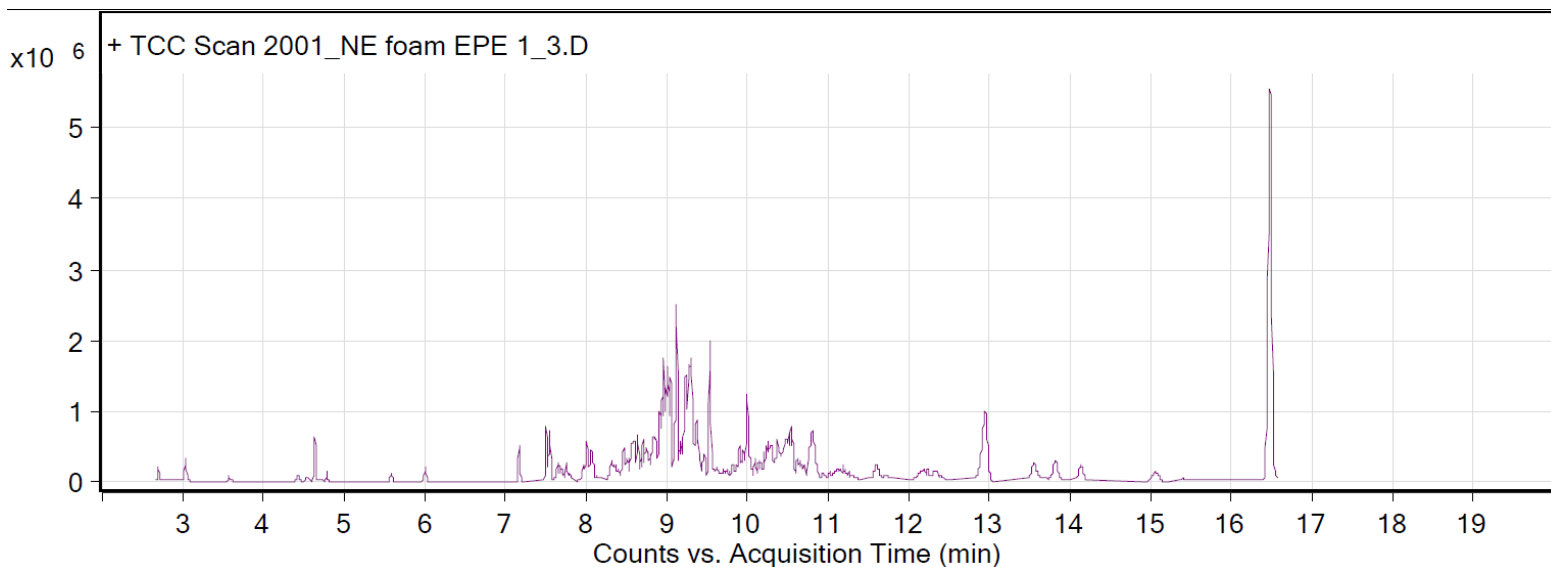
Sample: New England Foam 1.3 lb expanded polyethylene foam

Oddly test result: Temporary

Date collected: 12/23/2017

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 cryo-trapped for 2 min at -15°C; GC ramped from 35°C to 250 °C at 10°C/min. Data analyzed in Masshunter Qualitative Analysis. Samples > 85% match with a NIST 17.0 or Wiley 9 library are reported.

VOCs not highlighted are because they were also observed in blanks: (1) 13.8 min: 2-methyl-, 3-hydroxyl-2,2,4-trimethylpentyl ester propanoic acid



Compound table

RT	Score (Lib)	Area	Name	Formula
2.69	95.92	267923	2-Propanone	C3H6O
3.04	98.14	638981	Acetic acid	C2H4O2
3.57	95.51	251095	Silanediol, dimethyl-	C2H8O2Si
4.43	92.94	219716	Butanoic acid	C4H8O2
4.63	95.11	966057	Hexanal	C6H12O
4.78	94.84	235090	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.58	96.69	287951	Benzene, 1,4-dimethyl-	C8H10
6.01	89.31	407604	Heptanal	C7H14O
7.17	95.91	790940	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.5	94.86	583277	Decane	C10H22
7.55	97.67	1132674	Octanal	C8H16O
7.65	92.46	237864	Heptane, 4-(1-methylethyl)-	C10H22
7.69	89.4	350587	Octane, 2,5,6-trimethyl-	C11H24
7.75	93.4	212226	Dodecane, 2,6,11-trimethyl-	C15H32
8.01	92.52	815473	dl-Limonene	C10H16
8.47	86.15	407743	Octane, 1-chloro-	C8H17Cl
8.5	85.66	537262	Nonane, 3-methyl-	C10H22
8.63	94.42	1396573	Undecane, 5,7-dimethyl-	C13H28
8.71	91.7	1271566	Undecane, 5,7-dimethyl-	C13H28
8.91	91.81	1214988	Undecane, 4,6-dimethyl-	C13H28
8.95	86.36	714600	Dodecane, 2,6,11-trimethyl-	C15H32
9.05	94.34	2588054	Undecane, 4,6-dimethyl-	C13H28
9.12	97.39	4168971	Nonanal	C9H18O
9.24	89.01	3245842	Octane, 2,3,3-trimethyl-	C11H24
9.28	87.58	1326351	Phenol, 2-(1-phenylethyl)-	C14H14O
9.37	89.14	627159	2,3-Dimethyldecane	C12H26
9.47	91.39	953987	Undecane, 4,5-dimethyl-	C13H28

9.54	89.25	2853564	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.82	91.83	542479	Decane, 3,4-dimethyl-	C12H26
9.99	86.66	1158219	Acetic acid, 2-ethylhexyl ester	C10H20O2
10.23	89.73	650847	1-Hexanol, 2-ethyl-	C8H18O
10.29	87.28	664519	Undecane, 5-methyl-	C12H26
10.38	92.76	1035703	Nonanal	C9H18O
10.48	89.52	1222182	Undecane, 5-methyl-	C12H26
10.56	86.91	1057754	Tetradecane	C14H30
10.81	88.46	1880775	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
11.21	86.49	301483	1-Octanol	C8H18O
11.6	89.89	794086	Dodecane	C12H26
12.18	87.46	795698	2-Propenoic acid, octyl ester	C11H20O2
12.88	92.74	670623	Tridecane	C13H28
12.95	89.6	4070261	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
13.81	91.43	1167797	Propanoic acid, 2-methyl-, 3-hydroxy- 2,2,4-trimethylpentyl ester	C12H24O3
14.14	92.96	791887	Tetradecane	C14H30
15.37	90.19	185827	Dodecane, 2,6,11-trimethyl-	C15H32
16.48	87.82	18318477	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-	C16H30O4