

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

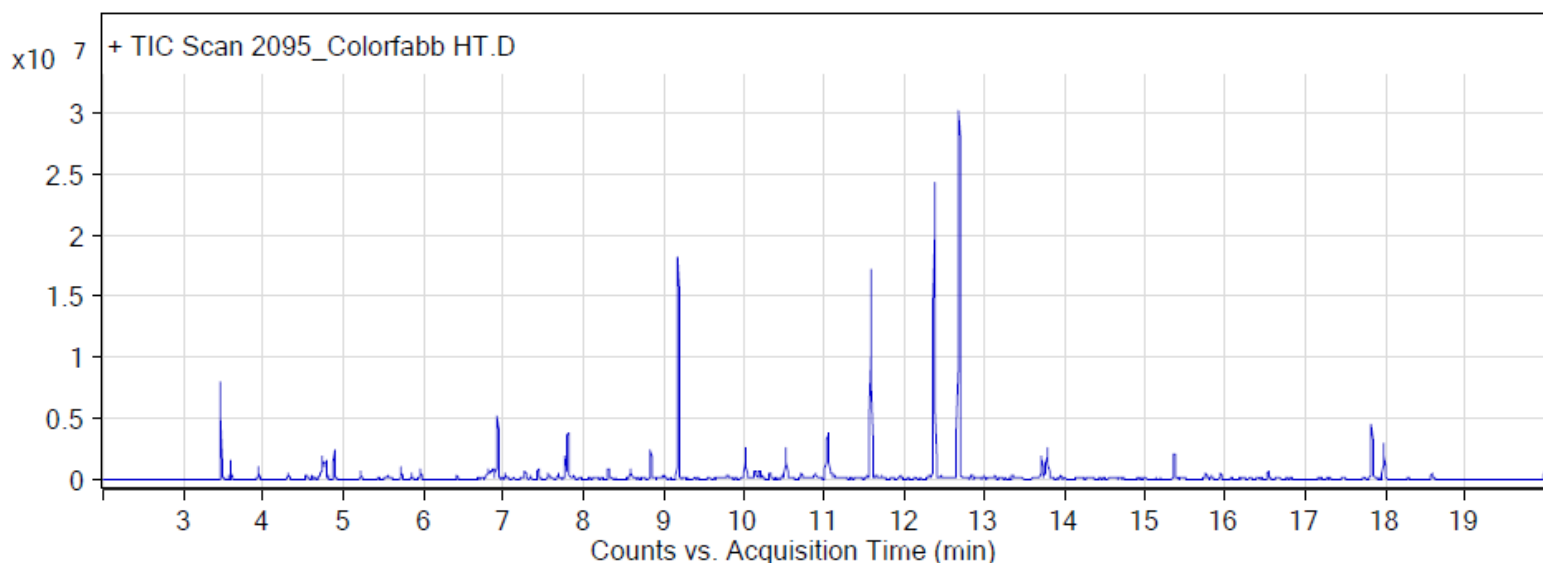
Sample: Eastman Chemical Colorfabb HT clear extruded filament

Oddy test result: Temporary

Date collected: 12/14/2017

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 > 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) 5.7 min: methoxy phenyl oxime; (2) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name	Formula
3.47	92.87	5224918	Formic acid	CH2O2
3.6	97.97	1302208	Acetic acid	C2H4O2
3.94	95.07	676205	Silanediol, dimethyl-	C2H8O2Si
4.31	86.19	489471	Propanoic acid, 2-methyl-	C4H8O2
4.55	89.46	684787	Butanoic acid	C4H8O2
4.74	92.74	1496301	3-Pentanone, 2,4-dimethyl-	C7H14O
4.78	93.17	4365724	Propanoic acid, 2,2-dimethyl-	C5H10O2
4.89	93.36	1795811	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.21	95.28	585782	2-Pentanone, 4-hydroxy-4-methyl-	C6H12O2
5.56	95.34	701746	Pentanoic acid	C5H10O2
5.72	85.04	967517	Oxime-, methoxy-phenyl-	C8H9NO2
5.96	94.72	876850	Ethanol, 2-butoxy-	C6H14O2
6.8	98.01	753014	Benzaldehyde	C7H6O
6.87	92.42	2141172	Hexanoic acid	C6H12O2
6.91	92.65	992861	Phenol	C6H6O
6.92	96.12	4618806	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.02	93.28	646886	Propanoic acid, 3-ethoxy-, ethyl ester	C7H14O3
7.26	89.84	794238	Ethanol, 2-(2-ethoxyethoxy)-	C6H14O3
7.43	98.07	1080742	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.55	93.94	618629	2-Propanol, 1,1'-oxybis-	C6H14O3
7.68	97.45	631526	1-Hexanol, 2-ethyl-	C8H18O
7.77	94.2	1981939	dl-Limonene	C10H16
7.8	96.48	4540711	Benzyl Alcohol	C7H8O
8.83	97.31	2804112	Nonanal	C9H18O

9.18	95.5	20379150	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
10.01	96.29	3150229	Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
10.14	96.01	903893	Azulene	C10H8
10.19	96.94	853278	Methyl salicylate	C8H8O3
10.32	97.36	683221	Decanal	C10H20O
10.52	92.99	3047152	Ethanol, 2-phenoxy-	C8H10O2
10.89	93.18	620453	1-Phenoxypropan-2-ol	C9H12O2
11.05	94.99	8117200	Caprolactam	C6H11NO
11.58	96.01	21308956	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
12.37	89.01	35660648	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.68	93.46	46814540	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
13.95	94.91	503531	1-Dodecanol	C12H26O
15.76	89.53	624059	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
15.94	97.87	629550	Methanone, diphenyl-	C13H10O
17.83	97.63	5896530	2-Ethylhexyl salicylate	C15H22O3
17.98	95	4022825	Isopropyl Myristate	C17H34O2
18.59	96.97	707105	1-Hexadecanol	C16H34O
19.99	92.94	1004329	Isopropyl palmitate	C19H38O2