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

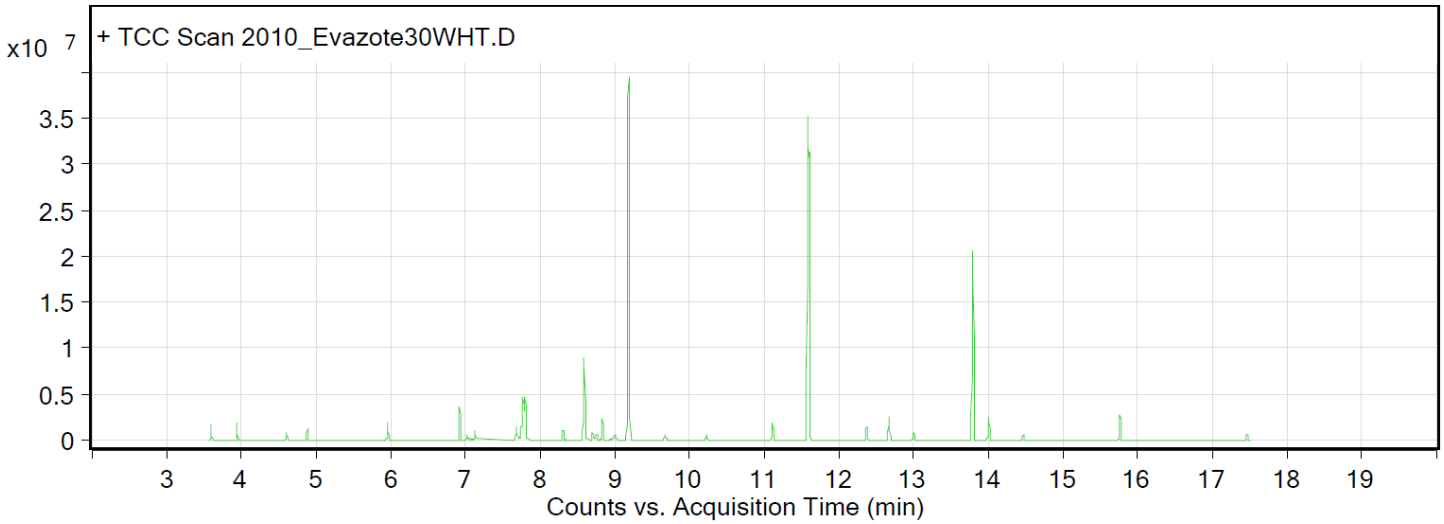
Sample: UFP Technologies; Zote Foams Evazote 30

Oddy test result: Temporary

Date collected: 03/19/2018

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 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. Deconvoluted data with > 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) 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



Compound Table

RT	Score (Lib)	Area	Name	Formula
3.6	97.97	1434854	Acetic acid	C2H4O2
3.94	93.69	1471156	Silanediol, dimethyl-	C2H8O2Si
4.88	92.48	1164883	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.96	96.93	2189283	Ethanol, 2-butoxy-	C6H14O2
6.92	96.09	4164151	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.02	89.15	864096	Propanoic acid, 3-ethoxy-, ethyl ester	C7H14O3
7.13	91.15	1271078	1-Heptanol, 6-methyl-	C8H18O
7.68	91.26	2173596	1-Hexanol, 2-ethyl-	C8H18O
7.77	93.39	4884321	dl-Limonene	C10H16
7.78	87.13	1563405	Octyl ester of formic acid	C9H18O2
7.8	93.45	2970742	Benzyl Alcohol	C7H8O
8.3	85.9	1410061	Ethanone, 1-phenyl-	C8H8O
8.59	92.08	11428787	Benzenemethanol, .alpha.,.alpha.-dimethyl-	C9H12O
8.75	91.05	1063306	Undecane	C11H24
8.83	97.32	2796866	Nonanal	C9H18O
9.19	96.79	68923286	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
10.23	88.11	1058228	Dodecane	C12H26
11.58	95.75	79196152	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
12.37	90.32	2165978	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.67	93.84	3802013	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
13	95.35	1204713	Tetradecane	C14H30
14.47	86.85	833407	Ethanone, 1-[4-(1-hydroxy-1-methylethyl)phenyl]-	C11H14O2
15.76	90.56	4033258	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8