Analysis of 18 Polycyclic Aromatic Hydrocarbons (PAHs) Using a Hypersil Green PAH Column

Eilidh MacRitchie, Thermo Fisher Scientific, Runcorn, Cheshire, UK

Key Words

Polycyclic aromatic hydrocarbons (PAHs), Hypersil Green PAH, environmental, EPA Method 610, benzo[e]pyrene, benzo[j]fluoranthene

Abstract

This application note demonstrates the use of the Thermo Scientific Hypersil Green PAH HPLC column for the separation of 18 PAHs.

Introduction

Polycyclic aromatic hydrocarbons (PAHs) are compounds that consist of two or more fused aromatic rings. They can be produced naturally in the environment by volcanoes and forest fires. However, most PAHs present in the air are due to man-made sources such as incomplete combustion of fossil fuels and waste incineration. PAHs are known as priority pollutants and can accumulate in soil and sediment. As some PAHs are known carcinogens, they are monitored by environmental agencies. The United States Environmental Protection Agency (EPA) has developed Method 610 to target 16 common PAHs.

Thermo Scientific Hypersil Green PAH columns are optimized for EPA Method 610. These columns contain specially tailored alkyl bonded silica with a high carbon loading, which is designed specifically for the analysis of PAHs.

Some European health agencies are now extending the number of PAHs monitored to include benzo[e]pyrene and benzo[j]fluoranthene. Due to their proximity to benzo[b]fluoranthene, a method with sufficient resolution to separate these compounds is needed.

This application note demonstrates the separation of eighteen PAHs using the Hypersil™ Green PAH column. In particular, baseline resolution is demonstrated between benzo[e]pyrene and benzo[j]fluoranthene.

Experimental Details

Consumables	Part Number
Fisher Scientific HPLC grade water	W/0106/17
Fisher Scientific HPLC grade acetonitrile	A/0626/17
Thermo Scientific borosilicate glass vials (2 mL, 12 mm x 32 mm) with 8 mm black screw cap fitted with a silicone/PTFE seal	60180-600

Sample Preparation

A 16 PAH standard, purchased from Sigma-Aldrich®, contained 10 µg/mL of each of the following components in acetonitrile: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[a]pyrene, dibenzo[a,h]anthracene, benzo[ghi]perylene, indeno[1,2,3-cd]pyrene. Single standards of benzo[e]pyrene and benzo[j]fluoranthene were purchased from Sigma-Aldrich and spiked into the 16 PAH standard.

Separation Conditions			Part Number
Instrumentation:	Thermo Scientific Accela UHPLC System		
Column:	Hypersil Green PAH 5 µm, 150 mm x 4.6 mm		31105-154630
Measured pressure at start of method:	90 bar		
Column temperature	30 °C		
Mobile phase A:	Water		
Mobile phase B:	Acetonitrile		
Gradient:	Time (minutes)	%B	
	0.0	60	
	1.0	60	
	30.0	100	
	30.1	60	
	35.0	60	
Injection volume:	10 µL		
Flow rate:	1 mL/min		
UV detection:	225 nm		

Results

The analysis was carried out on a Hypersil Green PAH 5 µm, 150 x 4.6 mm column. The eighteen PAHs eluted in under 30 minutes (Figure 1). Baseline resolution was achieved between benzo[e]pyrene and benzo[j]fluoranthene. Replicate injections of the PAH mix showed that the Hypersil Green PAH column produced stable and reproducible results (Table 1).
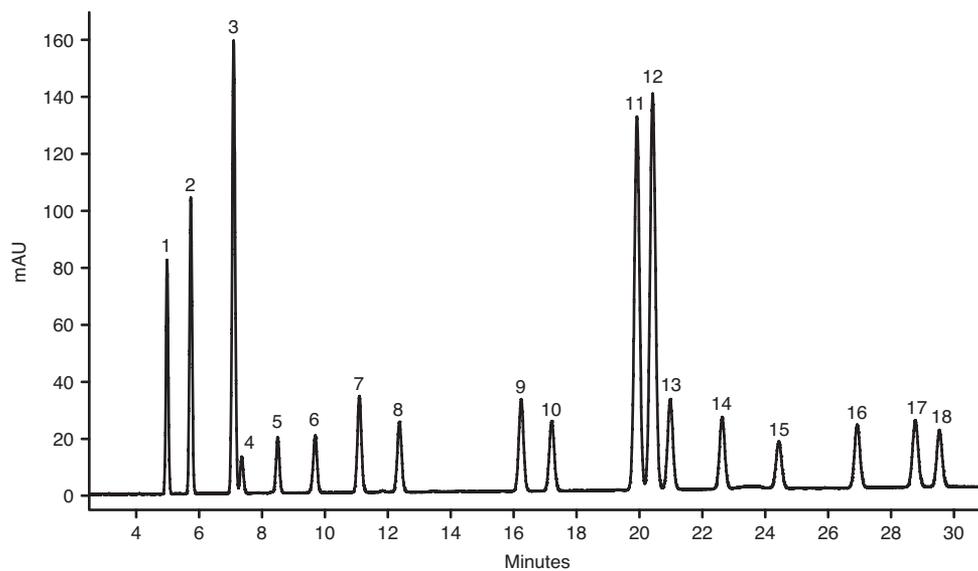

Figure 1: Chromatogram showing the separation of 18 PAHs including benzo[j]fluoranthene (11) and benzo[e]pyrene (12) on a Hypersil Green PAH 5 µm, 150 mm x 4.6 mm column

Peak #	Analyte Name	Retention Time (min)	%RSD on Retention Time	Resolution	%RSD on Resolution
1	Naphthalene	4.98	0.09	N/A	N/A
2	Acenaphthylene	5.73	0.08	5.01	1.15
3	Acenaphthene	7.09	0.07	7.09	1.07
4	Fluorene	7.35	0.05	1.37	1.28
5	Phenanthrene	8.50	0.07	5.77	0.71
6	Anthracene	9.69	0.06	5.42	1.28
7	Fluoranthene	11.09	0.06	5.87	1.01
8	Pyrene	12.36	0.05	5.03	0.73
9	Benzo[a]anthracene	16.24	0.04	13.99	0.69
10	Chrysene	17.21	0.04	3.27	0.82
11	Benzo[j]fluoranthene	19.93	0.03	8.72	0.76
12	Benzo[e]pyrene	20.43	0.02	1.55	0.74
13	Benzo[b]fluoranthene	20.99	0.02	1.72	1.05
14	Benzo[k]fluoranthene	22.64	0.02	5.16	0.78
15	Benzo[a]pyrene	24.44	0.02	5.48	0.96
16	Dibenzo[a,h]anthracene	26.93	0.02	7.37	0.93
17	Benzo[g,h,i]perylene	28.78	0.02	5.43	0.90
18	Indeno[1,2,3-cd]pyrene	29.54	0.01	2.27	0.62

Table 1: Retention time and resolution data for eighteen PAHs (data calculated from six replicate injections)

Conclusion

Eighteen PAHs were separated in approximately 30 minutes with excellent resolution. The sixteen common PAHs targeted by EPA Method 610 and two additional PAHs now being monitored by European agencies, benzo[e]pyrene and benzo[j]fluoranthene, are well resolved. As demonstrated here, the Hypersil Green PAH column is well suited for the successful analysis of PAHs.

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USA and Canada +1 800 332 3331
France +33 (0)1 60 92 48 34
Germany +49 (0) 2423 9431 20 or 21
United Kingdom +44 (0)1928 534110
Japan +81 3 5826 1615

China +86 21 68654588 +86 10 84193588 +86 20 83145199 800 810 5118
India +91 22 6742 9494 +91 27 1766 2352
Australia 1 300 735 292 (free call domestic)
New Zealand 0800 933 966 (free call domestic)
All Other Enquiries +44 (0) 1928 534 050

Technical Support
North America +1 800 332 3331
Outside North America +44 (0) 1928 534 440

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