EPA 8270 Semi-volatile Analysis on an Agilent J&W FactorFour VF-5ms GC Column

Application Note

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Introduction

U.S. Environmental Protection Agency (EPA) method 8270D, Semivolatile Organic Compounds By Gas Chromatography/Mass Spectrometry (GC/MS), is a challenging method. It describes the analysis for 240 semi-volatile organic compounds in extracts prepared from many types of solid waste matrices, soils, air sampling media and water. This method also describes different sample preparation methods for different sets of compounds.

EPA 8270 is widely used in contract laboratories and includes different compound groups, such as polycyclic aromatic hydrocarbons (PAHs), aniline and aniline derivates, phenols, and nitrosamines. These groups can be analyzed separately or can be combined for determination in a single run. In this note, an analysis of 64 compounds and six internal standards is described. The analytes are from different compound groups.

Technique:	GC/MS
Column:	J&W FactorFour VF-5ms, 30 m x 0.25 mm, df = 0.25 µm (part number CP8944)
Sample:	Concentration 1 µg/mL semi-volatile compounds, 2 µg/mL internal standards
Injection Volume:	1 µL
Temperature:	40 °C (1 min), 25 °C/min, 280 °C, 5 °C/min, 320 °C (1 min)
Carrier Gas:	Helium, constant flow, 1.2 mL/min
Injector:	250 °C, pulsed splitless
Detector:	Quadrupole MS, EI in scan mode, source 230 °C, transfer line 280 °C

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Results and Discussion

The J&W FactorFour VF-5ms column provided a semi-volatile analysis according to EPA 8270 within 18 minutes (Figure 1). Accurate quantification of all 70 compounds in a single run is quite challenging. Some compounds have similar mass spectra and are therefore difficult to resolve with MS only.

Within the PAH group three sets of compounds are difficult to resolve. The first set, benzo[b]fluoranthene and benzo[k] fluoranthene, are well known for their difficult separation. These two compounds have the same mass and therefore cannot be separated by MS alone. The same problem occurs with benz[a]anthracene and chrysene, which both have mass 228. The last PAH pair is indeno[1,2,3-c,d]pyrene and dibenz[a,h]anthracene. These compounds have different masses, 276 and 278 respectively, but are difficult to resolve with just MS.

2,4,5-Trichlorophenol and 2,4,6-trichlorophenol have exactly the same spectrum. To resolve the pairs with similar mass spectra the column phase and the optimized oven program have to be selected and designed specifically for the task, as shown in Figures 2 to 5.

Table 1. Peak Identification for Figure 1

Peak number	Compound
1	N-Nitrosodimethylamine
2	Phenol
3	Bis(2-chloroethyl)ether
4	2-Chlorophenol
5	1,3-Dichlorobenzene
6	1,4-Dichlorobenzene-D4
7	1,4-Dichlorobenzene
8	1,2-Dichlorobenzene
9	2-Methylphenol
10	Bis(2-chloroisopropyl)ether
11	4-Methylphenol
12	N-Nitrosodi-n-propylamine
13	Hexachloroethane
14	Nitrobenzene
15	Isophorone
16	2-Nitrophenol
17	2,4-Dimethylphenol
18	Bis(2-chloroethoxy)methane
19	2,4-Dichlorophenol
20	1,2,4-Trichlorobenzene
21	Naphthalene-D8
22	Naphthalene
23	4-Chloroaniline
24	Hexachlorobutadiene
25	4-Chloro-3-methylphenol
26	2-Methylnaphthalene
27	Hexachlorocyclopentadiene
28	2,4,6-Trichlorophenol
29	2,4,5-Trichlorophenol
30	2-Chloronaphthalene
31	2-Nitroaniline
32	Dimethylphthalate
33	2,6-Dinitrotoluene
34	Acenaphthylene
35	4-Nitroaniline
36	Acenaphthene-D10
37	Acenaphthene
38	2,4-Dinitrophenol
39	4-Nitrophenol
40	2,4-Dinitrotoluene
41	Dibenzofuran
42	Diethylphthalate
43	4-Chlorophenyl phenyl ether
44	Fluorene
45	3-Nitroaniline
46	2-Methyl-4,6-dinitrophenol
47	Azobenzene
48	4-Bromophenyl phenyl ether
49	Hexachlorobenzene
50	Pentachlorophenol
51	Phenanthrene-D10
52	Phenanthrene
53	Anthracene
54	Carbazole
55	Di-n-butyl phthalate
56	Fluoranthene
57	Pyrene
58	Butyl benzyl phthalate
59	Bis(2-ethylhexyl)phthalate
60	Benz[a]anthracene
61	Chrysene-D12
62	Chrysene
63	Di-n-octylphthalate
64	Benzo[b]fluoranthene
65	Benzo[k]fluoranthene
66	Benzo[a]pyrene
67	Perylene-D12
68	Indeno[1,2,3-c,d]pyrene
69	Dibenz[a,h]anthracene
70	Benzo[g,h,i]perylene

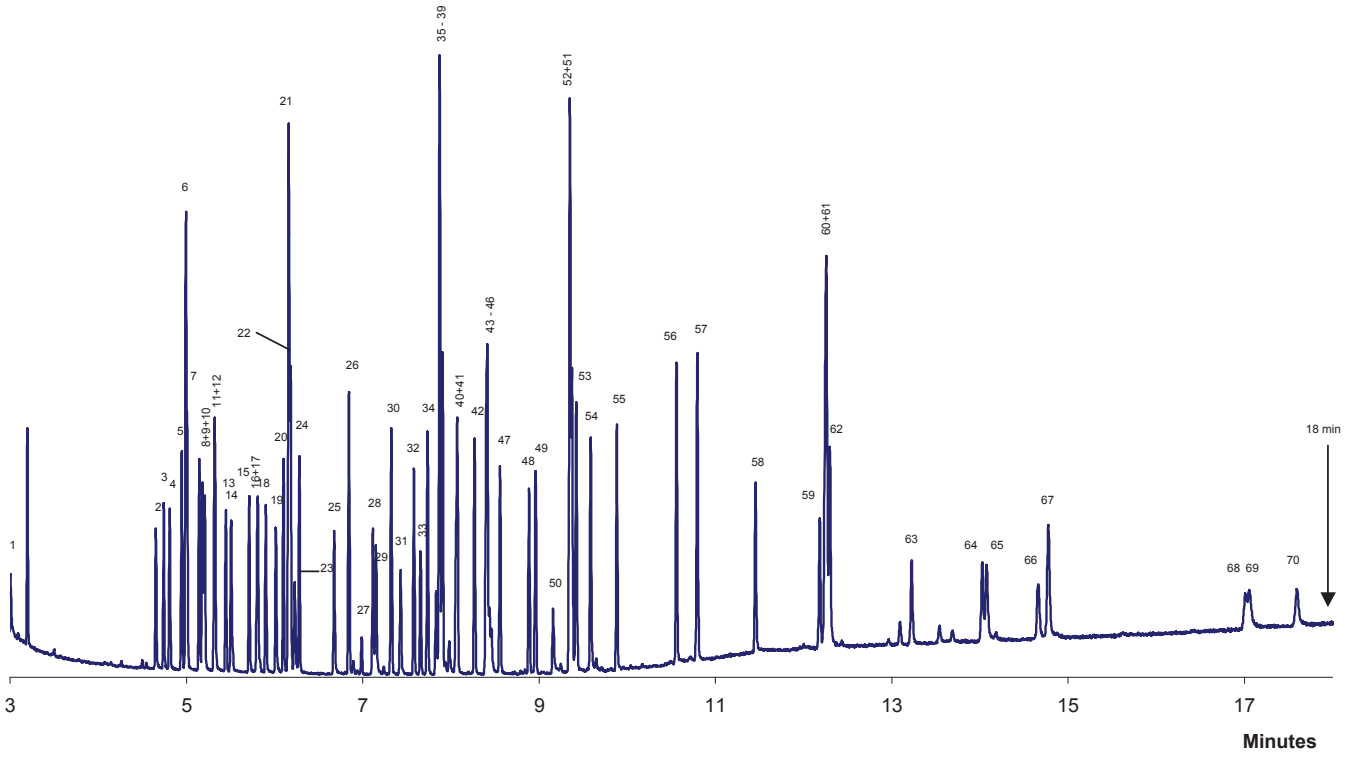

Figure 1. Total ion chromatogram EPA 8270 analysis on J&W FactorFour VF-5ms

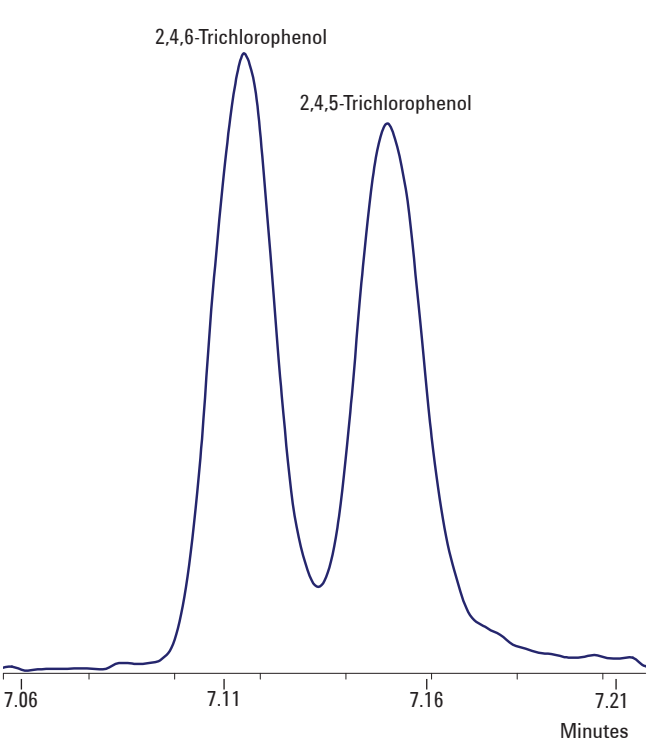

Figure 2. Zoomed total ion chromatogram of 2,4,5-trichlorophenol/2,4,6-trichlorophenol

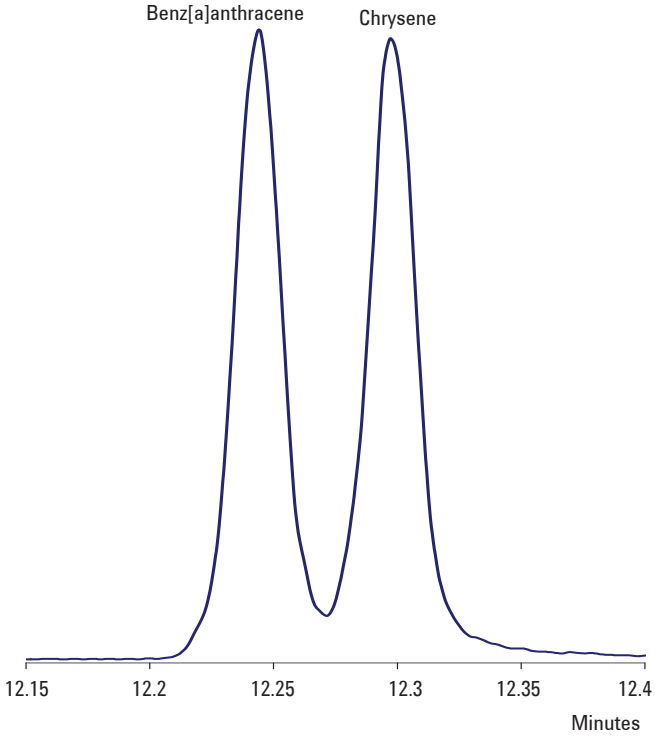

Figure 3. Selected ion chromatogram (m/z 228) of benz[a]anthracene/chrysene

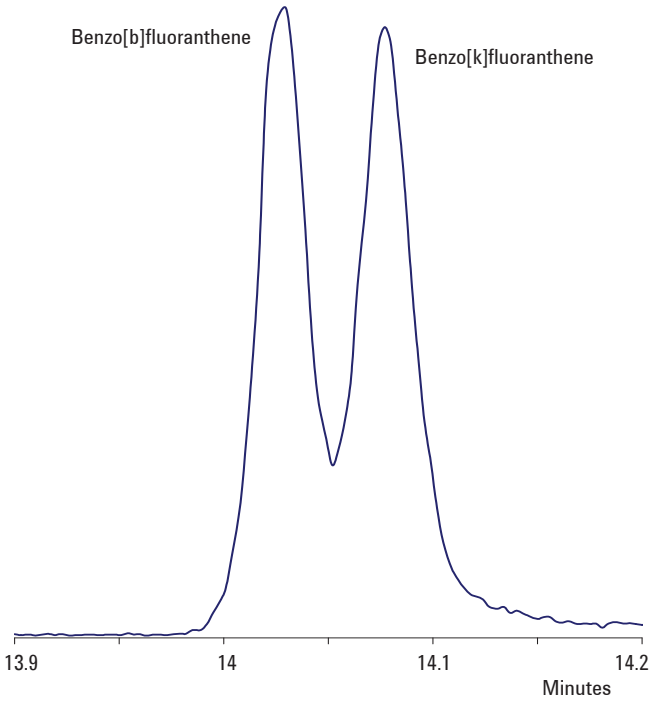

Figure 4. Selected ion chromatogram (m/z 252) of benzo[b]fluoranthene/ benzo[k]fluoranthene

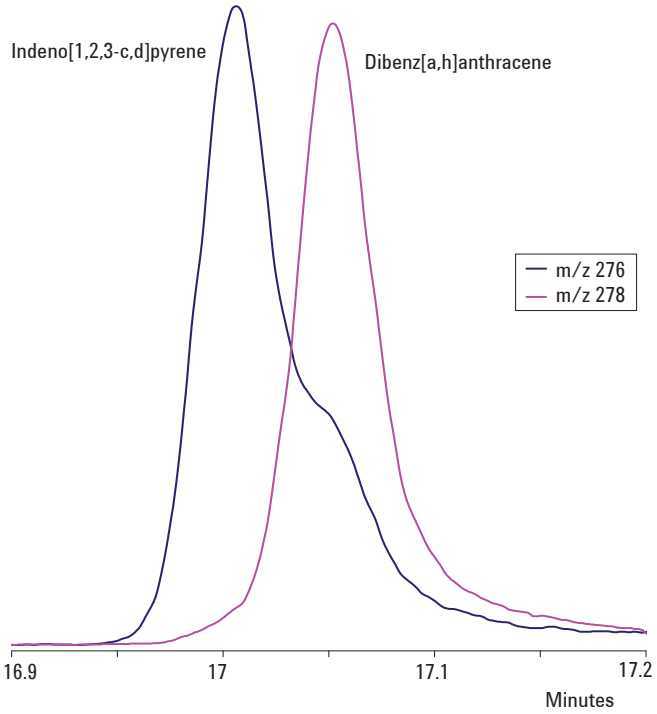

Figure 5. Selected ion chromatogram (m/z 276 and 278) of indeno[1,2,3-c,d]pyrene and dibenz[a,h]anthracene

Conclusion

The J&W FactorFour VF-5ms column and an optimized oven program separated 70 semi-volatile environmental pollutants in less than 18 minutes. The challenging requirements of EPA 8270 are well within the capability of this column.

Reference

EPA Method 8270D Semivolatile Organic Compounds By Gas Chromatography/Mass Spectrometry (GC/MS) Revision 4, February 2007. U.S. Environmental Protection Agency.

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