

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

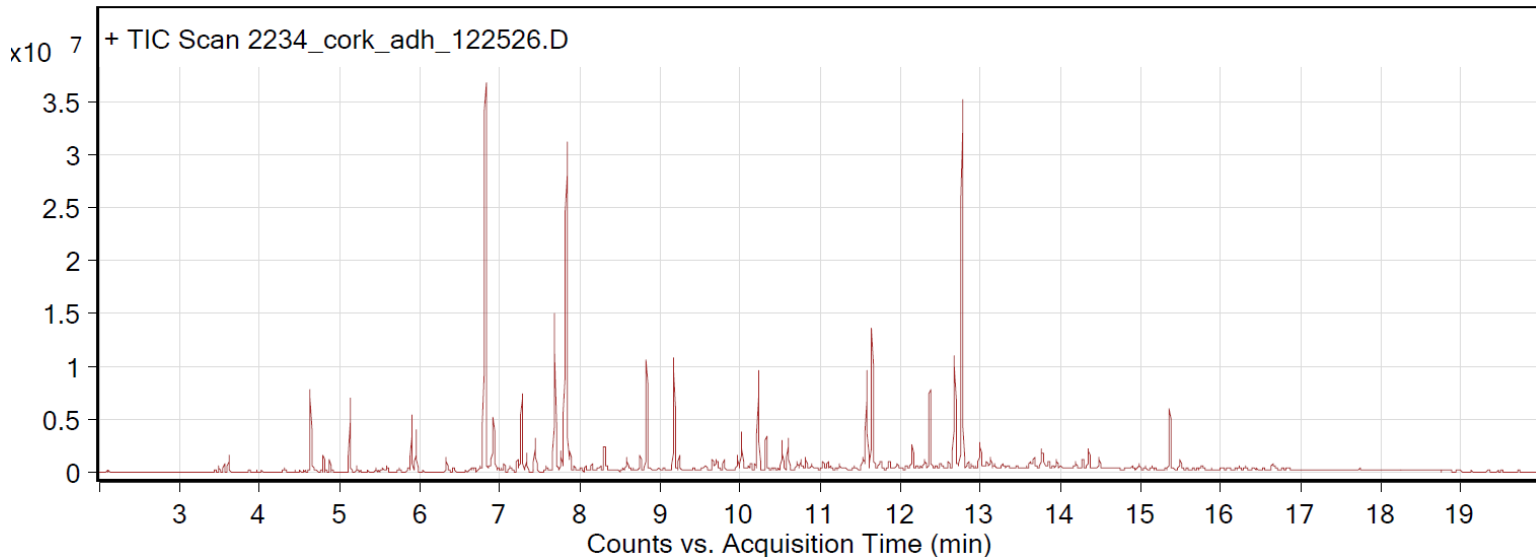
Sample: Kittrich Corporation: Self Adhesive Natural Cork, 04F-C6421-06

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
3.61	98.03	1411185	Acetic acid	C2H4O2
4.63	94.7	7663593	Formamide, N,N-dimethyl-	C3H7NO
4.8	96.73	1266814	Hexanal	C6H12O
4.88	92.48	883262	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.13	90.14	6517819	2-Furancarboxaldehyde	C5H4O2
5.58	97.08	746811	Benzene, 1,4-dimethyl-	C8H10
5.9	96.49	5679109	Cyclohexanone	C6H10O
5.95	94.32	4059576	Ethanol, 2-butoxy-	C6H14O2
6.82	97.42	61709125	Benzaldehyde	C7H6O
7.22	98.37	1280421	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.28	92.04	9931309	Ethanol, 2-(2-ethoxyethoxy)-	C6H14O3
7.33	96.66	1958850	Octanal	C8H16O
7.68	97.18	18185873	1-Hexanol, 2-ethyl-	C8H18O
7.76	98	2378547	dl-Limonene	C10H16
7.84	96.11	63035630	Benzyl Alcohol	C7H8O
8.26	92.16	1118531	Heptanoic acid	C7H14O2
8.75	91.48	2051264	Undecane	C11H24
8.83	96.91	13192322	Nonanal	C9H18O
9.18	94.69	11947360	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.24	97.07	1990437	Pentanedioic acid, dimethyl ester	C7H12O4
9.65	90.55	1362005	2-Nonenal, (E)-	C9H16O
9.72	87.28	1901356	Octanoic acid	C8H16O2
9.79	87.37	1088545	Dichloroacetic acid, decyl ester	C12H22Cl2O2
9.96	97.53	2044216	Cyclohexanol, 5-methyl-2-(1-methylethyl)-, (1.alpha.,2.beta.,5.alpha.)-(./-./-)	C10H20O
10.02	96.21	4857247	Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
10.13	96.09	871400	Azulene	C10H8
10.18	96.94	787048	Methyl salicylate	C8H8O3
10.22	95.49	12107615	Dodecane	C12H26

10.32	97.42	4172143	Decanal	C10H20O
10.52	92.98	3444789	Ethanol, 2-phenoxy-	C8H10O2
10.59	94.88	3503955	2-Ethylhexyl acrylate	C11H20O2
10.76	85.09	1243003	2-Propanol, 1,1'-oxybis-	C6H14O3
10.82	88.84	1465140	2-Propanol, 1-(2-butoxy-1-methylethoxy)-	C10H22O3
11.1	93.77	1457364	Nonanoic acid	C9H18O2
11.24	91.33	769916	1-Decanol	C10H22O
11.53	90.51	1421123	1-Tridecanol	C13H28O
11.58	95.59	11917125	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.64	94.94	18643429	Tridecane	C13H28
11.74	96.19	993660	Benzaldehyde, 2,4,5-trimethyl-	C10H12O
11.76	93.74	912845	Tetradecanal	C14H28O
11.96	87.98	848348	Undecane, 3,6-dimethyl-	C13H28
12.3	85.53	1231807	Heptylcyclohexane	C13H26
12.36	89.22	10061118	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.68	93.71	15936967	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.77	96.39	51646928	2-Propenoic acid, 1,7,7-trimethylbicyclo[2.2.1]hept-2-yl ester, exo-	C13H20O2
12.85	94.05	792726	Isobornyl propionate	C13H22O2
13	94.62	3802664	Tetradecane	C14H30
13.08	88.98	774298	2,4,7,9-Tetramethyl-5-decyn-4,7-diol	C14H26O2
13.13	90.33	1486701	Tetradecanal	C14H28O
13.67	87.52	1715835	Cyclopentane, nonyl-	C14H28
13.85	90.68	830511	2,5-Cyclohexadiene-1,4-dione, 2,6-bis(1,1-dimethylethyl)-	C14H20O2
13.95	96.13	1176239	1-Dodecanol	C12H26O
14.18	90.01	917791	1-Heptadecene	C17H34
14.28	91.2	1302469	Pentadecane	C15H32
14.48	90.12	1516286	Tetradecane, 2,2-dimethyl-	C16H34
14.98	90.75	670299	n-Nonylcyclohexane	C15H30
15.49	90.43	1403249	Hexadecane	C16H34
16.64	90.29	1063388	Heptadecane	C17H36