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

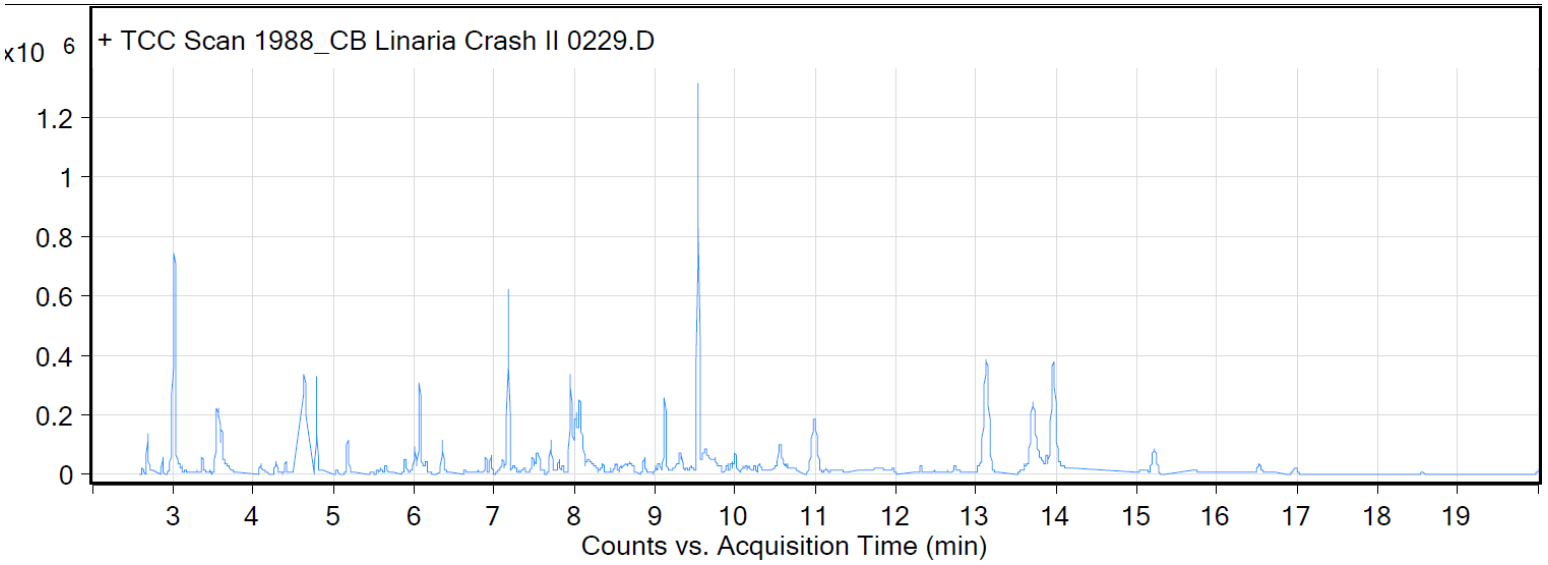
Sample: Creation Baumann Linaria crash II 0299 chocolate fabric

Oddy test result: Unsuitable

Date collected: 1/8/2018

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) 13.7 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 13.96 min: 2-methyl-, 3-hydroxyl-2,2,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
2.68	90.94	154197	Ethanol, 2-methoxy-, acetate	C5H10O3
2.87	94.16	71687	Silanol, trimethyl-	C3H10OSi
3.02	98.24	1652828	Acetic acid	C2H4O2
3.15	91.9	51792	2-Acetyltetrazole	C3H4N4O
3.55	96.08	563624	Silanediol, dimethyl-	C2H8O2Si
3.6	90.94	139352	Pentanal	C5H10O
4.4	92.45	71818	Pentanoic acid	C5H10O2
4.64	96.66	525617	Hexanal	C6H12O
4.79	94.92	510159	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.05	90.13	34391	2-Furancarboxaldehyde	C5H4O2
5.18	96.03	198549	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
5.65	89.19	33835	Pentanoic acid	C5H10O2
6.01	97.16	119445	Heptanal	C7H14O
6.07	96.95	348912	Ethanol, 2-butoxy-	C6H14O2
6.35	95.04	191361	2,4-Pentanediol, 2-methyl-	C6H14O2
6.9	90.09	82222	Octane, 2,2,6-trimethyl-	C11H24
6.96	99.21	120721	Benzaldehyde	C7H6O
7.11	91.42	103106	Hexanoic acid	C6H12O2
7.15	89.53	50977	Phenol	C6H6O
7.18	95.63	847964	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.48	92.6	67254	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.53	85.32	110777	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.55	87.77	112203	Octanal	C8H16O
7.7	96.69	216070	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.86	91.34	40320	Hexatriacontane	C36H74
7.95	96.43	845853	1-Hexanol, 2-ethyl-	C8H18O

8.01	92.63	201182	dl-Limonene	C10H16
8.87	91.02	99560	Benzenemethanol, .alpha.,.alpha.-dimethyl-	C9H12O
9.01	97.83	46078	Benzoic acid, methyl ester	C8H8O2
9.12	97.72	372129	Nonanal	C9H18O
9.31	93.4	58877	DIMETHYL OCTANYL ACETATE	C12H24O2
9.54	88.49	1351680	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.63	90.19	166576	1-Hexanol, 2-ethyl-	C8H18O
10	87.31	83613	Acetic acid, 2-ethylhexyl ester	C10H20O2
10.09	86.71	24897	Acetic acid, decyl ester	C12H24O2
10.24	90.88	20415	DIMETHYL OCTANYL ACETATE	C12H24O2
10.3	86.66	50339	Cyclohexanol, 5-methyl-2-(1-methylethyl)-	C10H20O
11.22	85.66	46381	1-Hexanol, 3,5,5-trimethyl-	C9H20O
11.77	91.26	97414	1-Dodecanol	C12H26O
12.74	88.76	60679	2,2-Dimethyl-1-(2-hydroxy-1-isopropyl)propyl ester of isobutanoic acid	C12H24O3
13.03	95.42	42815	2,2-Dimethyl-3-hydroxypropyl butanoate	C9H18O3
13.13	89.13	1736527	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
13.57	89.25	67603	1,3-Diacetin	C7H12O5
13.71	92.58	1231810	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
13.96	92.33	1525129	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester	C12H24O3
20	85.09	38003	Benzene, 1,1'-sulfonylbis-	C12H10O2S