

Rapid HPLC Analysis of PAH Compounds, Using Porous 3 μ m Particles

We compared a selective 3 μ m LC-PAH column to a nonporous 1.5 μ m NPS-C18 column to determine the best separation for polynuclear aromatic hydrocarbons (PAHs). The SUPELCOSIL LC-PAH column easily separates PAHs because of the shape selectivity of the phase. This column is less expensive to use, provides separations in half the time, and is more rugged than the 1.5 μ m column.

Key Words:

- nonporous particles • octadecylsilane phase • PAHs
- shape selectivity • HPLC

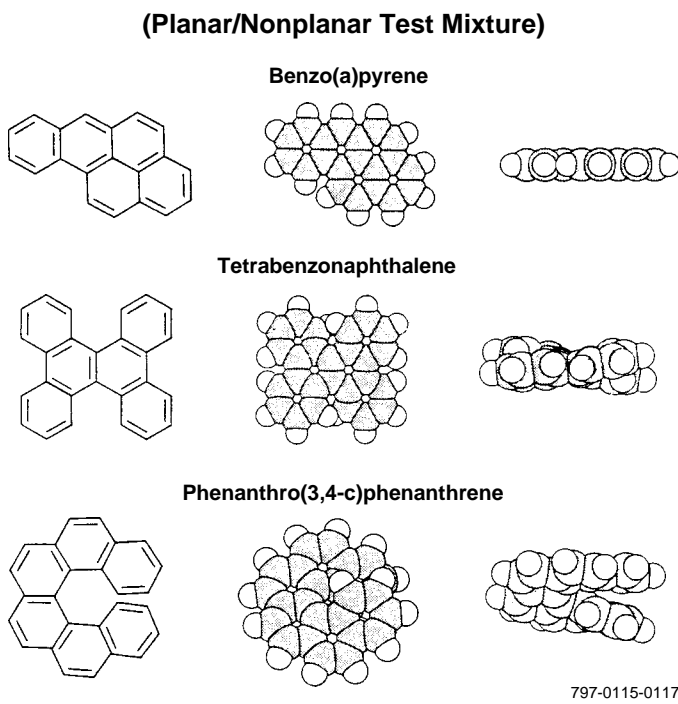
PAHs are a severe environmental hazard with a variety of sources. Air particulates, combustion products, and fossil fuels all contain these toxic aromatic substances. Analysis by gas chromatography (GC) has been problematic because GC phases do not meet the need for shape selectivity in separating PAHs (1). Conversely, high-density C18 octadecylsilane (ODS) phases for liquid chromatography (LC) have the proper bonded structure to allow this type of separation. The SUPELCOSIL™ LC-PAH column rapidly and economically separates PAH compounds.

One theory states that shape selectivity is caused by slots in the bonded phase that selectively capture PAHs. Compounds containing a high degree of planar structure are held in these slots and are retained longer than compounds with a non-planar structure (Figure A). A selective ODS phase, like that in the LC-PAH column, retains compounds in order of planarity, with the more planar molecules eluting after the non-planar compounds.

A 3 μ m SUPELCOSIL LC-PAH column was compared to a nonporous 1.5 μ m C18 column to determine the effect of particle size. Typically, decreasing the particle size of the LC packing can increase the efficiency of the column, because both the A and C term in the Van Deemter equation are proportional to particle diameter. However, there are problems associated with using the smaller, nonporous 1.5 μ m particles. The main problem is increased back pressure. Back pressure for the 1.5 μ m C18 column is more than 4000psi, at a flow rate of only 2mL/min, while the 3 μ m particles in the LC-PAH column allow flow rates greater than 3mL/min.

Other problems associated with using non-porous particles are low capacity and shorter retention. Because the particles do not have pores, total bonded phase surface area accessible to the analytes is very low. Much lower concentrations of organic component in the mobile phase are needed to significantly retain ethylbenzene on the 1.5 μ m particles, but these low percentages cause problems with sample solubility in sample preparation and during separation.

Figure A. Degree of Planarity Affects Compound Retention



A mixture of 16 PAHs were injected onto the two columns, using conditions given by the manufacturers. The 3 μ m LC-PAH column performs the separation in half the time of the 1.5 μ m C18 column, with better resolution of most components (Figure B).

The 3 μ m LC-PAH column also has a higher capacity, lower back pressure, and can function with a range of organic modifier in which satisfactory k' values are achieved. A cost comparison between the two columns shows that the LC-PAH column also is a much better value, both in the initial cost of the column and cost per analysis (Table 1).

Increasing resolution by using extremely small particles may not be the practical answer to difficult separations. The real need for good separations is met in developing phases that exhibit the proper selectivity for the desired separation, such as the high-density ODS phase used in the 3 μ m SUPELCOSIL LC-PAH column.

Figure B. Fast PAH Separation Using a 3µm SUPELCOSIL LC-PAH Column

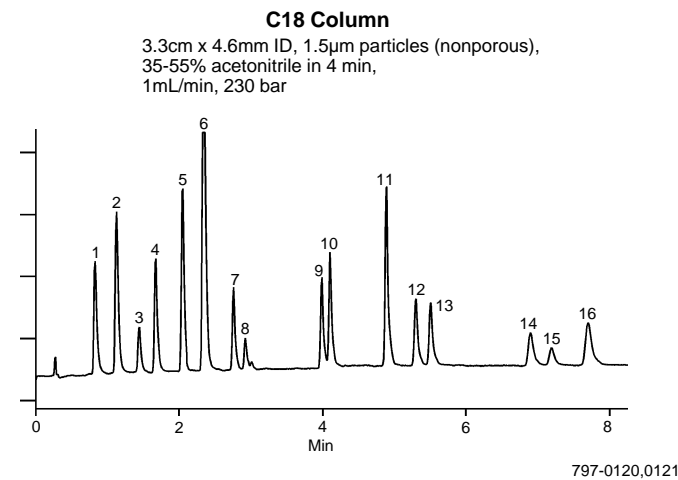
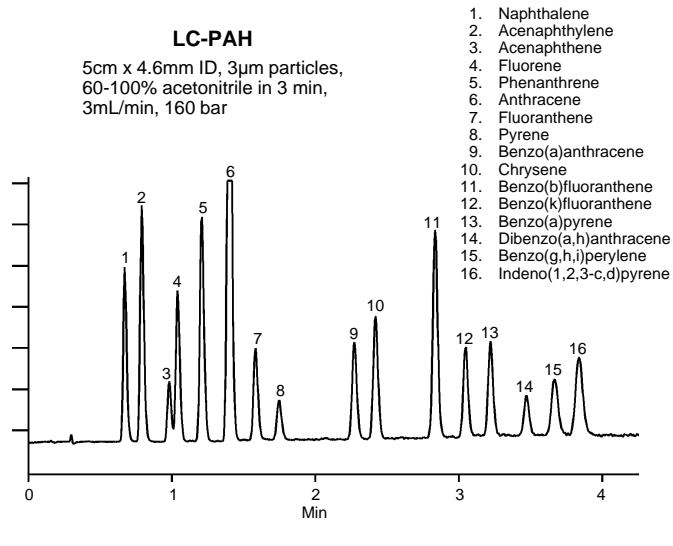


Table 1. Economy of the 3µm LC-PAH Column*

Factor	NPS-C18	SUPELCOSIL LC-PAH
Column Cost	\$800	\$280
Analysis Time	9000 min	4000 min
Labor Cost	\$7500	\$3333
Mobile Phase Used	9L	12L
Organic Solvent Used	4L	10L
Solvent Cost	\$72	\$180
Total Cost/1000 injections	\$8372	\$3793

* Based on local costs : solvent \$18/liter and labor \$50/hour.
These costs can vary.

Ordering Information:

SUPELCOSIL LC-PAH Column

5cm x 4.6mm ID, 3µm particles	59133
10cm x 4.6mm ID, 3µm particles	59134
25cm x 2.1mm ID, 5µm particles	57945
25cm x 3.0mm ID, 5µm particles	59187
15cm x 4.6mm ID, 5µm particles	58318
25cm x 4.6mm ID, 5µm particles	58229

PAH Standard

16 analytes in Figure A, in acetonitrile/methanol **49156**

Guard Columns

Kits (with holder), 2cm

4mm (for 4 and 4.6mm ID columns) **59554**

2.1mm **59612**

Replacement cartridges, pk. of 2, 2cm

4mm (for 4 and 4.6mm ID columns) **59564**

3mm **59564C30**

2.1mm **59613**

References

1. Wise, S.A., L.C. Sander, *Chromatographia*, **25**: 6 (June 1988).

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