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

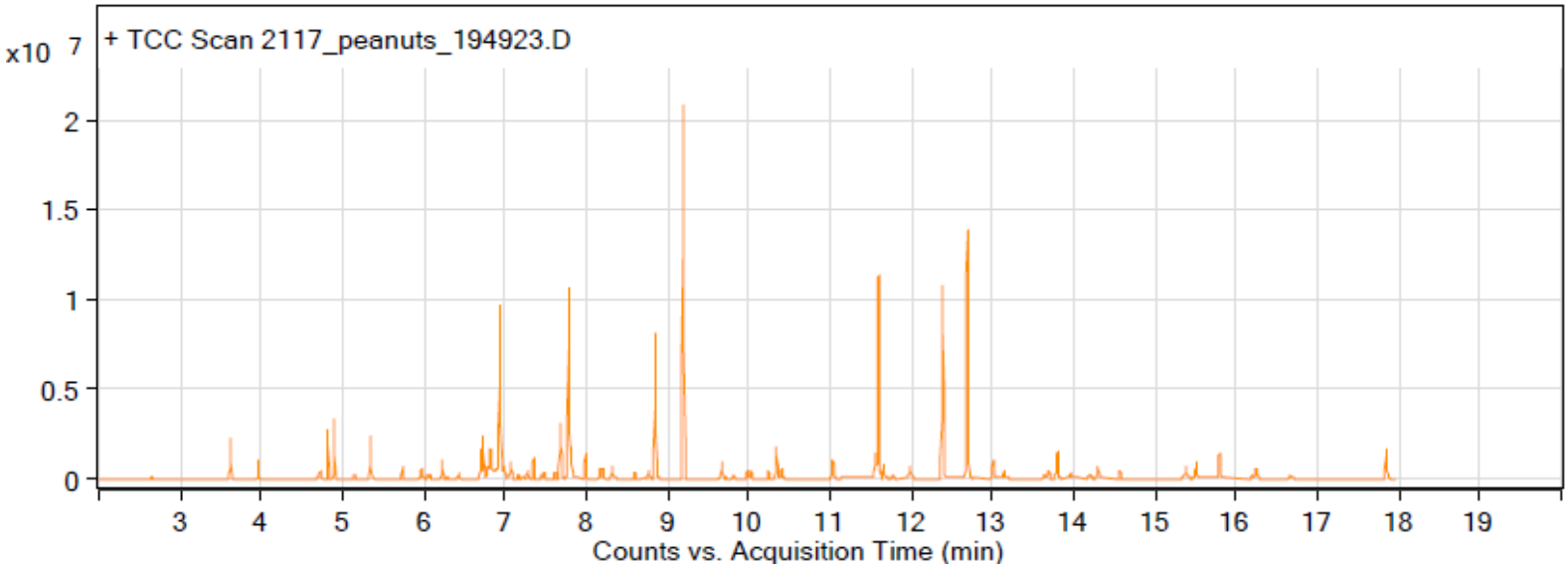
Alkynes – can become reactive when exposed to heat or UV light

Sample: Biodegradable Packing peanuts; Catalog # S-156; decomposes in water

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 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 17.0 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



RT	Mass	Name	DB Formula
2.65		(3R*,4S*)-2-(2-tert-Butyl-4-methyl-3-phenyl-1,2-oxazetidin-4-yl)-4,4-dimethy...	C18H26N2O2
3.62		Acetic acid	C2H4O2
3.96		Silanediol, dimethyl-	C2H8O2Si
4.73		Propanoic acid, 2,2-dimethyl-	C5H10O2
4.82		Hexanal	C6H12O
4.9		Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
5.15		2-Furancarboxaldehyde	C5H4O2
5.34		2-Furanmethanol	C5H6O2
5.97		Ethanol, 2-butoxy-	C6H14O2
6.22		2-Hydroxy-2-cyclopenten-1-one	C5H6O2
6.7		2-Heptenal, (Z)-	C7H12O
6.73		Octane, 2,2,6-trimethyl-	C11H24
6.82		Benzaldehyde	C7H6O
6.94		Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
7.08		Benzene, (1-methylethenyl)-	C9H10
7.17		Furan, 2-pentyl-	C9H14O
7.35		Octanal	C8H16O
7.45		dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN	C7H16O3
7.62		Heptane, 2,2,4,6,6-pentamethyl-	C12H26
7.78		dl-Limonene	C10H16
7.99		PHENYL ACETALDEHYDE	C8H8O
8.2		.gamma.-Terpinene	C10H16
8.85		Nonanal	C9H18O
9.19		Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.67		2-Nonenal, (E)-	C9H16O
9.98		Cyclohexanol, 5-methyl-2-(1-methylethyl)-	C10H20O
10.03		Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
11.04		Caprolactam	C6H11NO

11.56		Bicyclo[2.2.1]heptan-2-ol, 1,7,7-trimethyl-, acetate, (1S-endo)-	C12H20O2
11.6		Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.66		Tridecane	C13H28
11.98		Nonane, 2,2,4,4,6,8,8-heptamethyl-	C16H34
12.69		Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
13.01		Tetradecane	C14H30
13.96		1-Dodecanol	C12H26O
14.29		pentadecane	C15H32
14.57		Dodecanoic acid, methyl ester	C13H26O2
15.51		Hexadecane	C16H34
15.79		Dodecanoic acid, 1-methylethyl ester	C15H30O2
17.84		2-Ethylhexyl salicylate	C15H22O3