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

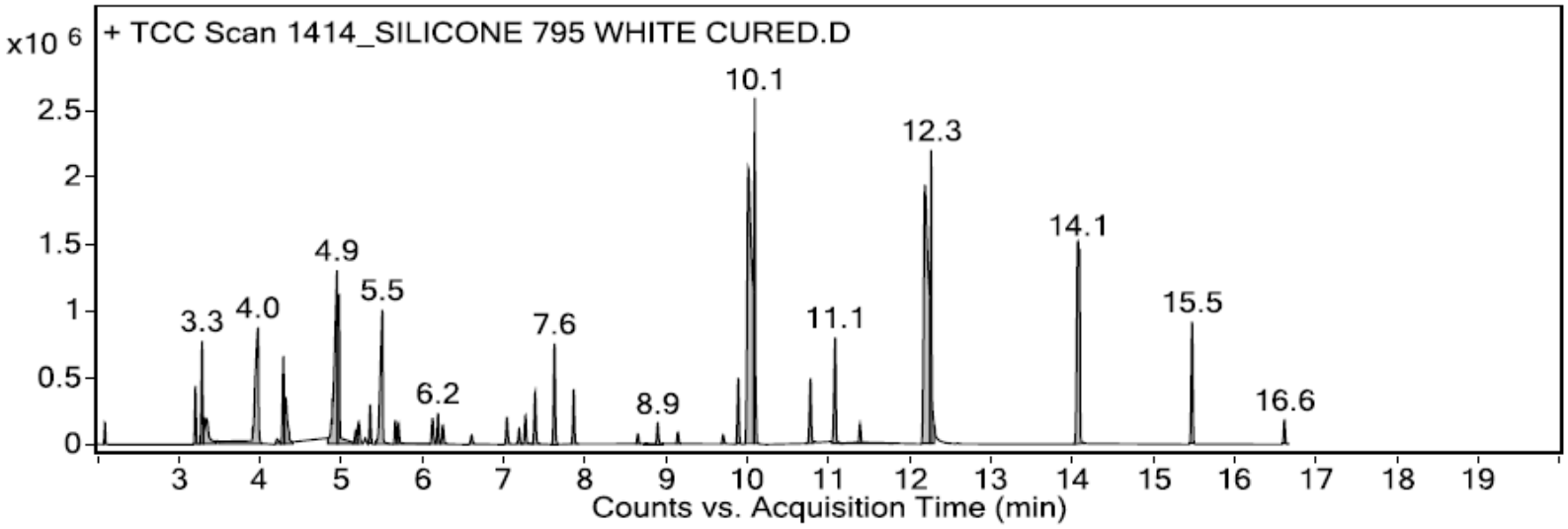
Sample: Dow Corning 795 white building sealant cured 22 days

Oddy test result: Permanent

Date GC-MS collected: 8/16/2016

Technique used: SPME Arrow 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 sample at 60°C for 20 minutes; fiber exposure to sample at 60°C for 20 minutes; fiber injected into 220°C inlet and cryotrapped 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) ~10.8 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) ~11.1 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
1.500	96.5	CH4O	32.0	751352	67-56-1	Methyl Alcohol
1.600	87.7	C2H6O	46.0	1565145	64-17-5	Ethanol
1.600	97.5	C3H6O	58.0	3738984	67-64-1	2-Propanone
1.600	95.7	C3H8O	60.1	1546301	67-63-0	Isopropyl Alcohol
2.100	95.9	C6H6	78.0	142898	71-43-2	Benzene
3.200	91.6	C6H18O3Si3	222.1	471306	541-05-9	Cyclotrisiloxane, hexamethyl-
3.300	88.9	C5H8O3	116.0	887393	105-45-3	Butanoic acid, 3-oxo-, methyl ester
3.300	88.6	C5H8O3	116.0	531797	105-45-3	Butanoic acid, 3-oxo-, methyl ester
3.900	97.7	C8H10	106.1	153592	0-00-0	unidentified C2-benzene
4.000	92.9	C5H8O3	116.0	2161031	105-45-3	Butanoic acid, 3-oxo-, methyl ester
4.200	82.0	C8H9NO2	151.1	122499	999067-93-9	2-Hydroxy-3-methylbenzaldehyde oxime
4.300	87.7	C6H10O3	130.1	977813	141-97-9	Butanoic acid, 3-oxo-, ethyl ester
4.300	81.0	C21H26O9	422.2	141645	114636-05-4	2-oxa-4-methylene-6-(methylethenylcarbonyloxy)-8-acetoxy-8,12-dimethyl-9,13-...
5.000	93.6	C6H10O3	130.1	3257740	141-97-9	Butanoic acid, 3-oxo-, ethyl ester
5.200	88.9	C7H6O	106.0	132881	100-52-7	Benzaldehyde
5.400	95.9	C8H24O4Si4	296.1	355015	556-67-2	Cyclotetrasiloxane, octamethyl-
5.500	91.5	C7H12O3	144.1	2072053	542-08-5	Butanoic acid, 3-oxo-, 1-methylethyl ester
5.700	94.4	C9H12	120.1	215338	526-73-8	Benzene, 1,2,3-trimethyl-

5.700	88.4	C10H22	142.2	164769	124-18-5	Decane
6.100	94.8	C8H18O	130.1	286902	104-76-7	1-Hexanol, 2-ethyl-
6.200	98.5	C10H16	136.1	195576	138-86-3	dl-Limonene
6.300	89.6	C7H8O	108.1	116931	100-51-6	Benzyl alcohol
6.600	88.6	C6H18O3Si3	222.1	123463	541-05-9	Cyclotrisiloxane, hexamethyl-
7.200	93.3	C11H24	156.2	139473	1120-21-4	Undecane
7.300	95.9	C9H18O	142.1	269601	124-19-6	Nonanal
7.400	86.7	C8H12OSi	152.1	569431	999069-77-6	Dimethyl(phenyl)silanol
7.900	96.8	C10H20O2	172.1	514094	103-09-3	Acetic acid, 2-ethylhexyl ester
9.100	86.6	C11H22O2	186.2	122407	999145-46-3	2-Ethyl-1-hexyl propionate
9.900	84.4	C15H14N2O3	270.1	670519	999375-81-1	6,7-Dihydroxy-1-(2-amino-5-hydroxyphenyl)-3,4-dihydroisoquinoline Dihydrobro...
10.800	88.2	C12H24O3	216.2	720250	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.100	93.3	C12H24O3	216.2	1229651	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
11.400	95.4	C14H30	198.2	210984	629-59-4	Tetradecane