

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

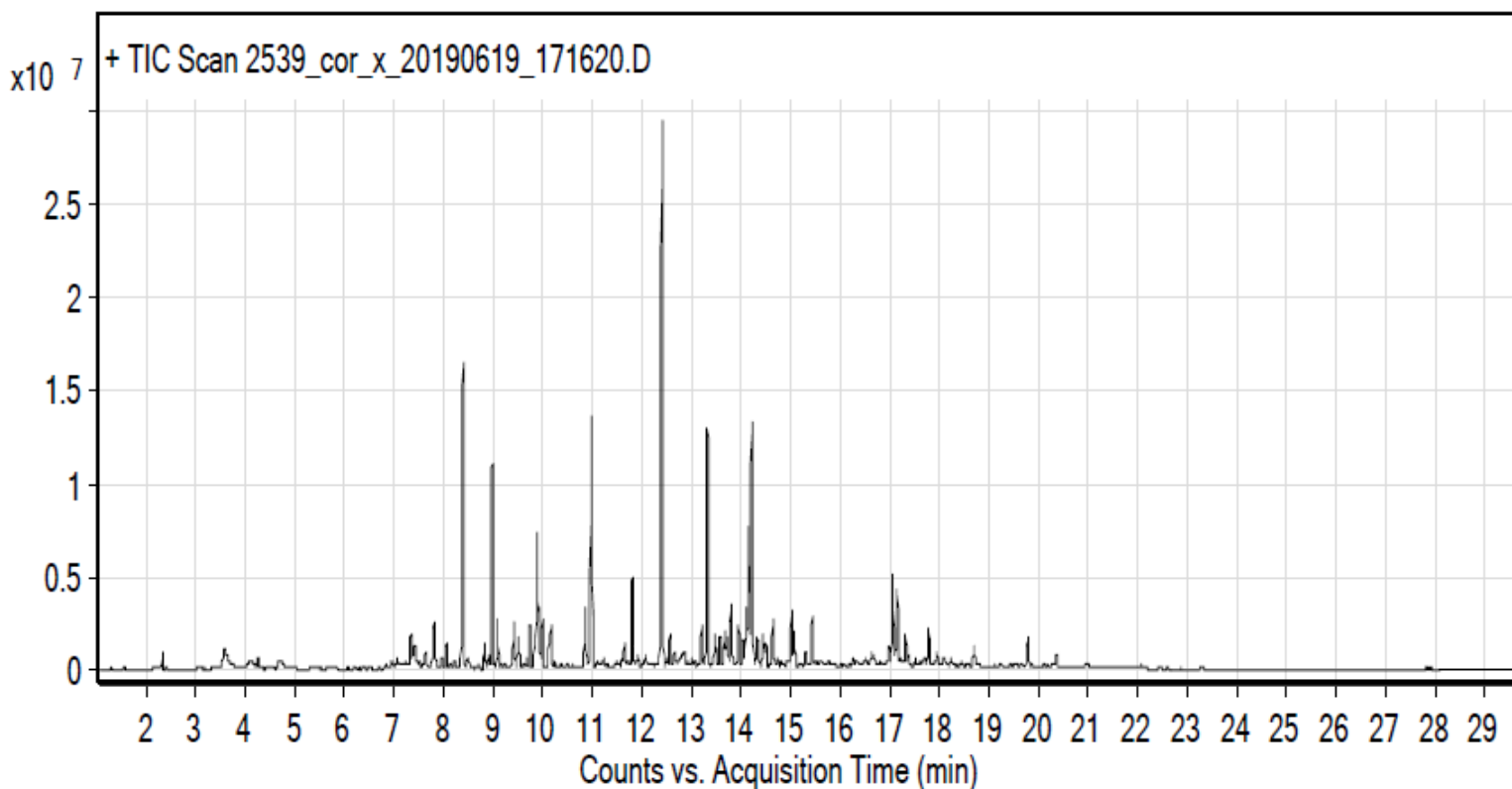
Alkynes – can become reactive when exposed to heat or UV light

Sample: Primex plastics Cor-X polypropylene board corrugated

Date collected: 6/19/2019

Oddy test result: temporary

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 cotrapped for 2 min at -15°C; GC ramped from 35°C to 225 °C at 7.5°C/min. Data analyzed in Masshunter Qualitative. Samples > 90% match with a NIST 17.0 library are reported. VOCs not highlighted are because they were also observed in blanks: (1) 15.0 min: 2-methyl-, 3-hydroxyl-, 2,4,4-trimethylpentyl ester propanoic acid



Compound Table

RT	Score (Lib)	Area	Name
2.18	91.26	1270593	Tricyclo[4.1.0.0(2,7)]hept-3-ene
3.6	91.89	6802093	Heptane, 2,4-dimethyl-
4.11	91.4	2354556	1-Heptanol
4.71	92.59	1926003	Dodecane, 5-methyl-
7.64	92.93	1186361	Benzene, 1,3,5-trimethyl-
7.78	95.55	2717710	Pentadecane
8.41	96.85	34236349	1-Hexanol, 2-ethyl-
8.84	92.42	2475425	Octane, 2,3,6,7-tetramethyl-
8.99	92.53	21083611	Octane, 5-ethyl-2-methyl-
9.1	92.34	4611920	Undecane, 4,7-dimethyl-
9.85	93.98	3089689	Undecane, 5,7-dimethyl-
9.9	92.57	15750717	Octane, 5-ethyl-2-methyl-
10.01	92.4	4911402	Octane, 5-ethyl-2-methyl-
10.14	90.38	4398913	Octane, 2,3,6,7-tetramethyl-
10.86	97.24	5886421	Acetic acid, 2-ethylhexyl ester
11.65	91.49	1831698	1-Undecanol
11.81	95.85	9210749	Undecane, 4,7-dimethyl-
11.93	90.54	1088735	Decanal
12.42	97.02	69255537	2-Ethylhexyl acrylate
13.02	92.06	592988	Undecane, 3-methyl-
13.33	91.03	26450181	Dodecane, 4,6-dimethyl-
13.48	90.51	3654173	Eicosane
13.58	90.16	2848272	Undecane, 3,8-dimethyl-
13.68	95.39	3578069	Undecane, 4,6-dimethyl-

14.16	90.39	15015225	Dodecane, 2,6,11-trimethyl-
14.22	91.33	25163300	Cyclohexasiloxane, dodecamethyl-
14.33	90.57	4312835	Octane, 5-ethyl-2-methyl-
15.02	90.65	5565778	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
15.31	91.46	1302859	Cyclohexadecane
15.45	94.9	5101664	Eicosane
16.51	91.83	941488	Hexacosane
16.99	91.44	2257118	Tricosane
17.72	91.13	706137	Nonadecane
18.08	92.17	919872	Hexadecane
18.24	90.4	588070	Hexadecane