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

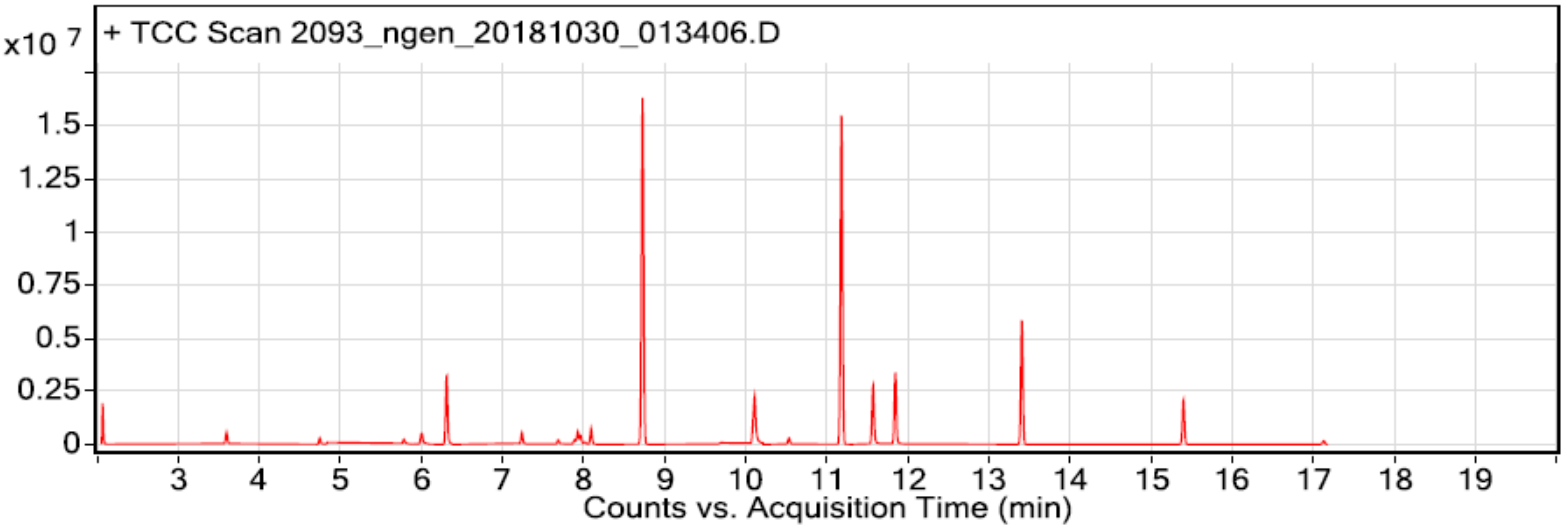
Sample: Eastman Chemical; Colorfabb ngen clear

Oddy test result: Permanent

Date collected: 10/30/2018

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 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) 4.75 min: methoxy-phenyl-oxime; (2) 11.6 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (3) 11.8 min: 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.070	93.7	C2H8O2Si	92.0	1788047	1066-42-8	Silanediol, dimethyl-
3.600	91.6	C6H18O3Si3	222.1	1051298	541-05-9	Cyclotrisiloxane, hexamethyl-
4.750	84.1	C8H9NO2	151.1	437557	1000222-86-6	Oxime-, methoxy-phenyl-_
6.310	95.9	C8H24O4Si4	296.1	5684562	556-67-2	Cyclotetrasiloxane, octamethyl-
7.240	92.4	C13H28	184.2	858449	17301-32-5	Undecane, 4,7-dimethyl-
7.690	88.5	C8H14O	126.1	342563	1004-24-6	Cyclohexanemethanol, 4-methylene-
7.930	91.3	C15H32	212.3	690726	31295-56-4	Dodecane, 2,6,11-trimethyl-
7.960	95.6	C9H18O	142.1	358699	124-19-6	Nonanal
8.730	96.1	C10H30O5Si5	370.1	29891935	541-02-6	Cyclopentasiloxane, decamethyl-
10.110	95.2	C6H11NO	113.1	4753826	105-60-2	Caprolactam
10.530	90.5	C14H30	198.2	449431	61141-72-8	Dodecane, 4,6-dimethyl-
11.180	96.2	C12H36O6Si6	444.1	29383994	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.570	90.1	C12H24O3	216.2	4955663	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.850	93.8	C12H24O3	216.2	5832361	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.400	80.7	C14H42O7Si7	518.1	10573898	107-50-6	Cycloheptasiloxane, tetradecamethyl-
15.400	89.6	C16H48O8Si8	592.2	3714067	556-68-3	Cyclooctasiloxane, hexadecamethyl-
17.130	84.5	C18H54O9Si9	666.2	332033	556-71-8	Cyclononasiloxane, octadecamethyl-