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

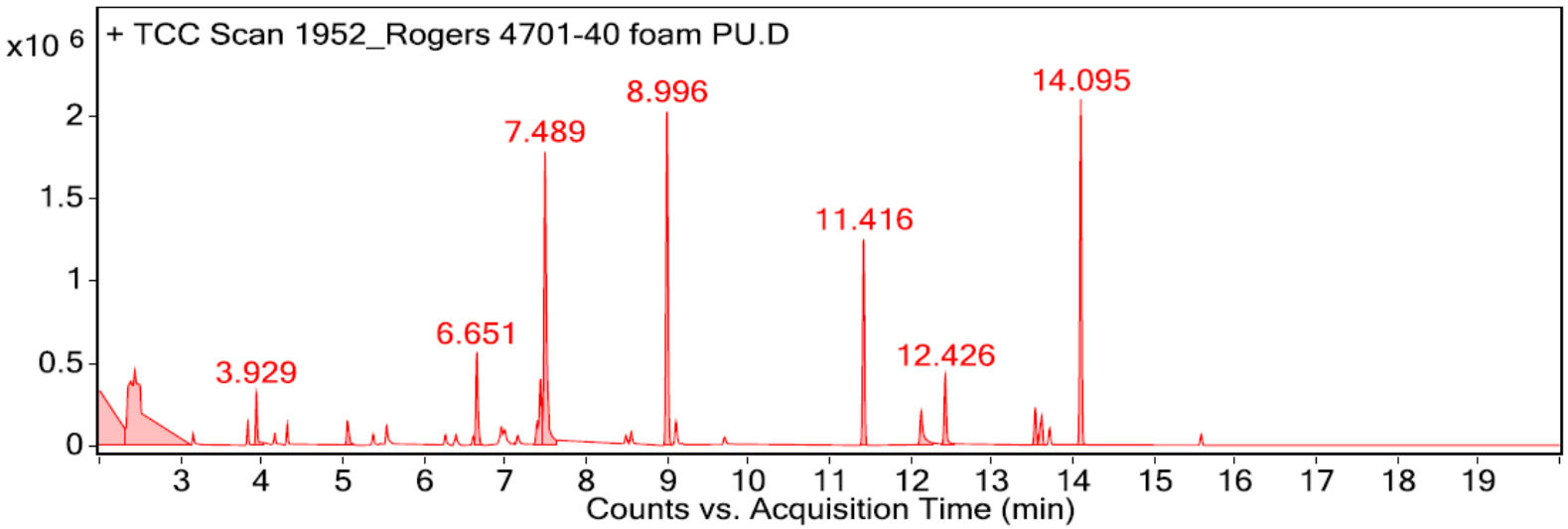
Sample: Rogers Corporation foamed polyurethane 4701-40; black

Oddy test result: Temporary

Date collected: 12/08/2017

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) 12.4 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
2.432	88.9	C4H7NO	85.1	154621	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
3.151	88.7	C2H8O2Si	92.0	132670	1066-42-8	Silanediol, dimethyl-
3.825	97.3	C7H8	92.1	180844	108-88-3	Benzene, methyl-
3.931	98.1	C5H8O2	100.1	481890	123-54-6	Acetylacetone
4.159	90.6	C6H12O	100.1	108430	66-25-1	Hexanal
4.311	87.3	C6H18O3Si3	222.1	191551	541-05-9	Cyclotrisiloxane, hexamethyl-
5.055	97.2	C8H10	106.1	319569	95-47-6	o-Xylene
5.371	87.3	C8H10	106.1	128435	95-47-6	o-Xylene
5.537	98.1	C6H14O2	118.1	249252	111-76-2	Ethanol, 2-butoxy-
6.393	99.0	C7H6O	106.0	154044	100-52-7	Benzaldehyde
6.604	98.1	C6H6O	94.0	101555	108-95-2	Phenol
6.649	95.4	C8H24O4Si4	296.1	996167	556-67-2	Cyclotetrasiloxane, octamethyl-
6.952	91.9	C13H28	184.2	126089	629-50-5	Tridecane
7.153	93.2	C7H16O3	148.1	127644	20324-32-7	2-Propanol, 1-(2-methoxy-1-methylethoxy)-
7.390	94.1	C8H18O	130.1	306524	104-76-7	1-Hexanol, 2-ethyl-
7.434	98.0	C10H16	136.1	595468	138-86-3	dl-Limonene
7.490	96.8	C7H8O	108.1	2183886	100-51-6	Benzenemethanol
8.487	82.1	C15H30	210.2	104562	59920-26-2	2,4,6,8-Tetramethyl-1-undecene
8.552	94.9	C9H18O	142.1	138188	124-19-6	Nonanal
8.995	92.4	C10H30O5Si5	370.1	3609605	541-02-6	Cyclopentasiloxane, decamethyl-
9.104	96.8	C6H10O2	114.1	268148	502-44-3	2-Oxepanone
9.703	91.3	C10H20O	156.2	103056	1490-04-6	Cyclohexanol, 5-methyl-2-(1-methylethyl)-
11.420	91.4	C12H36O6Si6	444.1	2096161	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.128	93.5	C12H24O3	216.2	581446	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.424	93.5	C12H24O3	216.2	790664	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
13.592	86.2	C14H20O2	220.1	151520	719-22-2	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)-
13.711	91.4	C15H22O	218.2	178939	2607-52-5	2,6-DI-T-BUTYL-4-METHYLENE-2,5-CYCLOHEXADIENE-1-ONE
14.096	95.3	C15H24O	220.2	3379832	128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
15.582	91.7	C16H48O8Si8	592.2	119819	556-68-3	Cyclooctasiloxane, hexadecamethyl-