

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

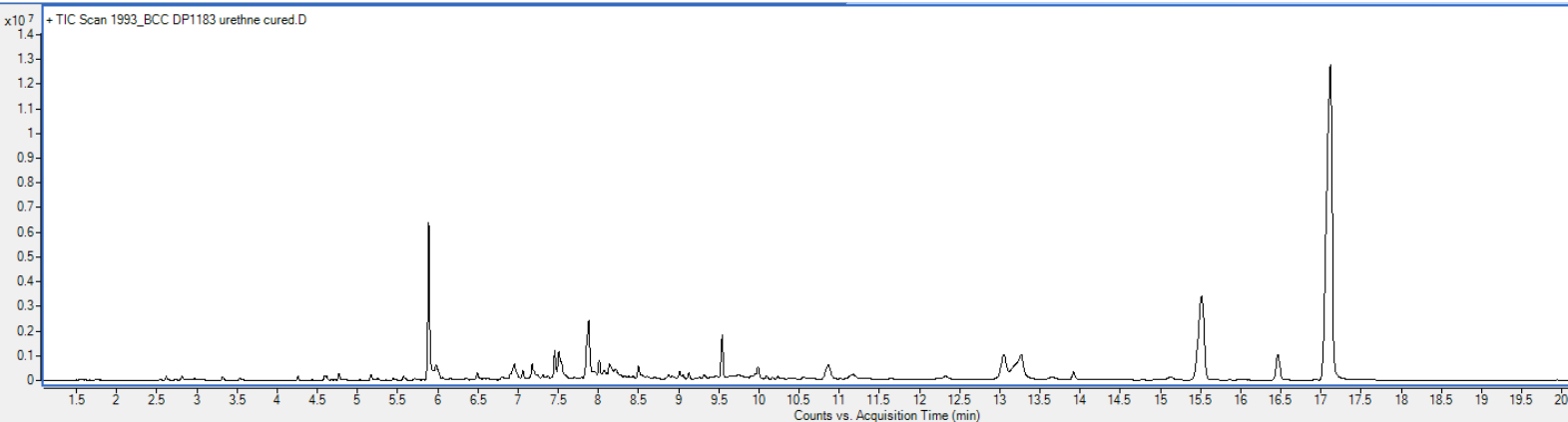
Sample: McCausey BCC DP1183 2-part urethane adhesive

Oddy test result: Permanent

Date collected: 12/23/2017

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: (3) 13.9 min: 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
5.887	99.3	C8H8	104.1	11203672	100-42-5	Styrene
6.932	86.3	C9H12	120.1	726747	0-00-0	unidentified C3-benzene
7.176	95.3	C8H24O4Si4	296.1	903639	556-67-2	Cyclotetrasiloxane, octamethyl-
7.457	83.0	C16H16O2	240.1	2128343	60045-26-3	3-Phenylpropyl benzoate
7.508	96.0	C10H22	142.2	1703610	124-18-5	Decane
7.536	92.7	C9H10	118.1	1220210	100-80-1	Benzene, 1-ethenyl-3-methyl-
7.879	88.3	C6H14O3	134.1	6279913	25265-71-8	2-Propanol, 1,1'-oxybis-
8.011	97.0	C10H16	136.1	1259314	138-86-3	dl-Limonene
8.139	92.0	C6H12N2	112.1	2860608	280-57-9	Triethylenediamine
8.500	95.6	C7H12O4	160.1	713574	105-53-3	Diethyl malonate
9.542	88.7	C10H30O5Si5	370.1	2342229	541-02-6	Cyclopentasiloxane, decamethyl-
9.984	87.5	C10H22O2	174.2	640288	112-48-1	1,2-Dibutoxyethane
10.865	88.5	C10H30O5Si5	370.1	2234556	541-02-6	Cyclopentasiloxane, decamethyl-
11.170	80.6	C9H18O2	158.1	898530	2445-76-3	Propanoic acid, hexyl ester
12.322	92.4	C12H26O2	202.2	663206	5921-80-2	Butane, 1,1-dibutoxy-
13.051	89.4	C12H36O6Si6	444.1	3402594	540-97-6	Cyclohexasiloxane, dodecamethyl-
13.266	92.9	C6H14O3	134.1	7998353	25265-71-8	2-Propanol, 1,1'-oxybis-
13.919	92.5	C12H24O3	216.2	768604	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
15.514	95.4	C15H24O	220.2	14785380	128-37-0	Phenol, 2,6-bis(1,1-dimethylethyl)-4-methyl-
16.463	92.1	C16H30O4	286.2	2986290	6846-50-0	PENTAN-1,3-DIOLDIISOBUTYRATE, 2,2,4-TRIMETHYL-
17.117	91.5	C12H27O4P	266.2	54006807	126-73-8	Phosphoric acid, tributyl ester