Application Note

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Fast Separation of 16 US EPA 610 Regulated PAHs on Agilent J&W Select PAH GC Columns

Author

John Oostdijk
Agilent Technologies, Inc.

Introduction

Polycyclic aromatic hydrocarbons (PAHs) are compounds that contain two or more aromatic rings. They are formed during incomplete combustion or pyrolysis of organic matter, industrial processes, and cooking and food processing. PAHs are therefore analyzed in environmental and food samples. The difficulty in determining PAHs is that several of their isomers have the same mass. This makes the separation of PAHs with GC/MS rather difficult, and so column selectivity and an optimized oven program are necessary for their resolution. This application note describes the interference-free analysis of 16 PAHs listed in EPA 610 using the Agilent J&W Select PAH GC column.

Conditions

Parameter	Value
Technique	GC/MS, Triple Quad
Column	Agilent J&W Select PAH, 30 m × 0.25 mm, 0.15 µm (p/n CP7462)
Sample	SRM 1647c, concentration appr. 0.8 to 21 µg/mL (www.nist.com)
Injection Volume	1 µL
Temperature	70 °C (0.80 minutes), 60 °C/min to 180 °C, 20 °C/min to 350 °C (5 minutes)
Carrier Gas	Helium, constant flow 2.0 mL/min
Injector	300 °C, Splitless mode, 0.75 minutes at 50 mL/min
Detector	Triple Quad, EI in SIM mode, ion source 275 °C, transfer line 300 °C

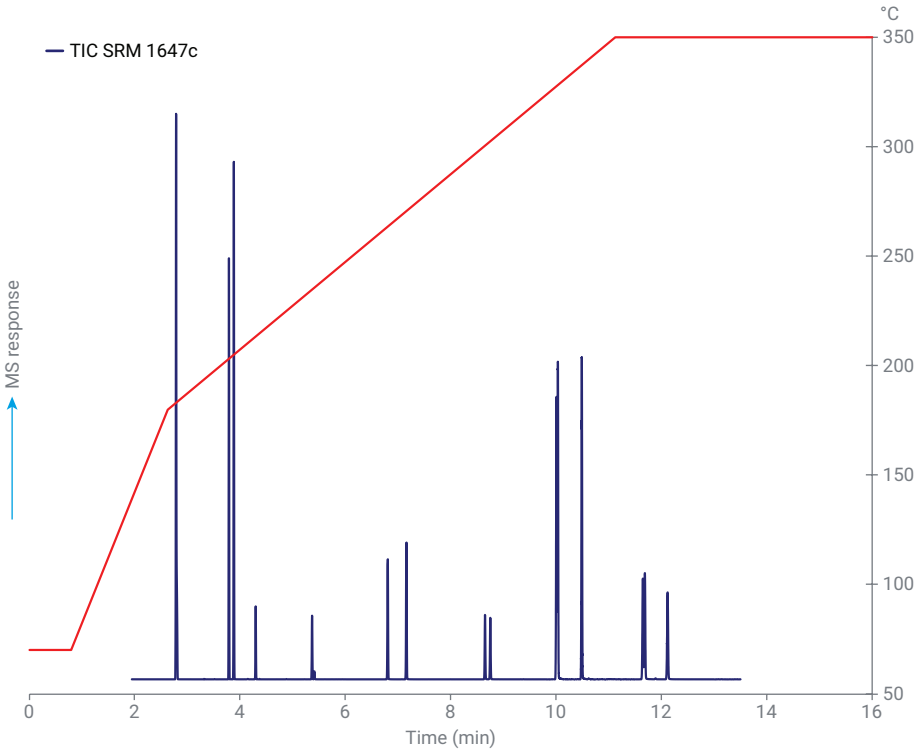

Figure 1. Fast GC/MS analysis of 16 US EPA PAHs on an Agilent Select PAH, 30 m × 0.25 mm, 0.15 µm

Results and discussion

When performing this analysis, the conditions are optimized to give a fast separation of the 16 EPA PAHs. The most important isomers to resolve are phenanthrene and anthracene (*m/z* 178), benzo[b and k]fluoranthene (*m/z* 252), and indeno[1,2,3-c,d]pyrene and dibenz[a,h]anthracene with *m/z* 276 and 278. These compounds are all resolved by the Select PAH column, as shown in Figure 1. Figures 2 and 3 provide detailed information on the 16 EPA PAHs.

Table 1. Peak identification for Figure 1.

Peak	MW	Compound	CAS
1	128	Naphthalene	91-20-3
2	152	Acenaphthylene	208-96-8
3	154	Acenaphthene	83-32-9
4	166	Fluorene	86-73-7
5	178	Phenanthrene	85-01-8
6	178	Anthracene	120-12-7
7	202	Fluoranthene	206-44-0
8	202	Pyrene	129-00-0
9	228	Benz[a]anthracene	56-55-3
10	228	Chrysene	218-01-9
11	252	Benzo[b]fluoranthene	205-99-2
12	252	Benzo[k]fluoranthene	207-08-9
13	252	Benzo[a]pyrene	50-32-8
14	278	Dibenz[a,h]anthracene	53-70-3
15	276	Indeno[1,2,3-c,d]pyrene	193-39-5
16	276	Benzo[g,h,i]perylene	191-24-2

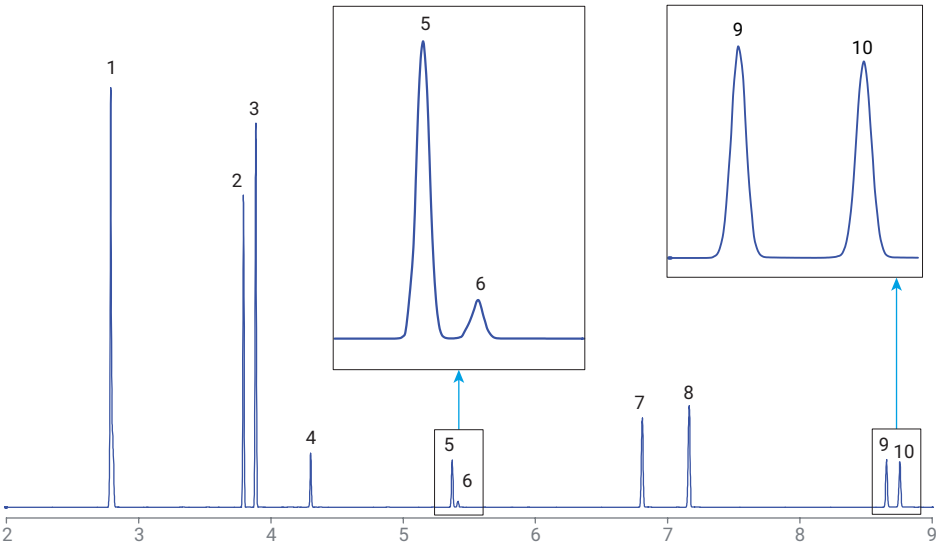

Figure 2. Details and identification of PAH peaks 1 to 10.

Table 2. Peak identification for Figure 2.

Peak	MW	Compound	CAS
1	128	Naphthalene	91-20-3
2	152	Acenaphthylene	208-96-8
3	154	Acenaphthene	83-32-9
4	166	Fluorene	86-73-7
5	178	Phenanthrene	85-01-8
6	178	Anthracene	120-12-7
7	202	Fluoranthene	206-44-0
8	202	Pyrene	129-00-0
9	228	Benz[a]anthracene	56-55-3
10	228	Chrysene	218-01-9

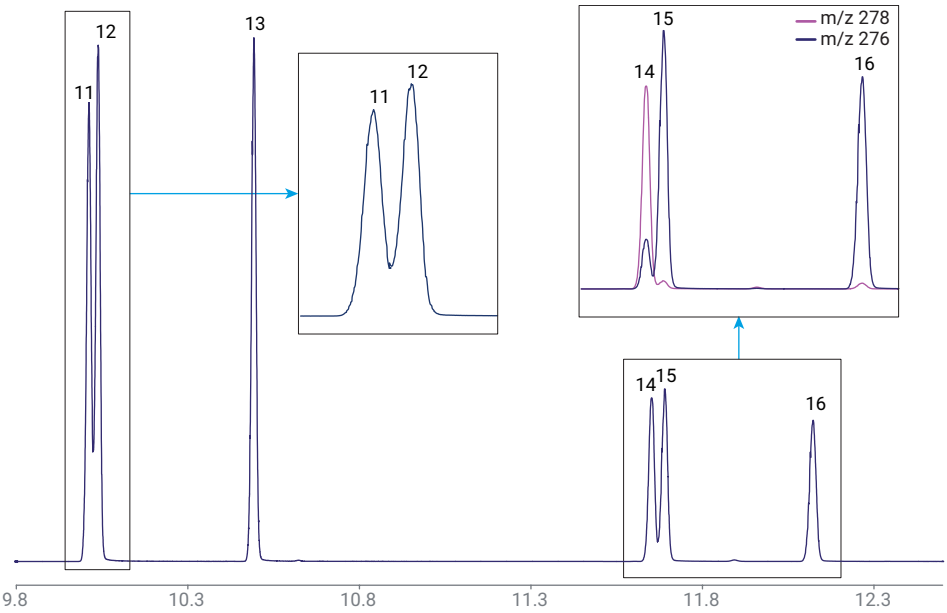

Figure 3. Details and identification of PAH peaks 11 to 16.

Table 3. Peak identification for Figure 3.

Peak	MW	Compound	CAS
11	252	Benzo[b]fluoranthene	205-99-2
12	252	Benzo[k]fluoranthene	207-08-9
13	252	Benzo[a]pyrene	50-32-8
14	278	Dibenz[a,h]anthracene	53-70-3
15	276	Indeno[1,2,3-c,d]pyrene	193-39-5
16	276	Benzo[g,h,i]perylene	191-24-2

Conclusion

Both GC column phase and oven program affect the separation of difficult to resolve PAH sets. With the optimized oven program described here, all 16 EPA PAHs are resolved in a single run with a runtime of less than 13 minutes. The Select PAH column also offers enhanced resolution of PAHs, preventing coelution of interfering PAHs that can cause false positives and inaccurate results. Typical interferences are triphenylene on chrysene, and benzo[j]fluoranthene on benzo[k]fluoranthene. Application note SI-02232 describes the separation of 54 PAHs, including the 16 EPA PAHs and their interferences.

References

1. Anon. Report Joint FAO/Who Expert Committee on Food Additives, Sixty-fourth meeting, Rome, 8–17 February **2005**.
2. Bordajandi, L. R. *et al.* Optimisation of the GC-MS conditions for the determination of the 15 EU foodstuff priority polycyclic aromatic hydrocarbons. *J. Sep. Sci.* **2008**, *31*, 1769–1778.
3. EPA Appendix A to Part 136 Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater. Method 610—Polynuclear Aromatic Hydrocarbons. *US Environmental Protection Agency*, Washington DC, **1984**.
4. Lerda, D. Polycyclic Aromatic Hydrocarbons (PAHs) Factsheet, **2009**.
5. European Commission, Joint Research Centre, Institute for Reference Materials and Measurements, JRC 500871.
6. Poster, D. L. *et al.* Analysis of Polycyclic Aromatic Hydrocarbons (PAHs) in Environmental Samples: a Critical Review of Gas Chromatographic (GC) Methods. *Anal. Bioanal. Chem*. **2006**, *386*, 859–881.
7. Fast Separation of EU and US EPA Regulated PAHs on Agilent J&W Select PAH. *Agilent Technologies Application Note*, publication number SI-02259, **2009**. www.agilent.com
8. Ziegenhals, K. *et al.* Fast-GC/HRMS to quantify the EU priority PAH, *J. Sep. Sci.* **2008**, *31*, 1779–1786.

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