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

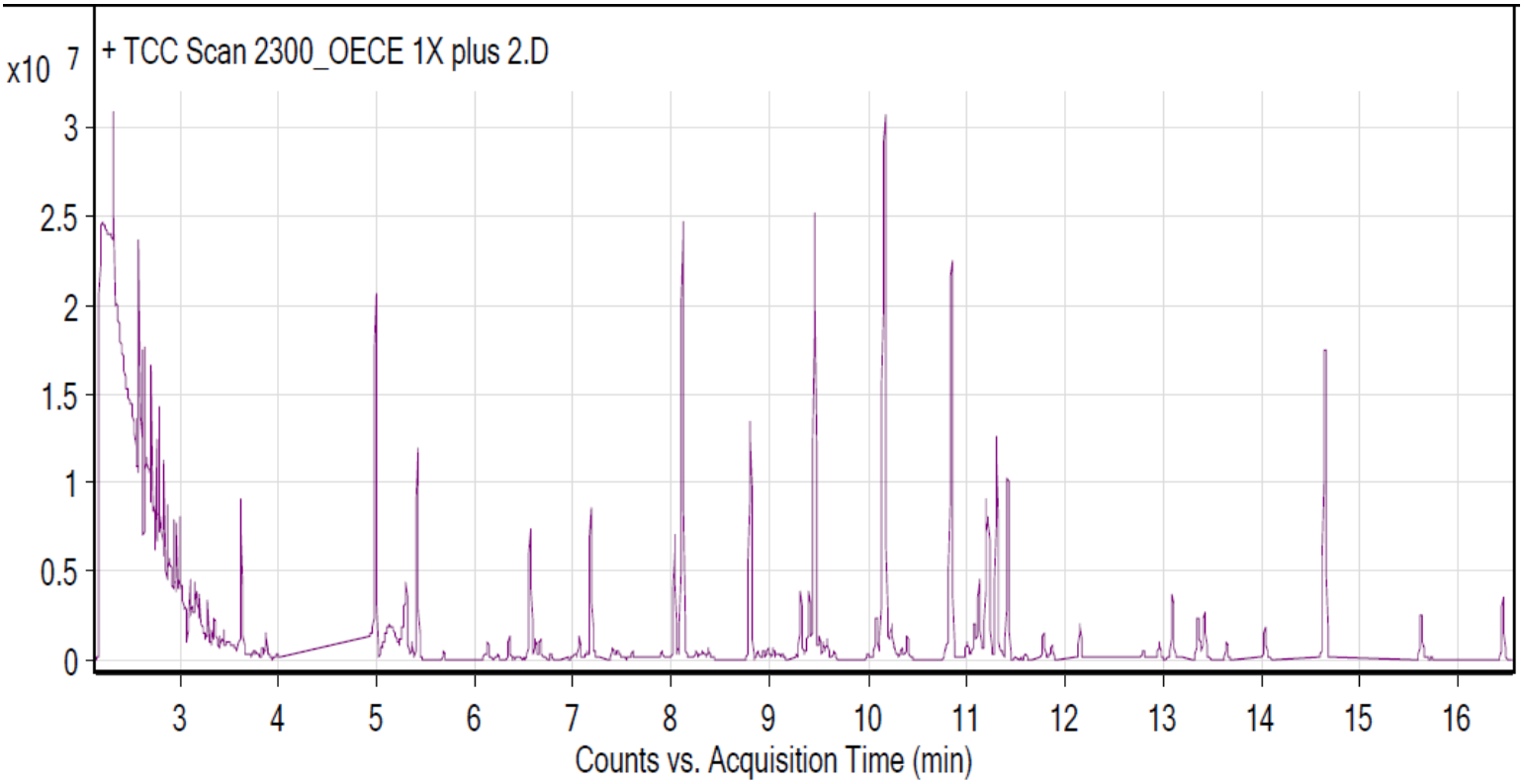
Sulfur-containing compounds – known to tarnish and corrode some metals

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: OECE paint
Date collected: 08/22/2018
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 crotrapped 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.



Compound Table

RT	Score (Lib)	Area	Name
2.6	95.83	29202748	Triethylamine
2.63	91.31	8619546	2-(4-Chlorophenacyl)-3-phenoxymethyl-1,4-naphthoquinone
2.66	95.84	47581961	Triethylamine
2.73	95.81	21782920	Triethylamine
2.78	95.81	14513746	Triethylamine
2.81	95.81	20827637	Triethylamine
2.85	95.08	11507459	triethylammonium phenylmethanesulfonate
2.9	95.78	18425279	Triethylamine
2.96	95.79	7624003	Triethylamine
2.99	95.78	9718834	Triethylamine
3.02	94.54	11790495	Triethylamine
3.09	91.97	3460029	triethylammonium phenylmethanesulfonate
3.12	94.48	6624082	Triethylamine
3.16	92.57	6889026	exo-Tetracyclo[4.4.1.1(2,5).0(7,10)]dodeca-3,8-diene
3.17	94.48	6373602	Triethylamine
3.22	91.69	6056147	1,1-Dichloro-1a,2,4,5,6,6a-hexahydro-1H,3H-cycloprop[f]inden-4-yl methanesul...
3.35	90.91	5706262	triethylammonium phenylmethanesulfonate
3.43	90.93	2745310	1,1-Dichloro-1a,2,4,5,6,6a-hexahydro-1H,3H-cycloprop[f]inden-4-yl methanesul...
3.5	91.01	6523434	1,1-Dichloro-1a,2,4,5,6,6a-hexahydro-1H,3H-cycloprop[f]inden-4-yl methanesul...

3.63	95.43	11275850	Triethylamine
3.7	91.52	847343	Diethyl(2-propenyloxymethyl)amine
5.3	91.25	5371132	Cyclohexanone
5.42	96.68	16686200	Ethanol, 2-butoxy-
6.13	91.74	1231433	(2R,3S)-2,3-Epoxy-3-(3-phenoxyphenyl)-1-phenylpropan-1-one
6.35	90.98	1896845	2-Propenoic acid, 2-methyl-, butyl ester
6.67	92.4	1580751	Octanal
7.18	94.05	13163632	2-Pyrrolidinone, 1-methyl-
8.03	93.81	10474049	Tetradecane
8.11	91.9	42214825	Nonanal
8.94	93.6	724156	Heptacosane
9.46	93.19	24341624	Tetradecane
9.65	98	686763	Pentadecane, 2,6,10-trimethyl-
10.14	90.91	3627315	2-Propanol, 1,1'-oxybis-
10.17	91	67899694	Ethanol, 2-(dibutylamino)-
10.34	92.94	1092965	Nonadecane
10.84	91.37	39892262	Tetradecane
11	92.22	2085034	tri (propylene glycol) monomethyl ether; isomer E
12.15	92.99	3260678	Tetradecane
12.96	92.59	1505646	Nonadecane
13.09	93.87	5628577	1-Nonanol