

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

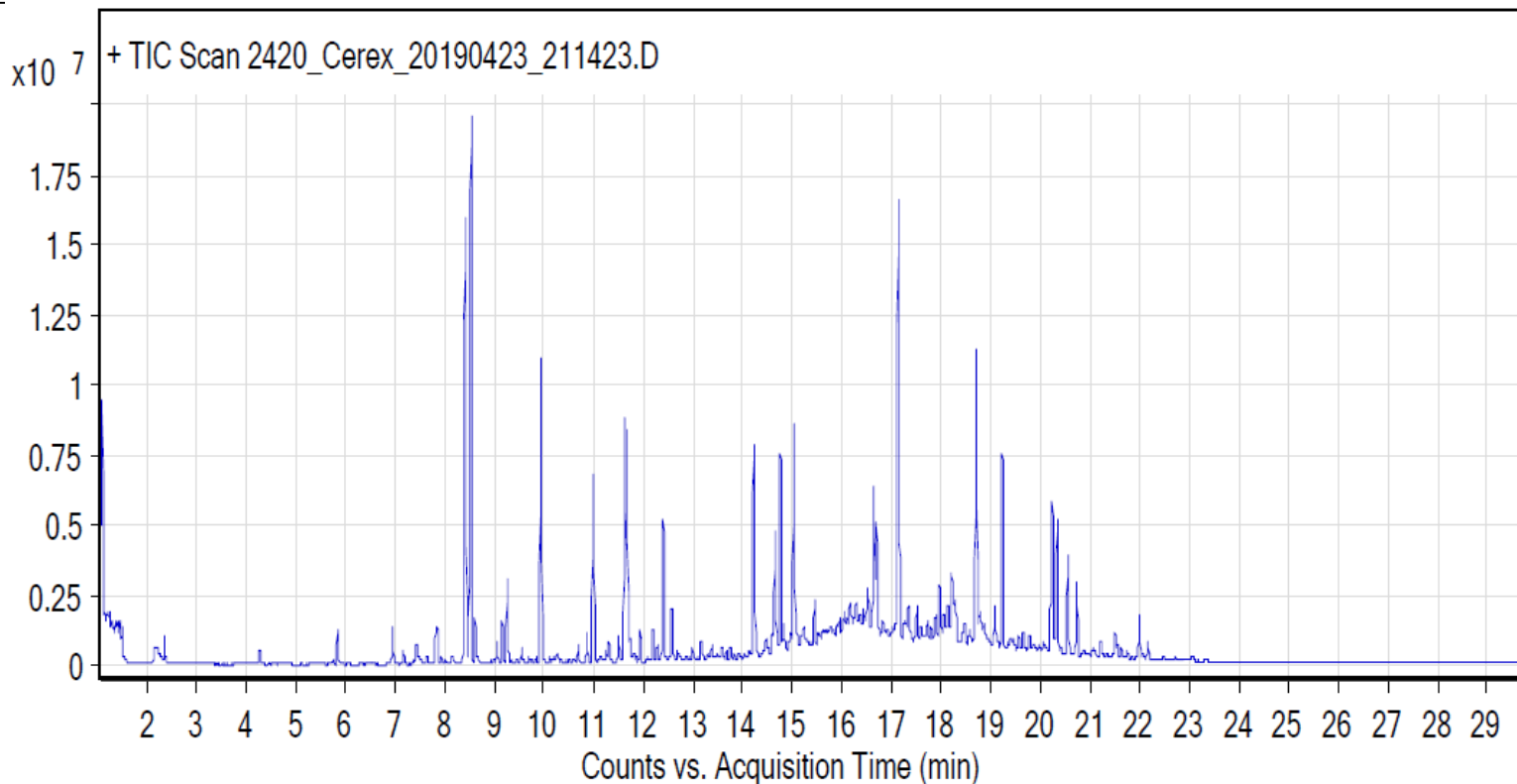
Alkynes – can become reactive when exposed to heat or UV light

Sample: Cerex

Date collected: 4/23/2019

Oddy test result: Temporary

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 cotrapped for 2 min at -15°C; GC ramped from 35°C to 225 °C at 7.5°C/min. Data analyzed in masshunter Qualitative. Samples > 90% match with a NIST 17.0 library are reported. VOCs not highlighted are because they were also observed in blanks: (1) 15.0 min: 2-methyl-, 3-hydroxyl-, 2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name
2.18	95.85	4828897	Benzene, methyl-
2.35	93.63	1093801	Silanediol, dimethyl-
5.84	93.13	1704425	Ethanol, 2-butoxy-
6.95	97.68	2226211	Benzaldehyde
7.17	94.46	583318	1-Nonanol
7.48	90.12	529602	Phenol
7.85	91.25	1799434	Octanal
8.38	94.51	1877165	dl-Limonene
8.41	96.81	42223848	1-Hexanol, 2-ethyl-
8.53	96.52	43480558	Benzyl Alcohol
8.61	96.69	2445469	2-Pyrrolidinone, 1-methyl-
9.06	90.93	1055592	Octane, 1-chloro-
9.16	96.65	2538987	Ethanone, 1-phenyl-
9.25	97.17	5229832	1-Octanol
9.94	95.76	19596872	Nonanal
10.87	91.91	1652138	Acetic acid, 2-ethylhexyl ester
11.5	95.45	1336575	Naphthalene
11.63	92.97	16802901	Ethanol, 2-(2-butoxyethoxy)-
11.73	95.48	1078174	Benzoic acid, 2-hydroxy-, methyl ester
11.93	92.98	1970321	Decanal
12.19	92.42	1879626	Ethanol, 2-phenoxy-
12.29	91.85	725926	Benzothiazole
12.4	97.13	9496823	2-Ethylhexyl acrylate

12.56	92.8	2154261	Benzyl alcohol, 2,3-dimethyl-
15.03	92.95	16172986	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
15.45	92.09	3051237	Nonane, 2-methyl-5-propyl-
17.13	94.84	33275700	Tetradecane
18.13	95.31	2385011	Tricosane
18.7	94.2	22497459	Nonadecane
20.19	90.53	2375569	Undecane, 4,6-dimethyl-
20.33	92.68	9603477	Octanoic acid, 2-ethylhexyl ester
21.54	92.86	718578	1-.alpha.-Cumyl-4-phenylurazole