Fast separation of EU and EPA Regulated PAHs on Agilent J&W FactorFour VF-17ms for PAH

Application Note

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Introduction

When analyzing polycyclic aromatic hydrocarbons (PAHs) the bottleneck is the number of PAHs with the same mass. With MS detection different compounds with the same mass cannot be resolved. To resolve these PAHs the column selectivity and the oven program are very important. The Agilent FactorFour VF-17ms for PAH has perfect selectivity and optimized film thickness to analyze the PAHs, addressing the increasing need of many laboratories for improved productivity.

PAHs enclose a large group of organic compounds which contain two or more aromatic rings. Hundreds of individual PAHs can be formed during incomplete combustion or pyrolysis of organic matter, industrial processes and cooking and food processing. PAHs are therefore analyzed in food as well as environmental samples. Because of the difference in European (EU) and American (EPA) legislation, different sets of PAHs are prescribed (Table 1). The EU PAH list is used for food samples while the EPA list concerns environmental samples. This application note describes the analysis of EU and EPA PAHs in a single run, which can therefore be used for environmental as well as for food samples.

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Conditions

Technique:	GC/MS
Column:	VF-17ms for PAHs, 20 m x 0.15 mm, df = 0.05 µm (part number CP9009)
Temperature:	70 °C (0.5 min), 70 °C/min, 180 °C (1 min), 5 °C/min, 245 °C (1 min), 4 °C/min, 270 °C (1.5 min), 15 °C/min, 350 °C
Carrier Gas:	Helium, constant flow 1 mL/min
Injector:	300 °C, Splitless mode
Detector:	Quadrupole MS, EI in SIM, ion source 275 °C, transfer line 300 °C
Sample:	Concentration approx. 1 µg/mL
Injection Volume:	1 µL

Table 1. Peak Identification for Figure 1

Peak	Compound	MW	EU PAH	EPA PAH
1	Naphthalene	128		X
2	Acenaphthylene	152		X
3	Acenaphthene	154		X
4	Fluorene	166		X
5	Phenanthrene	178		X
6	Anthracene	178		X
7	Fluoranthene	202		X
8	Pyrene	202		X
9	Benzo(c)fluorene	216	X	
10	Benz(a)anthracene	228	X	X
11	Cyclopenta(c,d)pyrene	226	X	
12	Triphenylene	228		
13	Chrysene	228	X	X
14	6-Methylchrysene	242		
15	5-Methylchrysene	242	X	
16	Benzo(b)fluoranthene	252	X	X
17	Benzo(k)fluoranthene	252	X	X
18	Benzo(j)fluoranthene	252	X	
19	Benzo(a)pyrene	252	X	X
20	Indeno(1,2,3-cd)pyrene	276	X	X
21	Benzo(b)triphenylene	278		
22	Dibenz(a,h)anthracene	278	X	X
23	Benzo(g,h,i)perylene	276	X	X
24	Dibenzo(a,l)pyrene	302	X	
25	Dibenzo(a,e)pyrene	302	X	
26	Dibenzo(a,i)pyrene	302	X	
27	Dibenzo(a,h)pyrene	302	X	

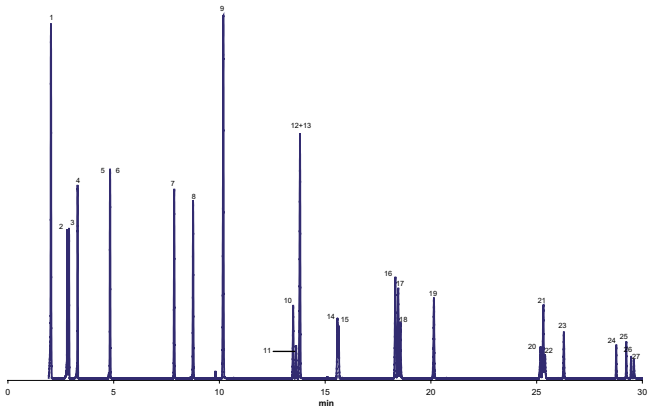

Figure 1. GC/MS analysis of EU and EPA PAHs on VF-17ms 20 m x 0.15 mm x 0.05 µm

Results and Discussion

When analyzing PAHs some peak groups are difficult to resolve on the MS because of their identical mass. One of the groups, Benz(a)anthracene, Cyclopenta(c,d)pyrene, Chrysene and Triphenylene, has compounds with different masses, but the difference between these masses, m/z 226 and 228, is difficult to distinguish with MS. Therefore these compounds should be resolved chromatographically (Figure 2). The same problem occurs when resolving Indendo(1,2,3-cd)pyrene, Benzo(b)triphenylene and Dibenz(a,h)anthracene with m/z 276 and 278 (Figure 4).

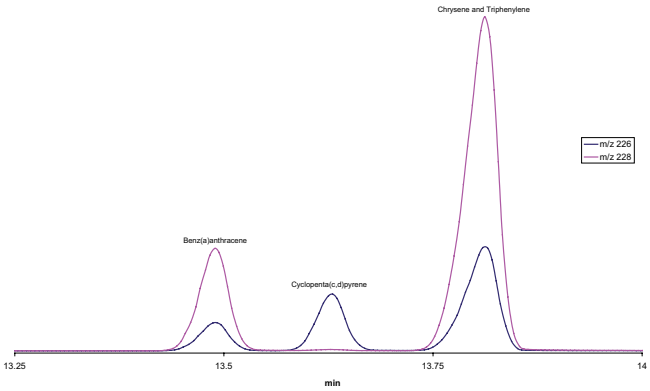

Figure 2. Separation of m/z 226 and 228

In the other difficult group, the Benzofluoranthene isomers, all three compounds have the same mass (m/z 252). With most analyses, Benzo(b)fluoranthene and Benzo(k)fluoranthene are not resolved very well. However, in this analysis, not only are Benzo(b)fluoranthene and Benzo(k)fluoranthene fully resolved, but also Benzo(j)fluoranthene (Figure 3).

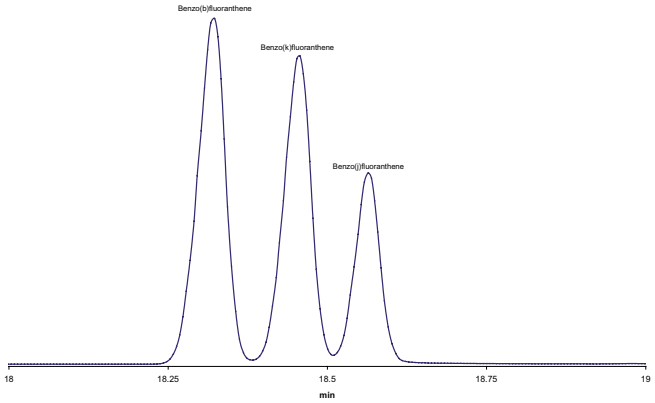

Figure 3. Separation of Benzofluoranthene isomers (m/z 252)

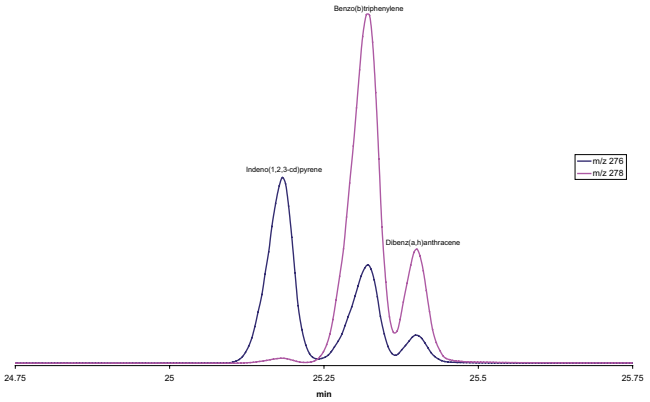

Figure 4. Separation of m/z 276 and 278

Conclusion

In this application note the EU and EPA regulated PAHs are perfectly separated using the VF-17ms for PAH in less than 30 minutes. With the optimized oven program the difficult groups are nearly baseline resolved. However, it should be noted that Triphenylene, which is not listed in either EPA or EU lists, can cause a false positive because of its co-elution with Chrysene.

References

Report Joint FAO/Who Expert Committee on Food Additives, Sixty-fourth meeting, Rome, 8-17 February 2005.

Polycyclic Aromatic Hydrocarbons (PAHs) factsheet, European Commission, Joint Research Centre, Institute for Reference Materials and Measurements.

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Published in UK, October 08, 2010
SI-02125

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