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Application Note SI-01318

Paraffins, Iso-Paraffins, Naphthenes and Aromatics (PINA) in Hydrocarbon Streams

Coen Duvekot
Varian, Inc.

Introduction

This application note describes the quantitative determination of paraffins, iso-paraffins, naphthenes and aromatics (PINA) in spark ignition fuels by the multi-dimensional gas chromatography separation approach utilized in the Varian PIONA+™ GC analysis system.

The Varian PIONA+ Analyzer is a comprehensive GC system that offers the ability to characterize and quantify the components in a variety of spark ignition fuels according to an array of industry standard method protocols. The system is highly flexible and can be operated in one of multiple method modes depending on the analysis requirements for a given stream type. For this application, the system was set up to characterize the PINA content of spark ignition fuels.

Instrumentation

Varian PIONA+ Analyzer
Varian 450-GC Gas Chromatograph
PIONA+ multi column module
Galaxie™ Software from Varian with PIONA+ plug-in software

Conditions

All conditions for the different columns and traps are set in order to obtain the elution pattern outlined in Table 1.

Table 1. Elution scheme for PINA

From	To (min)	Components	Column route
0	30.0	C1 to C12 N + P	1st OV-275 fraction 13x
30.0	35.0	C6 to C8 A and PN	2nd OV-275 fraction via arom/eth to CP-Sil 5CB
35.0	40.0	>200 °C fraction	Back flush CP-Sil 5CB of 2nd OV-275 fraction
50.0	80.0	C3 to C12 nP	5A in flow to 13x
80.0	86.5	C8 to C10 A	3rd back flush OV-275 fraction via arom/eth to CP-Sil 5CB
86.5	95.0	>200 °C fraction	Back flush CP-Sil 5CB of 3rd OV-275 fraction

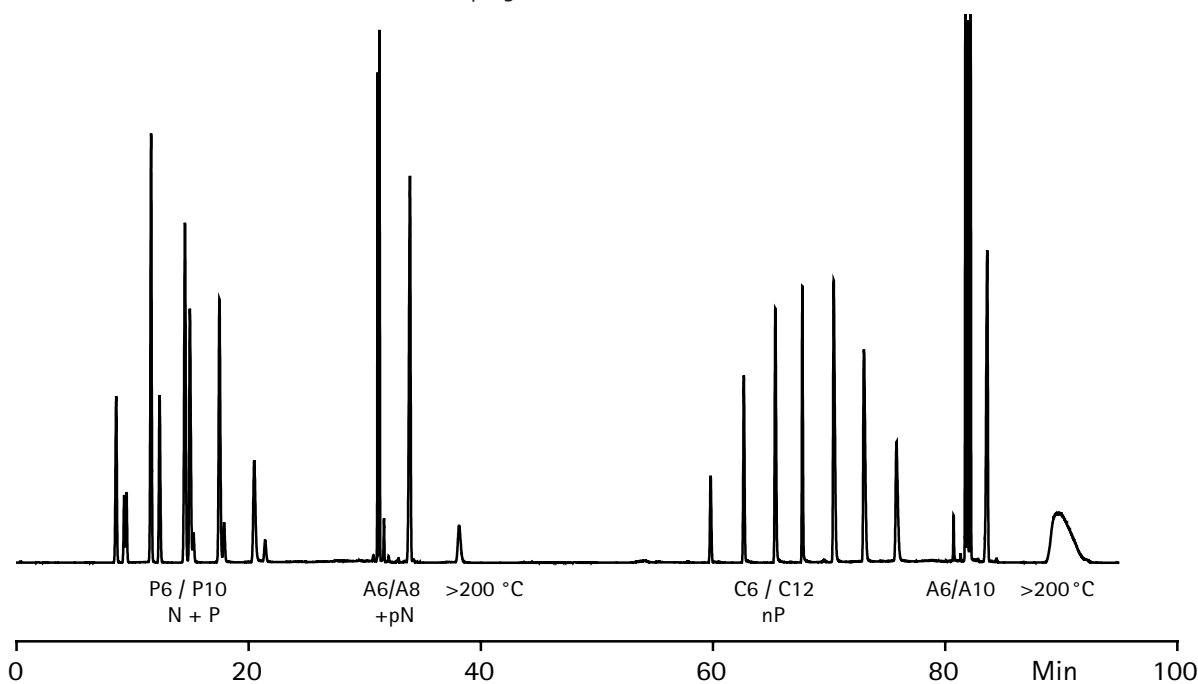


Figure 1. Chromatogram of a calibration sample CP299107.

Results and Discussion

The chromatogram in Figure 1 shows the analysis of a calibration sample CP299107. This sample is used to calibrate the analyzer. The component grouping is very clear, making identification and quantification easy and accurate. From the chromatogram the PIONA+ software generates reports. Weight% and volume% profile reports are shown in Tables 2 and 3. The paraffins, iso-paraffins, naphthenes and aromatics are grouped and reported per carbon number and as totals. Furthermore, totals per carbon number are reported.

Table 2. Weight% report of the calibration sample.

Normalized Weight Percent Profile					
Carbon	Naphthenes	Iso-Paraffins	Paraffins	Aromatics	Total
2					
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
6	2.39	1.73	1.28	2.85	8.26
7	5.66	2.55	2.59	2.90	13.70
8	5.69	4.61	3.92	10.46	24.68
9	4.57	0.69	3.00	6.76	15.01
10	2.40	0.50	5.10	5.19	13.20
11	0.00	0.01	4.24	0.00	4.25
Total	20.71	10.10	20.24	28.17	79.22
Fraction >200 °C		14.31			
Polynaphthenes		6.65			

Table 3. Volume% report of the calibration sample.

Normalized Volume Percent Profile					
Carbon	Naphthenes	Iso-Paraffins	Paraffins	Aromatics	Total
2					
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
6	2.45	2.03	1.51	2.51	8.49
7	5.80	2.88	2.92	2.58	14.15
8	5.77	5.05	4.30	9.32	24.33
9	4.55	0.73	3.20	5.98	14.39
10	2.25	0.53	5.40	4.52	12.74
11	0.00	0.02	3.92	0.00	3.93
Total	20.82	11.24	21.40	24.91	78.19
Fraction >200 °C		14.83			
Polynaphthenes		6.98			

Another example of a PINA analysis is shown in Figure 2. This chromatogram shows a reformer feed, a fairly simple sample containing hydrocarbons from C6 to C11. From this chromatogram, Galaxie software with the PIONA+ plug-in generate weight% and volume% profile reports. In this case, only the weight percent profile report is shown (Table 4). Thus, in one overview, the amounts of the different groups, naphthenes, iso-paraffins, paraffins and aromatics, are reported. In addition, the totals per group and per carbon number are displayed.

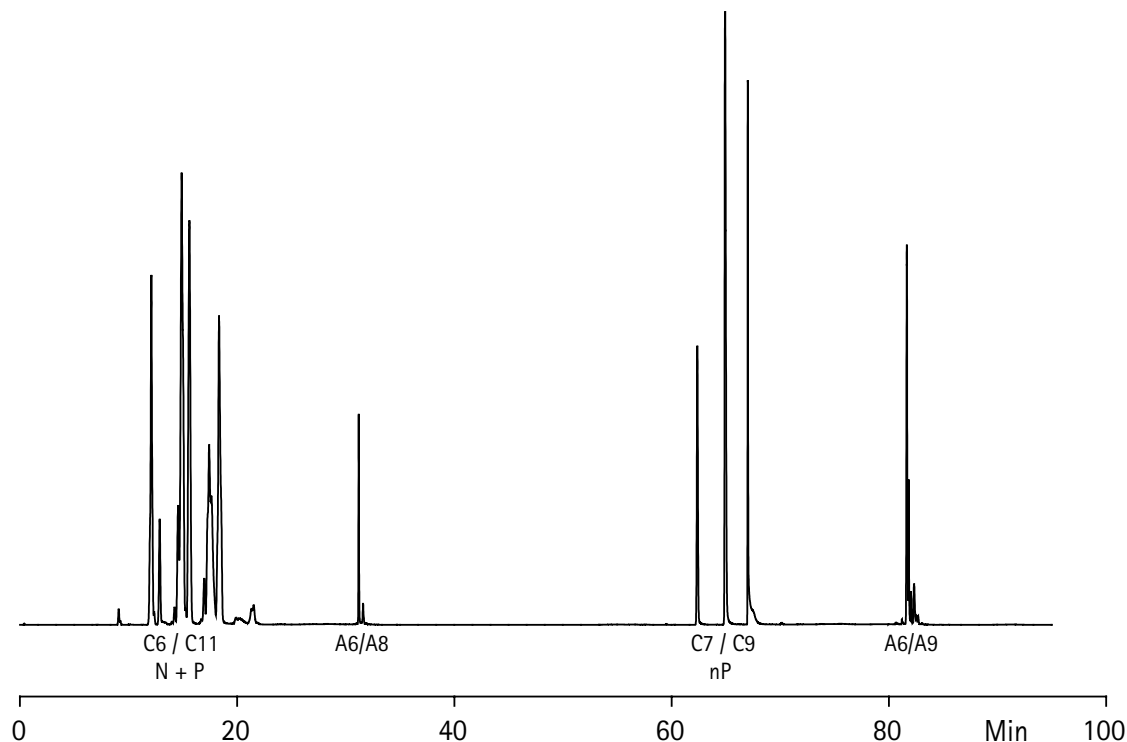


Figure 2. Chromatogram of a reformer feed.

Table 4. Weight% report of the reformer feed.

Normalized Weight Percent Profile					
Carbon	Naphthenes	Iso-Paraffins	Paraffins	Aromatics	Total
3	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00	0.00
6	0.28	0.00	0.02	0.02	0.32
7	8.33	2.30	4.57	1.71	16.90
8	19.51	12.32	11.62	5.88	49.32
9	12.29	11.50	5.70	1.32	30.80
10	0.83	0.92	0.13	0.05	1.93
11	0.00	0.09	0.09	0.00	0.19
Total	41.23	27.13	22.12	8.97	99.45
Fraction >200 °C		0.5			
Polynaphthenes		0.05			

Conclusion

The Varian PIONA+ Analyzer successfully analyzed paraffins, iso-paraffins, naphthenes and aromatics in a calibration sample and a reformer feed. The PIONA+ Analyzer provided comprehensive mass% and volume% reports.

*These data represent typical results.
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Varian, Inc.
www.varianinc.com
North America: 800.926.3000 – 925.939.2400
Europe: *The Netherlands*: 31.118.67.1000
Asia Pacific: *Australia*: 613.9560.7133
Latin America: *Brazil*: 55.11.3238.0400