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

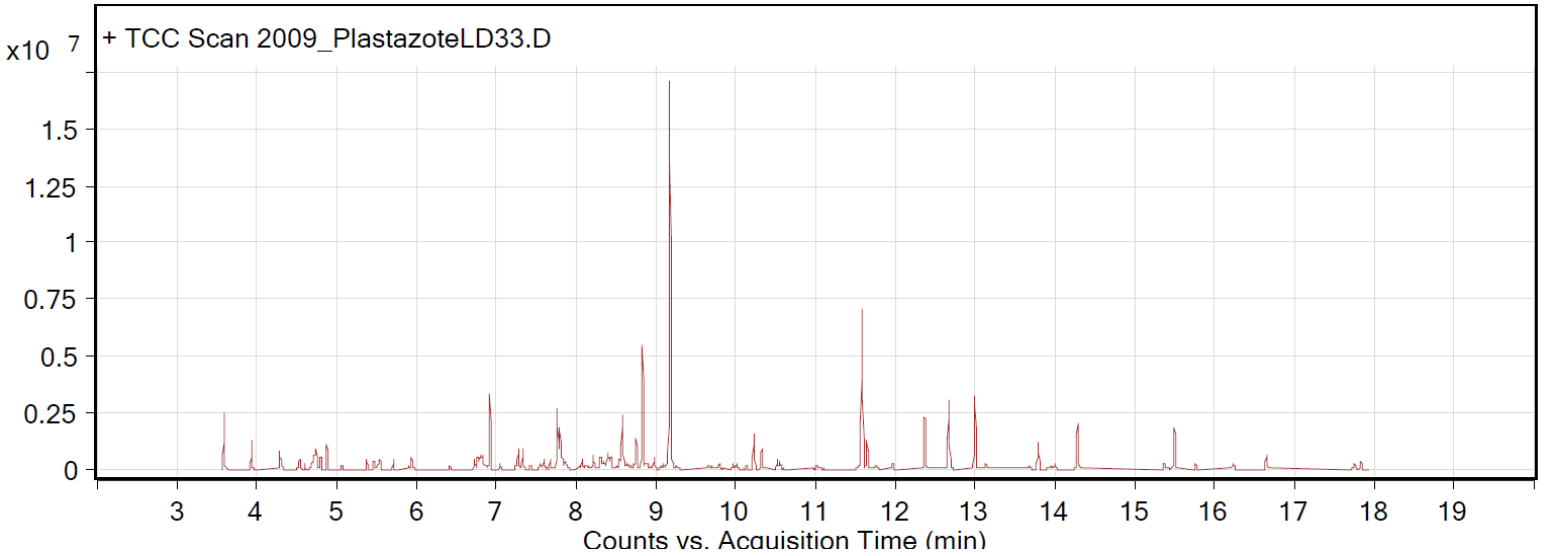
Sample: UFP Technologies; Zote Foams Plastazote LD33 white

Oddy test result: Temporary

Date collected: 03/19/2018

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) 5.7 min: methoxyphenyl 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
3.59	98.59	2579001	Acetic acid	C2H4O2
4.31	88.89	657440	Propanoic acid, 2-methyl-	C4H8O2
4.54	93.45	939826	Butanoic acid	C4H8O2
4.74	90.27	2058273	Propanoic acid, 2,2-dimethyl-	C5H10O2
4.8	96.19	570161	Hexanal	C6H12O
4.88	93.37	1014519	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.07	92.48	185357	Butanoic acid, 3-methyl-	C5H10O2
5.38	89.54	515158	tetrahydro - 4 - methyl - 3 - furanone	C5H8O2
5.46	90.85	497990	1,3-Butanediol, (S)-	C4H10O2
5.54	92.52	617767	Pentanoic acid	C5H10O2
5.71	85.43	455763	Oxime-, methoxy-phenyl-_	C8H9NO2
5.95	85.03	285878	Ethanol, 2-butoxy-	C6H14O2
6.8	97.9	296587	Benzaldehyde	C7H6O
6.92	96.34	4047978	Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.05	88.18	316812	6-Methyl-5-hepten-2-one	C8H14O
7.25	93.26	181833	unidentified C3-benzene	C9H12
7.28	96.34	975369	Decane	C10H22
7.33	97.65	1038280	Octanal	C8H16O
7.43	98.19	273848	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.55	86.99	405001	2-Propanol, 1,1'-oxybis-	C6H14O3
7.6	87.32	293423	Octane, 2,6-dimethyl-	C10H22
7.67	97.39	616137	1-Hexanol, 2-ethyl-	C8H18O
7.76	97.61	2726796	dl-Limonene	C10H16
8.07	86.92	756958	Dodecane, 2,6,11-trimethyl-	C15H32
8.22	91.6	506268	Dodecane, 2,6,11-trimethyl-	C15H32
8.31	85.23	294067	Silane, triethoxypentyl-	C11H26O3Si
8.4	91.3	348389	Decane, 2,3,4-trimethyl-	C13H28
8.54	85.55	393733	Undecane, 4,7-dimethyl-	C13H28

8.68	85.29	343879	Decane, 2,4,6-trimethyl-	C13H28
8.75	97.39	2083757	Undecane	C11H24
8.83	97.77	7021341	Nonanal	C9H18O
8.93	87.33	351865	Hexadecane, 2,6,10,14-tetramethyl-	C20H42
8.98	87.37	812519	Benzeneethanol	C8H10O
9.14	85.47	417002	Tetradecane	C14H30
9.18	95.58	17872075	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.2	96.57	206291	2-methoxy[1]benzothieno[2,3-c]quinolin-6(5H)-one	C16H11NO2S
9.96	95.23	290445	Cyclohexanol, 5-methyl-2-(1-methylethyl)-	C10H20O
10.13	96.07	298956	Azulene	C10H8
10.22	96.1	2112155	Dodecane	C12H26
10.32	97.61	1163095	Decanal	C10H20O
10.52	92.72	598559	Ethanol, 2-phenoxy-	C8H10O2
11.01	85.41	316844	Caprolactam	C6H11NO
11.58	95.91	9726618	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.64	95.32	1806773	Tridecane	C13H28
11.76	93.9	231784	Undecanal	C11H22O
11.97	96.31	388357	Nonane, 2,2,4,4,6,8,8-heptamethyl-	C16H34
12.36	90.57	3334650	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.67	93.28	4471965	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
13	94.43	4443257	Tetradecane	C14H30
13.13	92.21	379127	Dodecanal	C12H24O
13.68	87.65	220247	Cyclopentane, nonyl-	C14H28
13.95	91.91	294586	1-Dodecanol	C12H26O
14.28	94.96	2865953	pentadecane	C15H32
15.5	93.8	2499591	Hexadecane	C16H34
15.76	89.24	408359	Cyclooctasiloxane, hexadecamethyl-	C16H48O8Si8
16.23	93.33	421928	Decyl octyl ether	C18H38O
16.65	95.01	914290	Heptadecane	C17H36
17.83	98.45	510928	2-Ethylhexyl salicylate	C15H22O3