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

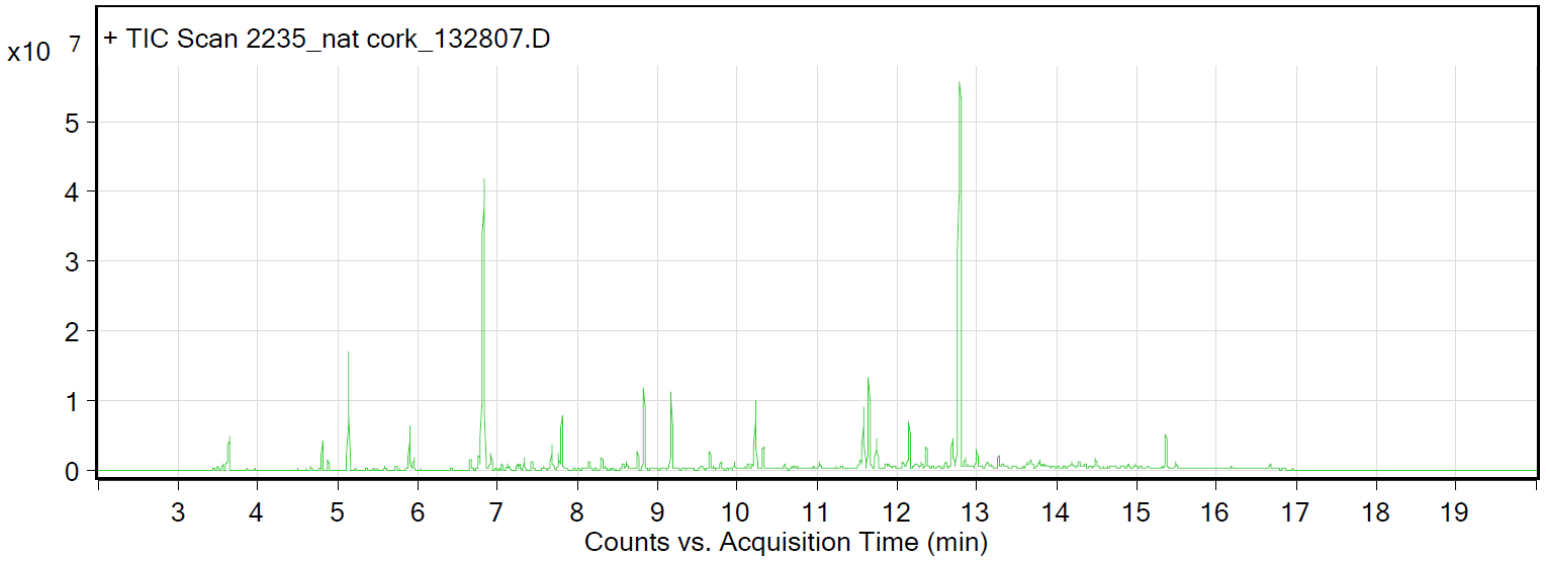
Halogenated compounds – can become reactive with exposure to heat and UV light

Nitrogen-containing, not amine – can react with other off-gassed chemicals

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

Sample: ACCO Brands: natural cork roll, UPC 034138103005
Oddy test result: unsuitable
Date collected: 7/23/2018
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
3.64	98.6	8032466	Acetic acid	C2H4O2
4.8	97.18	3430148	Hexanal	C6H12O
5.14	90.11	19349548	2-Furancarboxaldehyde	C5H4O2
5.9	96.38	6788074	Cyclohexanone	C6H10O
5.95	91.22	2032194	Ethanol, 2-butoxy-	C6H14O2
6.66	96.07	1830821	Camphene	C10H16
6.76	93.64	2949688	2-Furancarboxaldehyde, 5-methyl-	C6H6O2
6.82	87.37	41245665	(4S,4'S)-4-Benzyl-3-(2'-oxo-4'-phenyl-1',3'-oxzolidine-3'-carbonyl)-4H-pyrid...	C24H22N2O5
6.83	85.03	47004953	Benzenamine, N-hydroxy-N-nitroso-, ammonium salt	C6H6N2O2
6.92	96.42	1892897	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.33	97.62	2108930	Octanal	C8H16O
7.43	89.1	1419102	1-Hydroxyethyl ester of 2-methyl-2-propenoic acid	C6H10O3
7.68	97.46	3950864	1-Hexanol, 2-ethyl-	C8H18O
7.76	96.84	2951480	dl-Limonene	C10H16
7.8	95.62	9422091	Benzyl Alcohol	C7H8O
8.61	93.68	1339158	2-Nonanone	C9H18O
8.75	94.13	3298747	Undecane	C11H24
8.83	97.71	14245750	Nonanal	C9H18O
9.17	95.41	12838459	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.65	93.3	3284035	2-Nonenal, (E)-	C9H16O
9.96	97.76	1571562	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(.+/-.)-	C10H20O
10.22	95.45	12600197	Dodecane	C12H26
10.32	97.17	4188492	Decanal	C10H20O

11.53	91.25	1457319	1-Tridecene	C13H26
11.58	95.96	11515678	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.64	94.97	18397766	Tridecane	C13H28
11.74	96.18	5626268	Benzaldehyde, 2,4,5-trimethyl-	C10H12O
12.36	90.35	3968111	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.69	93.36	7007297	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.79	96.68	124400173	2-Propenoic acid, 1,7,7-trimethylbicyclo[2.2.1]hept-2-yl ester, exo-	C13H20O2
12.85	96.32	2003629	Isobornyl propionate	C13H22O2
13	94.76	4563560	Tetradecane	C14H30
13.13	88.47	1590452	Tetradecanal	C14H28O
13.67	92.66	2018055	Cyclopentane, nonyl-	C14H28
14.18	92.76	1587128	1-Pentadecene	C15H30
14.48	89.92	2031907	Tetradecane, 2,2-dimethyl-	C16H34
15.49	87.1	1298679	Dodecane, 2,6,10-trimethyl-	C15H32