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

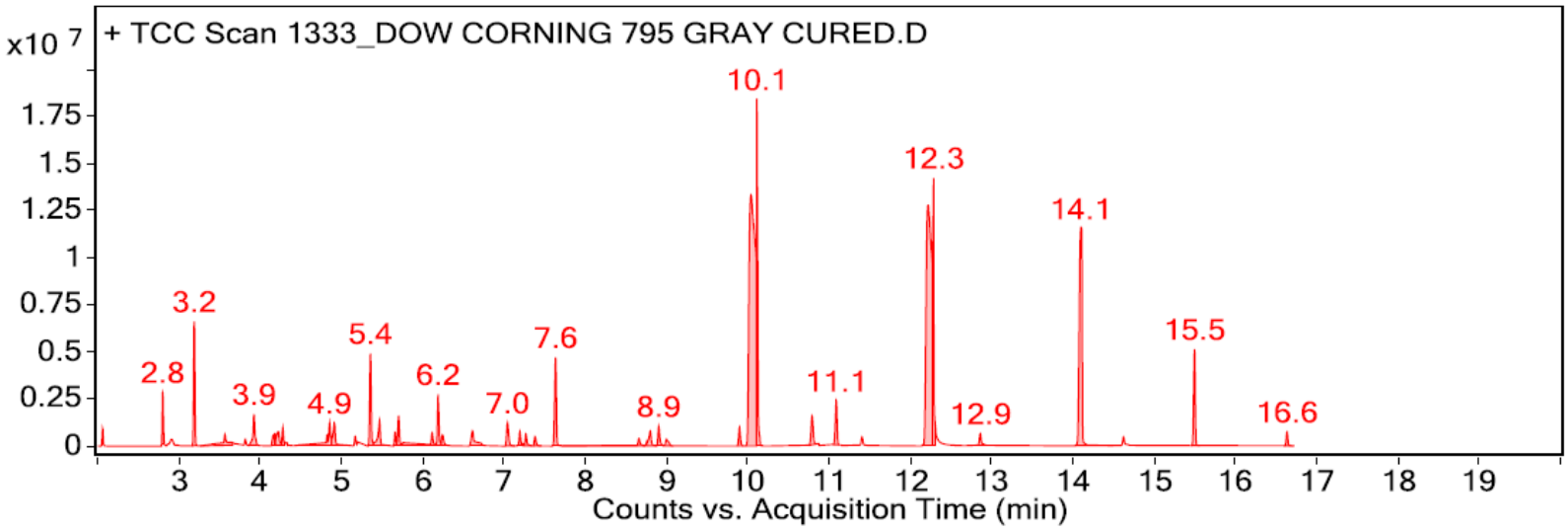
Sample: Dow Corning 795 silicone building sealant, gray

Oddy test result: Permanent

Date GC-MS collected: 6/23/2016

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) 4.2 min: methoxy-phenyl-oxime(2) ~10.8 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) ~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	93.4	CH4O	32.0	2417595	67-56-1	Methanol
1.500	97.8	C2H6O	46.0	4090287	64-17-5	Ethanol
1.500	97.4	C3H6O	58.0	11892588	67-64-1	Acetone
1.600	98.3	C3H8O	60.1	7985501	67-63-0	Isopropyl Alcohol
2.100	96.5	C6H6	78.0	818825	71-43-2	Benzene
2.800	97.5	C7H8	92.1	2820959	108-88-3	Benzene, methyl-
2.900	84.8	C4H9NO	87.1	1084734	96-29-7	2-Butanone, oxime
3.200	91.5	C6H18O3Si3	222.1	7036079	541-05-9	Cyclotrisiloxane, hexamethyl-
3.600	88.7	C6H12O2	116.1	1062474	123-42-2	2-Pentanone, 4-hydroxy-4-methyl-
3.800	91.0	C8H10	106.1	518723	100-41-4	Ethylbenzene
4.200	84.3	C8H9NO2	151.1	1037170	1000222-86-6	Oxime-, methoxy-phenyl-_
4.200	82.1	C8H9NO2	151.1	1662349	999067-93-9	2-Hydroxy-3-methylbenzaldehyde oxime
4.200	91.7	C8H10	106.1	575423	95-47-6	o-Xylene
4.300	96.8	C9H20	128.2	831550	111-84-2	Nonane
4.900	93.9	C6H10O3	130.1	2229022	141-97-9	Ethyl acetoacetate
5.400	94.5	C8H24O4Si4	296.1	6113140	556-67-2	Cyclotetrasiloxane, octamethyl-
5.500	92.1	C7H12O3	144.1	2325621	542-08-5	Butanoic acid, 3-oxo-, 1-methylethyl ester
5.700	94.8	C9H12	120.1	928623	0-00-0	unidentified C3-benzene
5.700	97.2	C10H22	142.2	1804143	124-18-5	Decane
6.100	80.9	C11H17F5O2	276.1	964823	1000365-51-1	2-Ethyl-1-hexanol, pentafluoropropionate
6.200	99.1	C10H16	136.1	2831349	138-86-3	dl-Limonene
6.600	86.3	C6H18O3Si3	222.1	2629931	541-05-9	Cyclotrisiloxane, hexamethyl-
7.200	94.5	C11H24	156.2	882859	1120-21-4	Undecane

7.300	84.5	C9H18O	142.1	760841	124-19-6	Nonanal
7.400	85.8	C8H12OSi	152.1	803915	999069-77-6	Dimethyl(phenyl)silanol
8.800	94.7	C8H24O4Si4	296.1	1736772	556-67-2	Cyclotetrasiloxane, octamethyl-
9.900	85.7	C15H14N2O3	270.1	1404459	999375-81-1	6,7-Dihydroxy-1-(2-amino-5-hydroxyphenyl)-3,4-dihydroisoquinoline Dihydrobro...
10.000	80.5	C22H15NOS	341.1	48712434	999556-92-5	3-Formyl-N-methyl-9-[phenylethynyl]dibenzo[2,3-a : 5,6-a'] (1,4)-thiazine
10.800	87.3	C12H24O3	216.2	1970319	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
11.100	93.8	C12H24O3	216.2	3557101	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
11.400	95.5	C14H30	198.2	670159	629-59-4	Tetradecane
12.200	89.1	C4H12Si	88.1	18931842	75-76-3	Silane, tetramethyl-