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

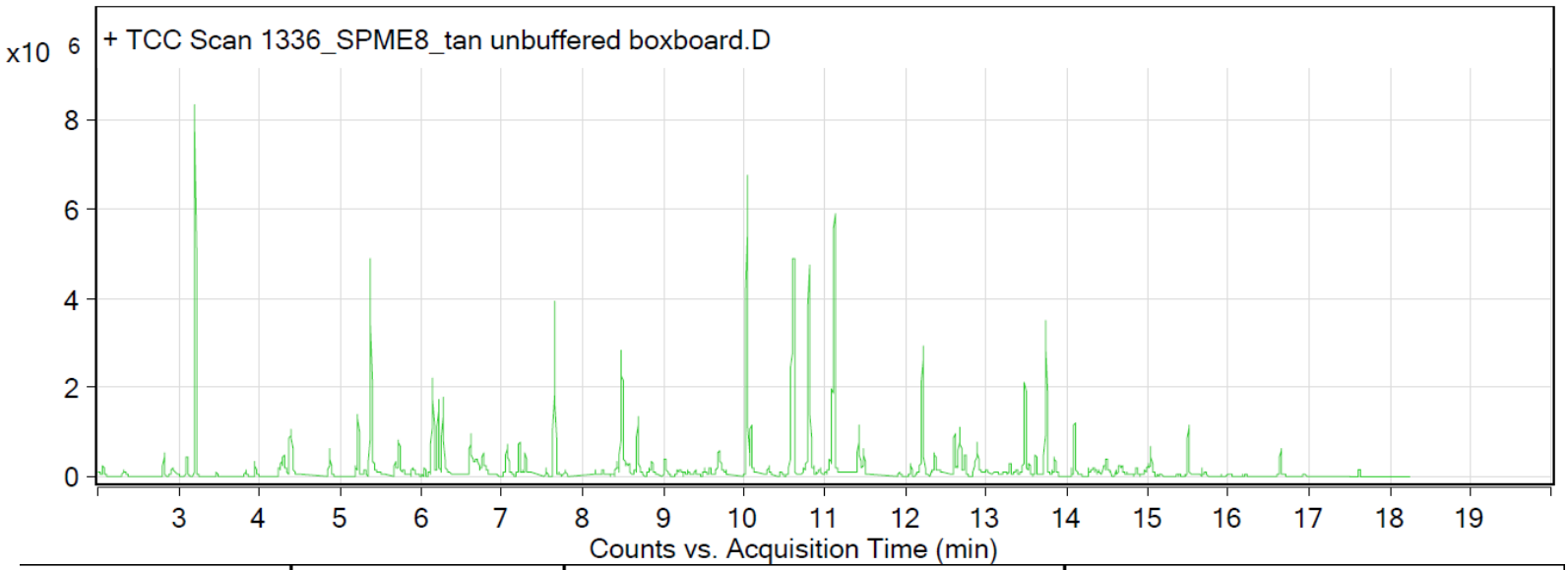
Nitrogen-containing, not amine – can react with other off-gassed chemicals

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

Sample: University Products unbuffered tan boxboard

Oddy test score: Temporary
Date collected: 06/24/2016

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 > 90% match with a NIST 17.0 library are reported.
VOCs not highlighted are because they were also observed in blanks: : (1) 11.1 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



RT	Mass	Name	DB Formula
1.78		2-Butanone	C4H8O
1.9		Furan, tetrahydro-	C4H8O
1.95		Acetic acid	C2H4O2
2.81		Benzene, methyl-	C7H8
3.1		Hexanal	C6H12O
3.2		Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
3.46		2-Furancarboxaldehyde	C5H4O2
3.94		m - xylene AND p - xylene	C8H10
4.24		3,4-Dibenzyloxy-2,5-dimethoxytetrahydrofuran	C20H24O5
4.39		Ethanol, 2-butoxy-	C6H14O2
5.22		Benzaldehyde	C7H6O
5.38		Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
5.39		Phenol	C6H6O
6.14		1-Hexanol, 2-ethyl-	C8H18O
6.21		dl-Limonene	C10H16
6.27		Benzyl Alcohol	C7H8O
8.16		Undecane, 2-methyl-	C12H26
8.49		Ethanol, 2-(2-butoxyethoxy)-	C8H18O3
8.68		Dodecane	C12H26
8.82		Cyclotetrasiloxane, octamethyl-	C8H24O4Si4
10.08		Tridecane	C13H28
10.61		1,3-Diacetin	C7H12O5
11.12		Propanoic acid, 2-methyl-, 3-hydroxy-2,2,4-trimethylpentyl ester	C12H24O3
11.42		Tetradecane	C14H30
11.48		1,1'-Biphenyl, 2-methyl-	C13H12
11.92		7-phenyl-tetracyclo[4.1.0.0(2,4).0(3,3)]heptane	C13H12
12.36		1-Dodecanol	C12H26O
12.61		1,1'-Biphenyl, 4-methyl-	C13H12
12.67		2,2'-Dimethylbiphenyl	C14H14
12.74		2,3-dihydro-1H-cyclopent[e]azulene	C13H12
12.85		1,1'-Biphenyl, 2,2'-dimethyl-	C14H14
13.74		1,2-Benzenedicarboxylic acid, diethyl ester	C12H14O4