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

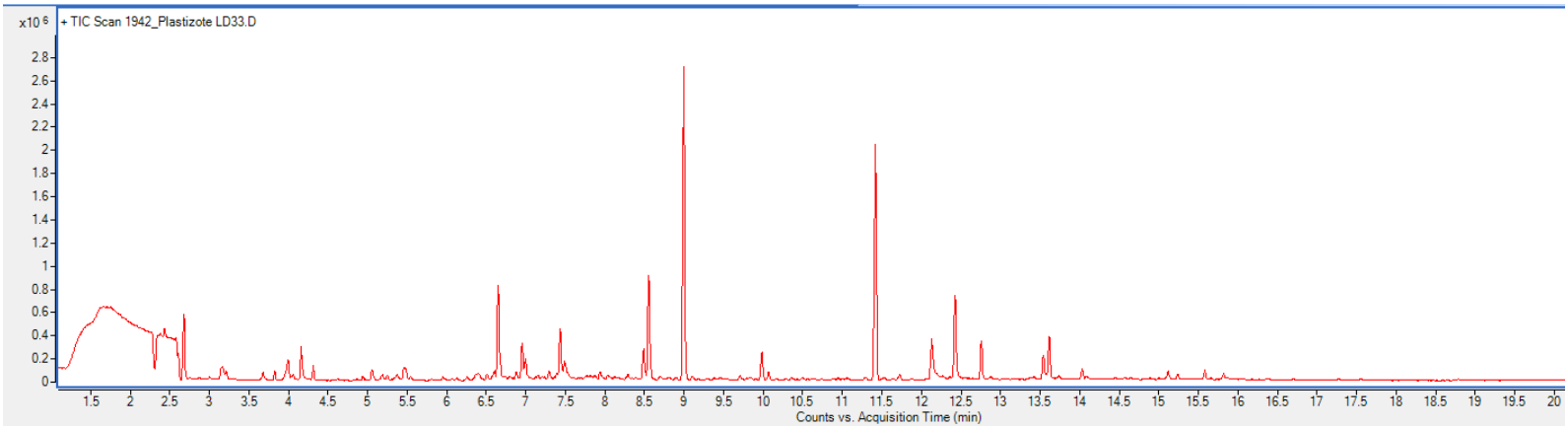
Sample: UFP Plastizote LD33 foamed polyethylene; white

Oddy test result: Permanent

Date collected: 12/09/2017

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) 12.1 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl) propyl ester propanoic acid; (2) 12.4 min: 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.682	96.4	C2H4O2	60.0	980580	64-19-7	Acetic acid
3.172	97.2	C3H6O2	74.0	228393	79-09-4	Propanoic acid
3.683	95.5	C4H8O2	88.1	143195	79-31-2	Propanoic acid, 2-methyl-
3.996	83.6	C4H8O2	88.1	402758	107-92-6	Butanoic acid
4.162	93.2	C6H12O	100.1	500523	66-25-1	Hexanal
4.313	93.1	C6H18O3Si3	222.1	163379	541-05-9	Cyclotrisiloxane, hexamethyl-
5.057	92.6	C8H10	106.1	178109	95-47-6	o-Xylene
5.460	91.3	C9H20	128.2	192554	111-84-2	Nonane
6.602	86.8	C6H12O2	116.1	153305	142-62-1	Hexanoic acid
6.651	95.5	C8H24O4Si4	296.1	1175735	556-67-2	Cyclotetrasiloxane, octamethyl-
6.954	95.7	C10H22	142.2	485380	124-18-5	Decane
6.997	87.9	C8H16O	128.1	323189	124-13-0	Octanal
7.435	98.9	C10H16	136.1	743491	138-86-3	dl-Limonene
8.487	97.7	C11H24	156.2	429796	1120-21-4	Undecane
8.554	98.7	C9H18O	142.1	1541904	124-19-6	Nonanal
8.996	92.9	C10H30O5Si5	370.1	4026886	541-02-6	Cyclopentasiloxane, decamethyl-
9.983	96.1	C12H26	170.2	388013	112-40-3	Dodecane
11.407	96.3	C13H28	184.2	475573	629-50-5	Tridecane
11.421	91.5	C12H36O6Si6	444.1	2709945	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.130	93.4	C12H24O3	216.2	875758	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
12.427	93.5	C12H24O3	216.2	1264149	77-68-9	Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester
12.757	95.5	C14H30	198.2	516961	629-59-4	Tetradecane
13.545	81.2	C12H18O2	194.1	383113	1999-85-5	.alpha.,.alpha.'-Dihydroxy-m-diisopropylbenzene
15.118	91.5	C16H30O4	286.2	149477	74381-40-1	Propanoic acid, 2-methyl-, 1-(1,1-dimethylethyl)-2-methyl-1,3-propanediyl ester