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Application Note SI-01363

Fast Analysis of Paraffins, iso-Paraffins, Naphthenes and Aromatics in Hydrocarbon Streams

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Introduction

The Varian PIONA+™ Analyzer was developed to provide a high level of flexibility in determining the composition by hydrocarbon group-type of spark ignition fuels through the use of multi-dimensional gas chromatography. Through the use of different columns and specially selected and optimized traps, the hydrocarbon components in the fuel sample are separated by group according to carbon number. In this application, the PIONA+ system was set up to separate normal and iso-paraffins, naphthenes and aromatics (PINA). In conventional mode, there can be breakthrough of volatile n-paraffins from the Varian CP-Molsieve™ 5A trap, which can make quantification quite difficult. Also, co-elution is possible for high C number iso-paraffins and corresponding naphthenes. In addition, the total analysis time is approximately two hours. Temperature programming of the Varian CP-Molsieve 5A trap together with the Varian CP-Molsieve 13X trap results in two large advantages.

Firstly, grouping of naphthenes, iso-paraffins and n-paraffins according to carbon number will reduce both potential sources of miscalculation. Secondly, analysis time is markedly reduced, in this application by about 40 minutes, or nearly 45 %.

Instrumentation

Varian PIONA+ Analyzer
Varian 450-GC Gas Chromatograph
PIONA+ multi column module

Software

Galaxie™ Software from Varian with PIONA+ plug-in software

Results and Discussion

Figures 1 and 2 show some of the quantification problems encountered using conventional PINA analysis.

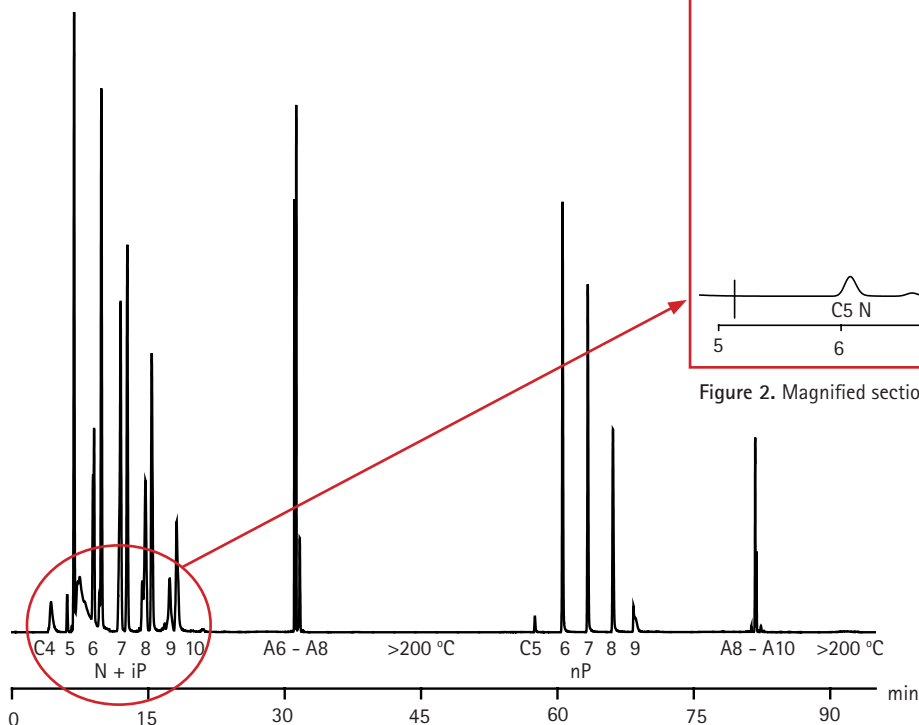


Figure 1. Chromatogram of a calibration sample CP 299107 in conventional PINA mode.

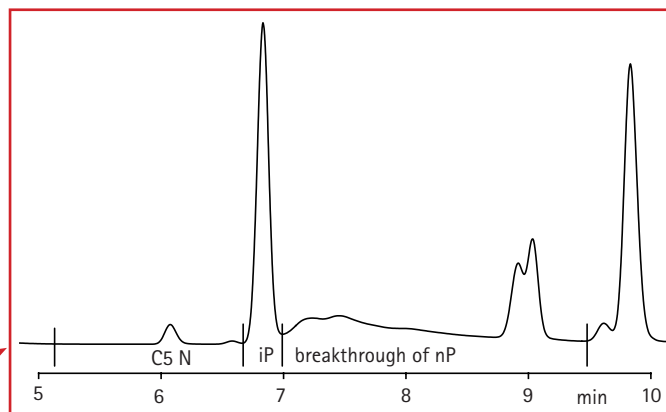


Figure 2. Magnified section from Figure 1 that is difficult to quantify.

A calibration mix was analyzed and breakthrough is apparent. The separation per component group and per carbon number is clearly shown. However, breakthrough of the volatile n-paraffins challenges the software, for example, in the case of C5 from 7 to 9.5 minutes as shown in Figure 2. This effect is particularly evident around 9 minutes when the C6 naphthene elutes.

Figures 3 and 4 clearly show the improved performance of the fast PINA system, enabling easier quantification and reduced analysis time. In the regular PINA mode analysis time is about 95 minutes. In fast PINA mode, this is reduced to 55 minutes. It is also apparent that the analysis time reduction is achieved without adaptations in hardware and without any negative effect on chromatographic separation. This means that the chromatographic specifications remain unchanged.

Conclusion

Temperature programming the CP-Molsieve 5A trap (concurrent heating) together with the CP-Molsieve 13X trap in the Varian PIONA+ Analyzer greatly extends the application range for wide samples. Quantification of volatile hydrocarbons in wide range samples is also improved. The reduction of analysis time in this example was 40 minutes, or nearly 45 %.

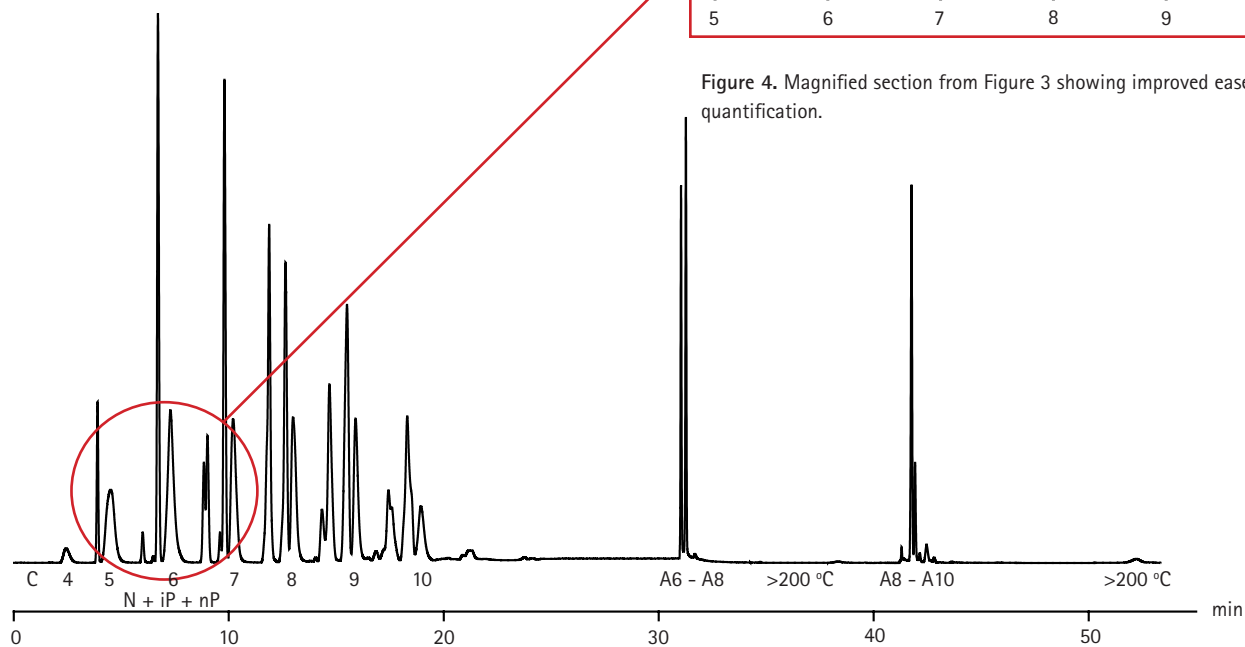


Figure 3. Chromatogram of calibration mix CP299107 in fast PINA mode.

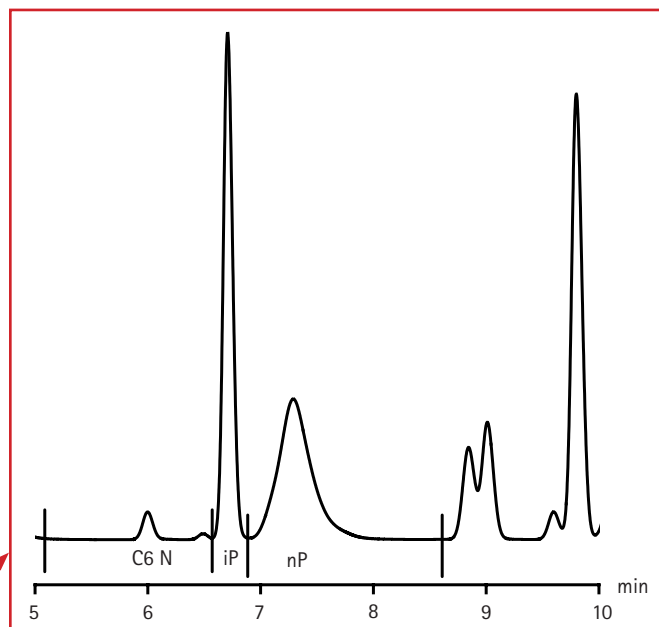


Figure 4. Magnified section from Figure 3 showing improved ease of quantification.

These data represent typical results.

For further information, contact your local Varian Sales Office.

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