

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

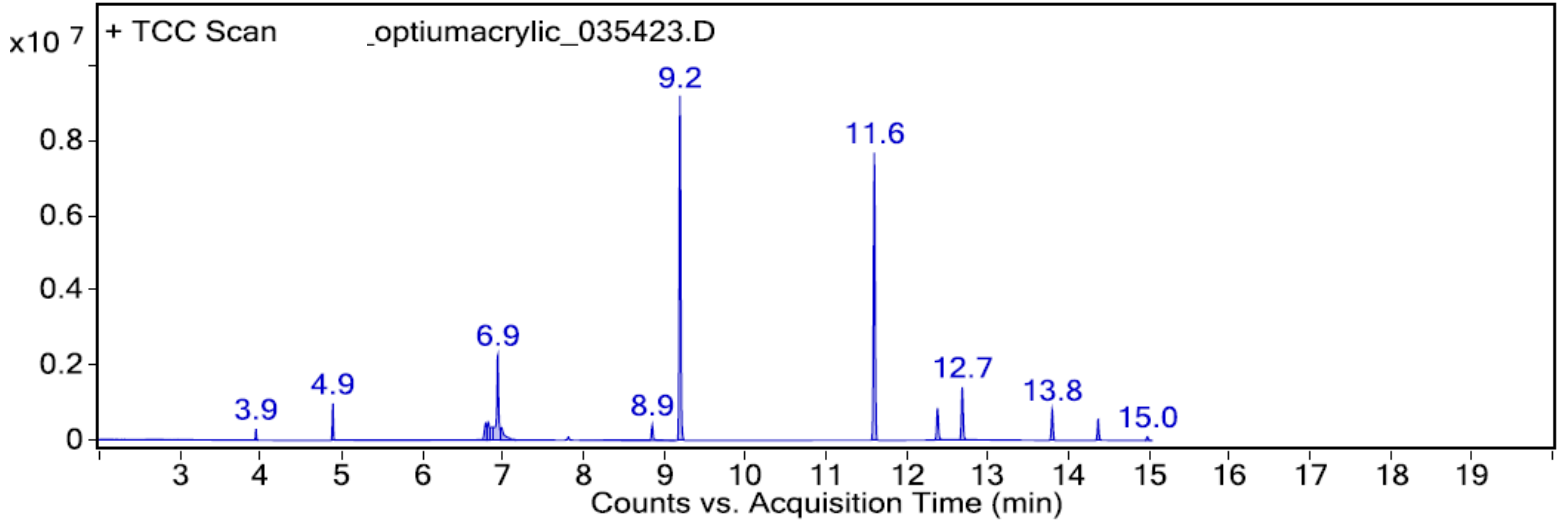
Alkynes – can become reactive when exposed to heat or UV light

Sample: Tru-View: 27310810 Optium Acrylic 3mm thick UV filtering acrylic sheet

Date collected: 06/20/2018

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 auto-sampler; Pre-heated at 60°C for 20 minutes; fiber exposure at 60°C for 20 minutes; sample injected into 220°C inlet and cryotrapped for 2 min at -15°C; GC ramped from 40°C to 225 °C at 10°C/min. Data analyzed using the Masshunter Qualitative program. Samples > 80% match with a NIST 17.0 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
3.900	95.1	C2H8O2Si	92.0	236686	1066-42-8	Silanediol, dimethyl-
4.900	92.5	C6H18O3Si3	222.1	872291	541-05-9	Cyclotrisiloxane, hexamethyl-
6.800	97.3	C7H6O	106.0	170645	100-52-7	Benzaldehyde
6.900	94.3	C8H24O4Si4	296.1	2201592	556-67-2	Cyclotetrasiloxane, octamethyl-
7.800	86.7	C7H8O	108.1	138316	100-51-6	Benzenemethanol
8.800	97.5	C9H18O	142.1	514234	124-19-6	Nonanal
9.200	94.8	C10H30O5Si5	370.1	12264367	541-02-6	Cyclopentasiloxane, decamethyl-
11.600	95.7	C12H36O6Si6	444.1	10742634	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.400	90.9	C12H24O3	216.2	1286590	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.700	92.9	C12H24O3	216.2	2086159	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
14.400	92.0	C14H22O	206.2	738551	96-76-4	Phenol, 2,4-bis(1,1-dimethylethyl)-
15.000	87.7	C15H22O2	234.2	137276	1620-98-0	3,5-di-tert-Butyl-4-hydroxybenzaldehyde