

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

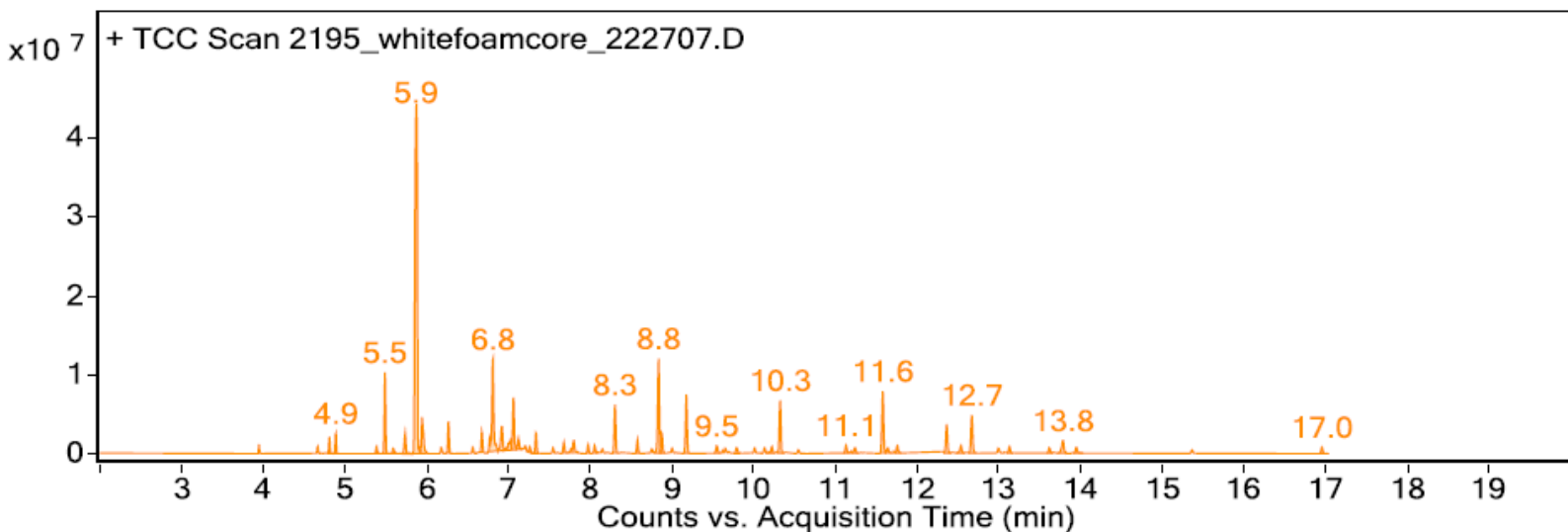
Sample: Uline Foam core, white, S-19739

Oddy test result: Temporary

Date collected: 06/26/2018

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 library are reported.

VOCs not highlighted are because they were also observed in blanks: : (1) 5.7 min: methoxyphenyl oxime; (2) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
1.500	90.6	C5H8O2	100.1	1426125	600-14-6	2,3-Pentanedione
1.500	83.7	C4H10	58.1	10659903	75-28-5	Propane, 2-methyl-
1.600	83.5	C3H7N	57.1	3338638	1072-44-2	Aziridine, 1-methyl-
3.900	93.7	C2H8O2Si	92.0	835295	1066-42-8	Silanediol, dimethyl-
4.700	91.1	C5H8O	84.1	889298	34314-83-5	Furan, 2,3-dihydro-4-methyl-
4.800	97.4	C6H12O	100.1	1925260	66-25-1	Hexanal
4.900	92.5	C6H18O3Si3	222.1	2360724	541-05-9	Cyclotrisiloxane, hexamethyl-
5.400	90.5	C6H12O	100.1	967863	97-96-1	Butanal, 2-ethyl-
5.500	96.7	C8H10	106.1	10485800	0-00-0	METHYLLAURATE
5.600	97.3	C8H10	106.1	976833	0-00-0	unidentified C2-benzene
5.700	84.7	C8H9NO2	151.1	734830	1000222-86-6	Oxime-, methoxy-phenyl-
5.700	92.0	C8H12O	124.1	2449152	932-66-1	Ethanone, 1-(1-cyclohexen-1-yl)-
5.900	86.9	C8H14O2	142.1	3572873	24070-70-0	3-Methylcyclopentyl acetate
6.000	86.3	C6H14O2	118.1	1238620	111-76-2	Ethanol, 2-butoxy-

6.000	92.8	C8H8	104.1	666666	100-42-5	Styrene
6.200	94.4	C6H14O2	118.1	956042	107-41-5	2,4-Pentanediol, 2-methyl-
6.300	96.8	C9H12	120.1	4360305	98-82-8	Benzene, (1-methylethyl)-
6.600	89.6	C9H10	118.1	919357	873-49-4	Benzene, cyclopropyl-
6.700	97.7	C9H12	120.1	2766203	0-00-0	unidentified C3-benzene
6.800	97.3	C7H6O	106.0	11433847	100-52-7	Benzaldehyde
6.900	87.3	C6H6O	94.0	2848359	108-95-2	Phenol
6.900	93.4	C8H24O4Si4	296.1	2344314	556-67-2	Cyclotetrasiloxane, octamethyl-
7.300	91.8	C6H14O3	134.1	845735	111-90-0	Ethanol, 2-(2-ethoxyethoxy)-
7.300	97.5	C8H16O	128.1	3039924	124-13-0	Octanal
7.700	94.5	C8H18O	130.1	1771997	104-76-7	1-Hexanol, 2-ethyl-
7.800	95.6	C10H16	136.1	823829	138-86-3	dL-Limonene
7.800	88.6	C7H8O	108.1	1409492	100-51-6	Benzenemethanol
8.000	96.4	C8H8O	120.1	1389694	122-78-1	PHENYL ACETALDEHYDE
8.100	81.7	C10H18	138.1	1254080	2492-22-0	cis-2,6-Dimethyl-2,6-octadiene
8.300	97.2	C8H8O	120.1	7883985	98-86-2	Ethanone, 1-phenyl-
8.800	91.3	C11H24	156.2	765898	1120-21-4	Undecane
8.800	94.6	C9H18O	142.1	15895001	124-19-6	Nonanal
8.900	80.9	C8H12O2	140.1	1486701	92466-42-7	(+)-(3E)-5,6-Epoxy-6-methyl-3-hepten-2-one
9.200	94.7	C10H30O5Si5	370.1	9604987	541-02-6	Cyclopentasiloxane, decamethyl-
9.700	91.8	C9H16O	140.1	844356	18829-56-6	2-Nonenal, (E)-
9.800	90.1	C12H26O	186.2	996079	112-53-8	1-Dodecanol
10.000	93.9	C8H18O3	162.1	875094	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
10.100	95.1	C10H8	128.1	966306	275-51-4	Azulene
10.200	94.3	C12H26	170.2	1120243	112-40-3	Dodecane
10.300	97.9	C10H20O	156.2	8551556	112-31-2	Decanal
11.100	90.9	C10H18O	154.1	1342672	3913-81-3	2-Decenal, (E)-
11.200	88.2	C13H28	184.2	1205795	62108-25-2	Decane, 2,6,7-trimethyl-
11.600	95.7	C12H36O6Si6	444.1	11048695	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.600	94.4	C13H28	184.2	1012010	629-50-5	Tridecane
11.800	98.2	C11H22O	170.2	1381039	112-44-7	Undecanal
12.400	90.1	C12H24O3	216.2	5310999	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.500	93.0	C11H20O	168.2	1518403	2463-77-6	2-Undecenal
12.700	93.3	C12H24O3	216.2	7249514	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.000	95.1	C14H30	198.2	959800	629-59-4	Tetradecane
13.100	98.0	C12H24O	184.2	1225554	112-54-9	Dodecanal
13.600	87.7	C13H22O	194.2	928804	3879-26-3	5,9-Undecadien-2-one, 6,10-dimethyl-, (Z)-
13.800	80.5	C14H42O7Si7	518.1	2217935	107-50-6	Cycloheptasiloxane, tetradecamethyl-
14.000	96.9	C12H26O	186.2	1086669	112-53-8	1-Dodecanol