Application Note 138

# Rapid HPLC Analysis of PAH Compounds, Using Porous 3µm Particles

*We compared a selective 3µm LC-PAH column to a nonporous 1.5µm 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 1.5µm column.*

**Key Words:**
• nonporous particles • octadecylsilane phase • PAHs
• shape selectivity • HPLC

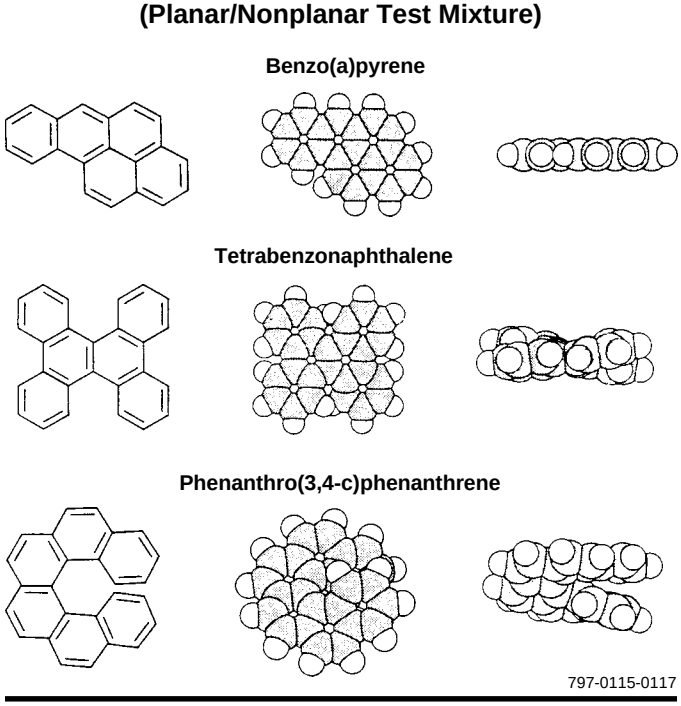
PAHs are a severe environmental hazard with a variety of sources. Air particulates, combustion products, and fossil fuels all contain these toxic aromatic substances. Analysis by gas chromatography (GC) has been problematic because GC phases do not meet the need for shape selectivity in separating PAHs (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 selectivity 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 3µm SUPELCOSIL LC-PAH column was compared to a nonporous 1.5µm 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 1.5µm particles. The main problem is increased back pressure. Back pressure for the 1.5µm C18 column is more than 4000psi, at a flow rate of only 2mL/min, while the 3µm 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 1.5µm particles, but these low percentages cause problems with sample solubility in sample preparation and during separation.

**Figure A. Degree of Planarity Affects Compound Retention**

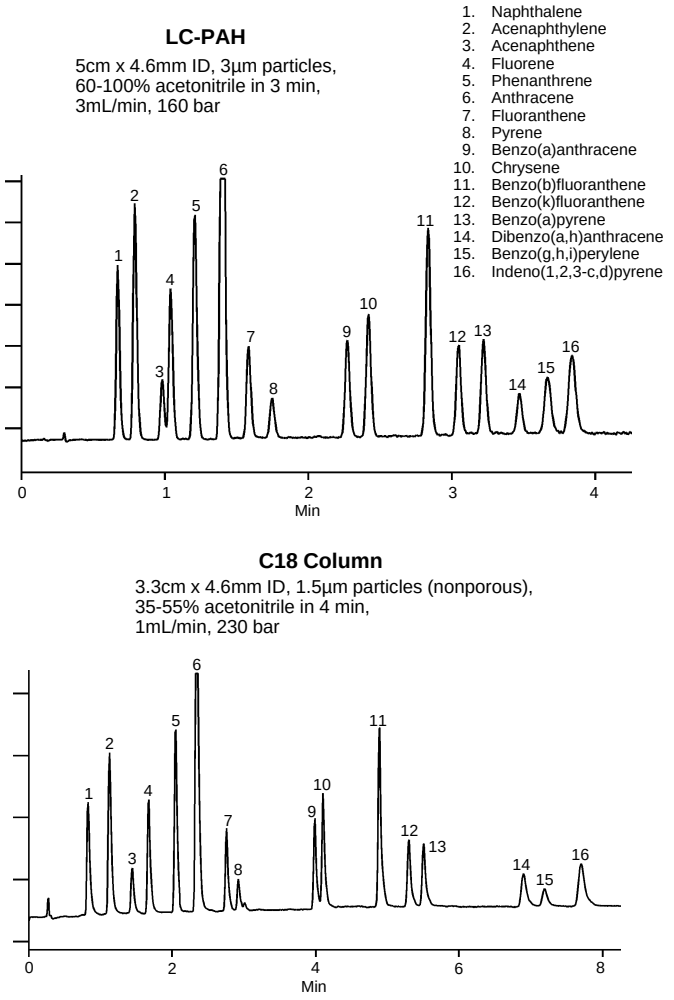



A mixture of 16 PAHs were injected onto the two columns, using conditions given by the manufacturers. The 3µm LC-PAH column performs the separation in half the time of the 1.5µm C18 column, with better resolution of most components (Figure B).

The 3µm 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 3µm SUPELCOSIL LC-PAH column.

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

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

| For 1000 Injections: 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).




Contact our Technical Service Department (phone 800-359-3041 or 814-359-3041, FAX 800-359-3044 or 814-359-5468) for expert answers to your questions.