

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

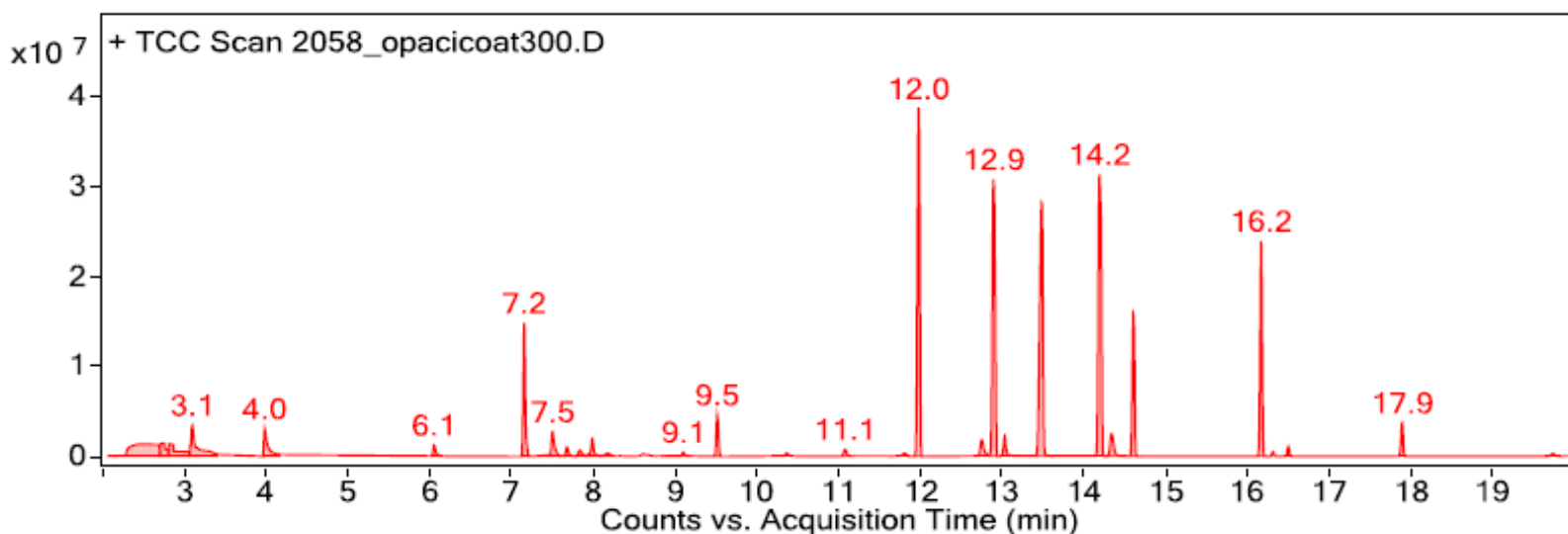
Sample: Opaci-coat 300 with "white pure" colorant

Oddy test result: Temporary

Date GC-MS collected: 02/09/2018

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.

VOCs not highlighted are because they were also observed in blanks: (1) 12.8 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (2) 13.0 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid



Library results

RT	Score	Formula	MW	Area	CAS #	Name
2.800	81.0	C ₂ H ₄ N ₂ O ₃	104.0	7572691	14011-21-3	Nitroacetamide
3.100	96.3	C ₄ H ₁₁ N	73.1	13680878	109-89-7	Ethanamine, N-ethyl-
4.000	93.6	C ₄ H ₁₁ NO	89.1	10407859	108-01-0	Ethanol, 2-(dimethylamino)-
6.100	97.1	C ₆ H ₁₄ O ₂	118.1	2920032	111-76-2	Ethanol, 2-butoxy-
7.200	97.7	C ₈ H ₂₄ O ₄ Si ₄	296.1	25739885	556-67-2	Cyclotetrasiloxane, octamethyl-
7.500	92.8	C ₆ H ₁₄ O ₃	134.1	6869111	111-90-0	Ethanol, 2-(2-ethoxyethoxy)-
7.700	97.8	C ₇ H ₁₆ O ₃	148.1	2310591	0-00-0	dipropylene glycol monomethyl ether isomer, STRUCTURE UNKNOWN
7.800	88.3	C ₆ H ₁₄ O ₃	134.1	2280860	110-98-5	2-Propanol, 1,1'-oxybis-
8.000	97.8	C ₁₀ H ₁₆	136.1	3415060	138-86-3	dl-Limonene
8.200	96.2	C ₆ H ₁₄ O ₃	134.1	1462053	25265-71-8	2-Propanol, 1,1'-oxybis-
8.600	86.3	C ₁₀ H ₂₂ O	158.2	945629	929-61-3	Octane, 1-ethoxy-
9.100	97.3	C ₉ H ₁₈ O	142.1	891855	124-19-6	Nonanal
9.500	94.3	C ₁₀ H ₃₀ O ₅ Si ₅	370.1	8491441	541-02-6	Cyclopentasiloxane, decamethyl-
10.400	95.8	C ₈ H ₁₈ O ₃	162.1	1014707	54446-78-5	Ethanol, 1-(2-butoxyethoxy)-
11.100	95.3	C ₁₀ H ₂₂ O ₂	174.2	1869249	1559-35-9	Ethanol, 2-[(2-ethylhexyl)oxy]-
11.800	95.4	C ₁₂ H ₃₆ O ₆ Si ₆	444.1	1292622	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.000	96.2	C ₁₂ H ₃₆ O ₆ Si ₆	444.1	79498311	540-97-6	Cyclohexasiloxane, dodecamethyl-
12.800	90.7	C ₁₂ H ₂₄ O ₃	216.2	5390775	74367-33-2	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester
13.000	94.0	C ₁₂ H ₂₄ O ₃	216.2	4671618	74367-34-3	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester
13.500	95.5	C ₁₄ H ₂₆ O ₂	226.2	75941285	126-86-3	2,4,7,9-Tetramethyl-5-decyne-4,7-diol
14.200	82.4	C ₁₄ H ₄₂ O ₇ Si ₇	518.1	80843627	107-50-6	Cycloheptasiloxane, tetradecamethyl-
14.300	97.0	C ₁₂ H ₂₆ O	186.2	7093935	112-53-8	1-Dodecanol
16.200	88.2	C ₁₆ H ₄₈ O ₈ Si ₈	592.2	40400067	556-68-3	Cyclooctasiloxane, hexadecamethyl-
17.900	84.9	C ₁₈ H ₅₄ O ₉ Si ₉	666.2	6685545	556-71-8	Cyclononasiloxane, octadecamethyl-
19.700	80.2	C ₁₈ H ₅₄ O ₉ Si ₉	666.2	955777	556-71-8	Cyclononasiloxane, octadecamethyl-