

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

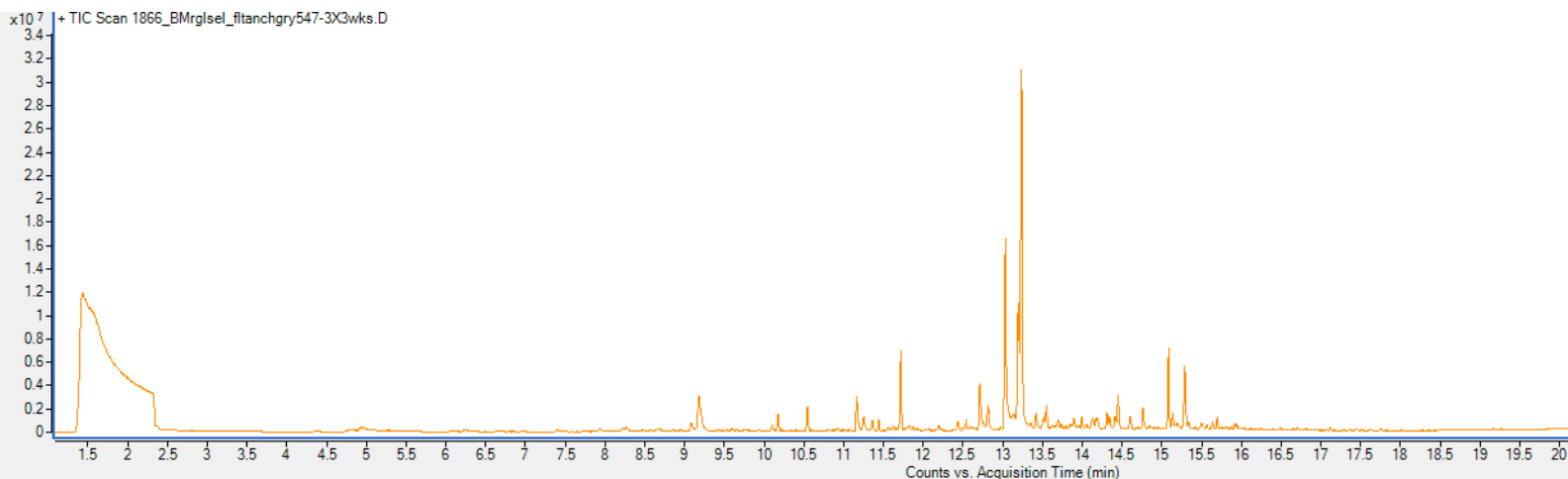
Sample: Benjamin Moore; Regal Select Flat anchor gray paint dried 3 weeks

Oddy test result: Temporary

Date collected: 09/14/2017

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: (1) 13.0 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (3) 13.1 and 13.2 min: 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
1.434	93.5	C13H20O2	208.1	9151893	23267-57-4	TRANS-.BETA.-IONON-5,6-EPOXIDE
1.441	95.3	CH6N2O2	78.0	79653313	1111-78-0	Carbamic acid, monoammonium salt
3.375	82.6	C2H8O2Si	92.0	1171419	1066-42-8	Silanediol, dimethyl-
4.798	82.9	C5H13NO	103.1	900492	63448-63-5	1-Methoxy-2-aminobutane
4.932	91.7	C5H11NO	101.1	2888284	51200-87-4	Oxazolidine, 4,4-dimethyl-
6.247	97.2	C8H10	106.1	849761	95-47-6	o-Xylene
9.085	86.7	C10H16	136.1	1573790	5989-54-8	l-Limonene
9.181	97.5	C7H8O	108.1	8459400	100-51-6	Benzyl Alcohol
10.177	97.4	C9H18O	142.1	2007937	124-19-6	Nonanal
10.545	93.5	C10H30O5Si5	370.1	2114826	541-02-6	Cyclopentasiloxane, decamethyl-
11.161	94.2	C4H5NOS	115.0	4149081	2682-20-4	3(2H)-Isothiazolone, 2-methyl-
11.249	94.9	C8H18O3	162.1	1870858	112-34-5	Ethanol, 2-(2-butoxyethoxy)-
11.362	95.7	C12H26	170.2	980932	112-40-3	Dodecane
11.443	97.8	C10H20O	156.2	1043009	112-31-2	Decanal
11.719	90.9	C8H13NO2	155.1	6403943	1000420-25-3	Carbonic acid, monoamide, N-butyl-, propargyl ester
12.193	88.0	C10H22O	158.2	911800	112-30-1	1-Decanol
12.538	93.8	C11H22O	170.2	1308243	112-44-7	Undecanal
12.600	83.7	C10H22O	158.2	800289	10042-59-8	1-Heptanol, 2-propyl-
12.808	90.8	C13H28O	200.2	2448264	57289-26-6	1-Dodecanol, 2-methyl-, (S)-
12.820	91.7	C9H14O6	218.1	1558063	102-76-1	Triacetin
13.031	90.9	C12H24O3	216.2	27023700	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
13.138	85.6	C12H24O3	216.2	3943250	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
13.193	98.4	C11H24O	172.2	19364861	112-42-5	1-Undecanol
13.237	94.0	C12H24O3	216.2	43190125	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
13.348	85.9	C12H24O3	216.2	871266	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.419	96.2	C14H30	198.2	1732822	629-59-4	Tetradecane
13.518	83.0	C12H24O	184.2	1162413	112-54-9	Dodecanal
13.548	86.2	C14H30O2	230.2	3158918	4536-30-5	Ethanol, 2-(dodecyloxy)-

14.124	95.3	C10H22O	158.2	1788420	112-30-1	1-Decanol
14.192	89.6	C15H30O2	242.2	1678835	999298-44-1	3-Heptyl 2-ethylhexanoate
14.309	81.1	C15H32	212.3	1560598	629-62-9	Pentadecane
14.343	87.6	C11H24O	172.2	1404645	18675-24-6	1-Decanol, 2-methyl-
14.412	84.8	C11H24O	172.2	1514175	18675-24-6	1-Decanol, 2-methyl-
14.448	90.9	C14H30O	214.2	4027712	1000406-32-5	Decyl isobutyl ether
14.600	80.5	C11H24O	172.2	1314459	18675-24-6	1-Decanol, 2-methyl-
14.764	83.9	C11H24O	172.2	2649621	18675-24-6	1-Decanol, 2-methyl-
15.079	89.0	C12H14O4	222.1	2885210	84-66-2	1,2-Benzenedicarboxylic acid, diethyl ester
15.086	93.0	C16H30O4	286.2	5513658	74381-40-1	Propanoic acid, 2-methyl-, 1-(1,1-dimethylethyl)-2-methyl-1,3-propanediyl ester
15.137	92.5	C16H34	226.3	1547303	544-76-3	Hexadecane
15.198	89.7	C14H30O	214.2	890574	4706-81-4	2-Tetradecanol
15.288	86.4	C14H30O2	230.2	7716693	4536-30-5	Ethanol, 2-(dodecyloxy)-
15.699	81.3	C8H12INO2	281.0	943273	55406-53-6	Carbamic acid, butyl-, 3-iodo-2-propynyl ester