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

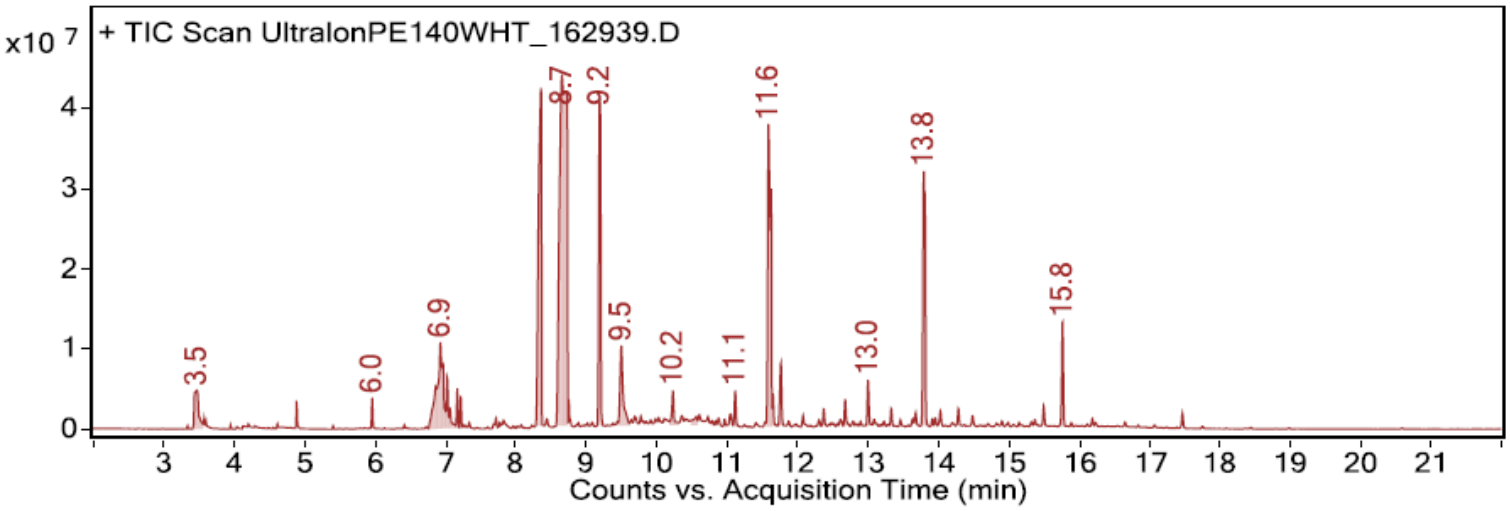
Sample: Ultralon PE140 foamed polyethylene; white

Oddy test result: Unsuitable

Date GC-MS collected: 03/20/2018

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) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
3.500	89.3	C4H6O3	102.0	21525273	108-24-7	Acetic anhydride
6.000	92.3	C6H14O2	118.1	4458305	111-76-2	Ethanol, 2-butoxy-
6.900	89.7	C4H10O3	106.1	17818068	111-46-6	Ethanol, 2,2'-oxybis-
7.000	87.1	C4H10O3	106.1	15762296	111-46-6	Ethanol, 2,2'-oxybis-
7.000	81.2	C7H14O3	146.1	9305163	763-69-9	Propanoic acid, 3-ethoxy-, ethyl ester
7.200	92.5	C12H26	170.2	6128606	13475-82-6	Heptane, 2,2,4,6,6-pentamethyl-
7.200	98.7	C6H14O3Si	162.1	4686530	1000376-38-1	1,3,6-Trioxa-2-silacyclooctane, 2,2,-dimethylsilyl-
8.400	97.5	C8H8O	120.1	123621144	98-86-2	Ethanone, 1-phenyl-
8.700	93.2	C9H12O	136.1	198215853	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
8.700	95.7	C9H12O	136.1	115882066	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
9.200	97.2	C10H30O5Si5	370.1	79300525	541-02-6	Cyclopentasiloxane, decamethyl-
9.500	89.1	C9H19NO	157.1	30841147	2403-88-5	4-Piperidinol, 2,2,6,6-tetramethyl-
11.600	93.8	C12H36O6Si6	444.1	109024876	540-97-6	Cyclohexasiloxane, dodecamethyl-
11.700	92.6	C13H28	184.2	5052521	629-50-5	Tridecane
11.800	84.4	C16H18O	226.1	13638375	4613-10-9	(l-Erythro-2,3-diphenyl)-2-butanol
12.700	90.9	C12H24O3	216.2	5085287	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
13.000	96.0	C14H30	198.2	8723684	629-59-4	Tetradecane
13.800	84.6	C14H42O7Si7	518.1	73076736	107-50-6	Cycloheptasiloxane, tetradecamethyl-
15.800	92.4	C16H48O8Si8	592.2	20312104	556-68-3	Cyclooctasiloxane, hexadecamethyl-