Rapid Screening Method for PAH Samples

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This work represents the fastest screening method available for Polyaromatic Hydrocarbons (PAHs) using a conventional GC system.

Introduction

Polyaromatic Hydrocarbons (PAHs) are a class of persistent organic pollutants (POPs) that are carcinogenic and mutagenic in humans. The US Environmental Protection Agency (USEPA) regulates PAHs under methods 610 (municipal and industrial discharge) and 8100 (solid waste). Due to their potential health risk at low levels, PAH testing is required for many different types of products. This method represents the fastest published work to date using a standard GC system. It can be easily adapted to increase sample throughput while maintaining resolution, detection limits, and data quality.

Experimental Conditions

Analysis was performed using an HP 6890 Gas Chromatograph (Agilent Technologies, Palo Alto, California, USA) with flame ionization detection (FID), split/splitless injector, G2614A autosampler, and HP ChemStation software (Version A.09.01). The GC column used for analysis was a Zebron™ ZB-5ms, 10 m x 0.10 mm x 0.10 µm (Phenomenex, Inc, Torrance, CA, USA). Carrier gas was UHP grade helium.

The initial oven temperature was 100 °C, then ramped to 200 °C at 33 °C/min, and then to 320 °C at 25 °C/min. Inlet temperature was set at 320 °C with helium carrier gas flow set at 0.60 mL/min operated in constant flow mode. A 1 µL injection was made at a 20:1 split ratio of an EPA 610 mix in methylene chloride (Ultra Scientific, North Kingstown, RI). The detector temperature was set at 330 °C.

Results & Discussion

The USEPA resolution requirements were achieved in less than 8 minutes for all 17 commonly screened PAH isomers. Further shortening of the method was limited by the ramp rate of the GC system and the initial oven temperature necessary to separate naphthalene from the solvent front. Using toluene as a solvent would have allowed for a higher initial starting temperature and thus a faster run time.

Almost complete resolution of the critical benzo[b]fluoranthene and benzo[k]fluoranthene isomers was achieved using the Zebron ZB-5ms phase. The column features Arylene Matrix Technology™, which provides enhanced resolution of PAHs and other polyaromatic compounds, such as PCBs and dioxins.

This method can be easily transferred onto a GC equipped with a mass spectrometer (MS) to obtain more detailed information about the components. The Zebron ZB-5ms is a MS certified phase and showed no perceptible bleed, even at 320 °C.

Very little mass discrimination was observed for the late eluting PAH isomers, such as benzo[g,h,i]perylene. This was attributed to the high efficiency of the column combined with short analysis time. The thin film and narrow internal diameter allows for efficient mass transfer between the stationary phase and carrier gas. The high response allowed for the low detection limits required by the USEPA to be achieved.

This method can be easily implemented in any laboratory and significantly increases productivity. The narrow bore GC columns do not require any special hardware or modification to the GC system. Imagine analyzing 180 samples in a 24 hr period…don't buy a new system, optimize the one you have!

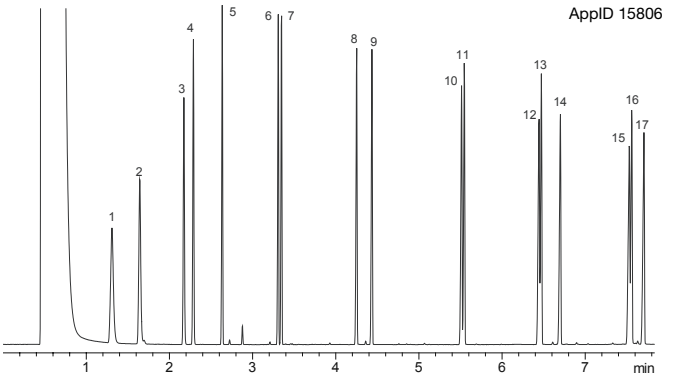

Figure 1. Separation of PAHs using Zebron™ ZB-5ms. Peaks (1) Naphthalene (2) 2-Methylnaphthalene (3) Acenaphthalene (4) Acenaphthene (5) Fluorene (6) Phenanthrene (7) Anthracene (8) Fluoranthene (9) Pyrene (10) Benz[a]anthracene (11) Chrysene (12) Benzo[b]fluoranthene (13) Benzo[k]fluoranthene (14) Benzo[a]pyrene (15) Indeno[1,2,3-cd]pyrene (16) Dibenz[a,h]anthracene (17) Benzo[g,h,i]perylene.

ORDERING INFORMATION

Part No.	Description
7CB-G010-02-TN	ZB-5ms, 10 m x 0.10 mm x 0.10 µm

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