Determination of Aromatic Hydrocarbons in Aviation Fuel with the Agilent 1260 Infinity Binary LC System with RI Detection According to IP436/ASTM D6379

Application Note

Energy & Chemicals - Petrochemicals

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Abstract
This Application Note shows that the Agilent 1260 Infinity Binary LC System is able to determine aromatic hydrocarbons in jet fuel under normal phase conditions with RI detection, and complies with the IP436/ASTM D6379 method.
**Introduction**

This test method covers the determination of mono-aromatic and di-aromatic hydrocarbon content in aviation kerosene and petroleum distillates of boiling range 50 to 300 °C, according to IP436/ASTM D6379, such as Jet A or Jet A-1 fuels and kerosene.

Accurate quantitative information on aromatic hydrocarbon types can be useful in determining the effects of petroleum processes on the production of various finished fuels. This information can also be useful for indicating the quality of fuels, and for assessing the relative combustion properties of finished fuels.

With the described instrumental setup, the determination of mono-, di-, and poly-aromatic hydrocarbons according to IP391 (2000)/ASTM D6591 and the determination of total aromatic hydrocarbons and total saturates according to ASTM D7419 are also possible.

This Application Note shows that the Agilent 1260 Infinity Binary LC system is able to determine aromatic hydrocarbons in jet fuel under normal phase conditions with RI detection, and complies with the IP436/ASTM D6379 method.

**Experimental**

**Instrument**

- Agilent 1260 Infinity Binary LC System
- Agilent 1260 Infinity Refractive Index Detector

**Column**

- Agilent ZORBAX NH2 Analytical HPLC Column 4.6 × 250 mm, 5 µm (p/n 880952-708)
- Agilent ZORBAX NH2 Guard Cartridges 4.6 × 12.5 mm (p/n 820950-908)
- Agilent High Performance ZORBAX Guard Fittings Kit (p/n 820888-901)

**Reagents**

Mobile Phase: Heptane, HPLC grade

**Standard**

- System Performance Standard (SPS) D-6379-SRS-PAK: cyclohexane (10 mg/mL), o-xylene (0.5 mg/mL), 1-methyl naphthalene (0.05 mg/mL) in n-heptane
- Calibration Standard D-6379-SET-PAK comprising standard 1 to standard 4 see table below

**Software**

Agilent OpenLAB CDS ChemStation Edition for LC and LC/MS Systems, Rev. C.01.04

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Standard 1 (mg/mL)</th>
<th>Standard 2 (mg/mL)</th>
<th>Standard 3 (mg/mL)</th>
<th>Standard 4 (mg/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cyclohexane</td>
<td>5</td>
<td>2</td>
<td>0.5</td>
<td>0.1</td>
</tr>
<tr>
<td>o-Xylene</td>
<td>15</td>
<td>5</td>
<td>1</td>
<td>0.1</td>
</tr>
<tr>
<td>1-Methyl naphtalene</td>
<td>5</td>
<td>1.0</td>
<td>0.2</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**LC method**

- Agilent 1260 Infinity Refractive Index Detector
  - Peak width > 0.2 minutes (4-second response time) (2.28 Hz)
  - Temperature 35.00 °C
- Agilent 1260 Infinity Column Compartment
  - Valve position Port 1 → 6
  - Temperature 35.00 °C
- Agilent 1260 Infinity Standard Autosampler
  - Injection volume 10.00 µL
  - Temperature 10 °C
- Agilent 1260 Infinity Binary Pump
  - Flow 1.000 mL/min
  - Stop time 15.00 minutes
  - Solvent A Heptane
Valve operation
In the 1 → 6 position, the sample is injected onto the column through the autosampler. The compounds o-xylene (mono-aromatic hydrocarbons, MAH) and 1-methyl naphthalene (di-aromatic hydrocarbons, DAH) are separated and detected. The valve can be used for the determination of MAH, DAB, and TRI+ (tri-aromatic hydrocarbons) according to IP391/ASTM D65913.

Sample preparation
Insert between 4.9 and 5.1 g, to the nearest 0.001 g, of sample into a 10-mL volumetric flask, and fill up to the mark with heptane. Shake thoroughly to mix. Allow the solution to stand for 10 minutes and filter to remove the insoluble material.

Results and Discussion
An initial experiment with the System Performance Standard (SPS) containing cyclohexane (10 mg/mL), o-xylene (0.5 mg/mL), and 1-methyl naphthalene (0.05 mg/mL) showed the separation of the saturated compound from the mono- and di-aromatic compound (Figure 2). Cyclohexane, as a model for the saturated compounds, eluted at 3.55 minutes, xylene, as a mono-aromatic compound, at 4.87 minutes, and the naphthalene derivative, as a di-aromatic compound, at 6.78 minutes.
The separation of the lowest level calibration standard containing 0.1 mg/mL o-xylene (MAH) and 0.05 mg/mL 1-methyl naphtalene (DAH) showed their clear detection by RID at the lowest concentration level (Figure 3). The calibration curves of o-xylene (MAH) and 1-methyl naphtalene (DAH) by RID detection demonstrated good linearity for quantification (Figure 4). For o-xylene, the linearity coefficient was 0.99990, and for 1-methyl naphtalene the linearity coefficient was 0.99997.

The precision performance of the system was shown for a comparable application including a valve, switching the column to backflush, to separate the analyte from the matrix. Typically, the retention time RSD was below 0.1 % and the area RSD was below 0.2 %. The typical limit-of-detection (LOD) for aromatic hydrocarbons under the used method is below 1 µg/mL (calculated for a signal-to-noise ratio of 3).

**Conclusion**

This Application Note demonstrates the use of the Agilent 1260 Infinity Binary LC System in combination with the Agilent 1260 Infinity Refractive Index Detector for the determination of MAH and DAH contaminants in aviation kerosene and petroleum distillates boiling in the range of 50 to 300 °C, according to IP436/ASTM D6379. The calibration of the RID showed excellent linearity for the range of 0.01 % to 1.5 % MAH and 0.005 % to 0.5 % DAH.

**References**


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