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

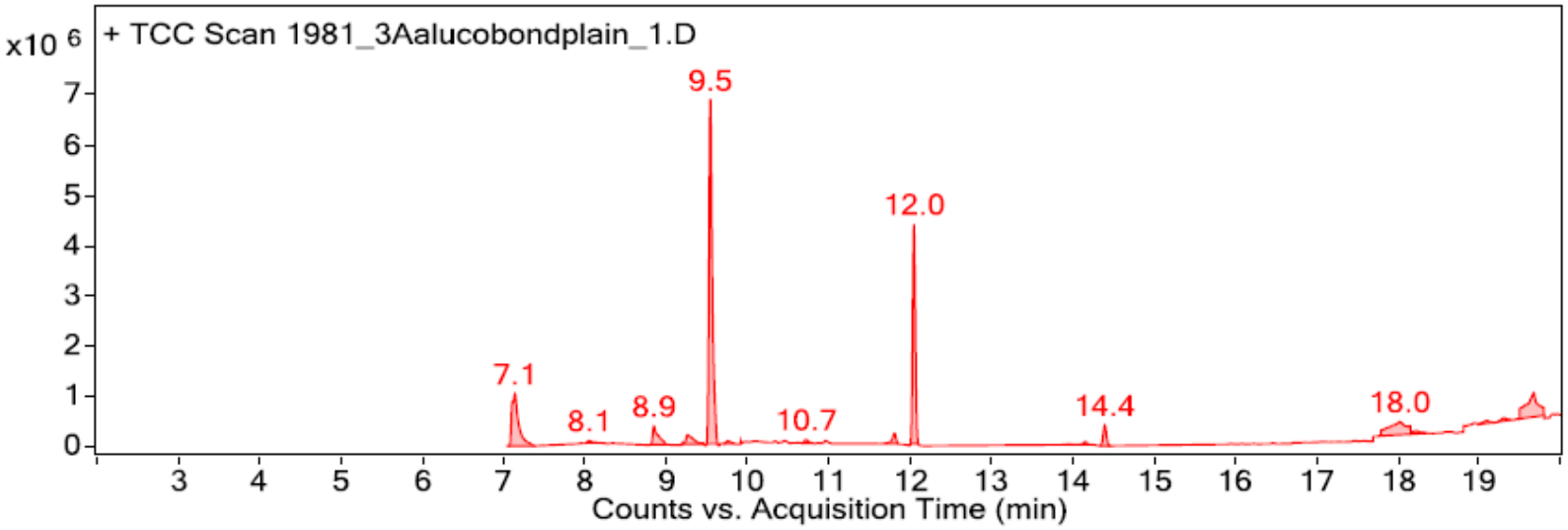
Alkynes – can become reactive when exposed to heat or UV light

Sample: 3A Composites; Alucobond 6mm, plain

Oddy test result: Permanent

Date GC-MS collected: 2/9/2018

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.



Library results

RT	Score	Formula	MW	Area	CAS #	Name
7.100	95.2	C8H24O4Si4	296.1	6053810	556-67-2	Cyclotetrasiloxane, octamethyl-
8.900	93.5	C9H12O	136.1	1821360	617-94-7	Benzenemethanol, .alpha.,.alpha.-dimethyl-
9.300	83.3	C12H24	168.2	857016	74630-45-8	2-Undecene, 9-methyl-, (Z)-
9.500	80.6	C13H25NO	211.2	194253	999210-53-6	5-Butyl-8/9-hydroxy-8-methylizidine
9.500	94.9	C10H30O5Si5	370.1	19150246	541-02-6	Cyclopentasiloxane, decamethyl-
9.800	87.4	C13H28	184.2	223606	62238-12-4	Decane, 2,3,6-trimethyl-
10.500	88.0	C9H18	126.1	200179	1678-97-3	Cyclohexane, 1,2,3-trimethyl-
10.700	88.1	C14H30	198.2	279053	61141-72-8	Dodecane, 4,6-dimethyl-
11.800	94.3	C12H36O6Si6	444.1	903585	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.000	95.7	C12H36O6Si6	444.1	10138722	540-97-6	Cyclohexasiloxane, dodecamethyl-
19.700	85.8	C16H32O2	256.2	428845	57-10-3	Hexadecanoic acid
20.100	90.8	C16H32O2	256.2	1097280	57-10-3	n-Hexadecanoic acid
21.300	84.9	C13H28O	200.2	256250	112-70-9	1-Tridecanol