

Application Note # CA-270378

Paraffins, Naphthenes and Aromatics (PNA) in Hydrocarbon Streams with the Bruker PIONA+™ Analyzer

Introduction

This application note describes the quantitative determination of paraffins, naphthenes and aromatics (PNA) in spark ignition fuels by the multi dimensional gas chromatography separation approach utilized in the Bruker PIONA+™ analyzer.

The Bruker PIONA+ Analyzer is a comprehensive GC system and 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 very flexible and can be operated in multiple method “modes” depending on the analysis requirement of a given stream type. For this particular application, the system was set up to characterize the PNA content of spark ignition fuel.

Instrumentation:
Bruker PIONA+ Analyzer

Software:
compassCDS Chromatography Software from Bruker with PIONA+ plug-in software

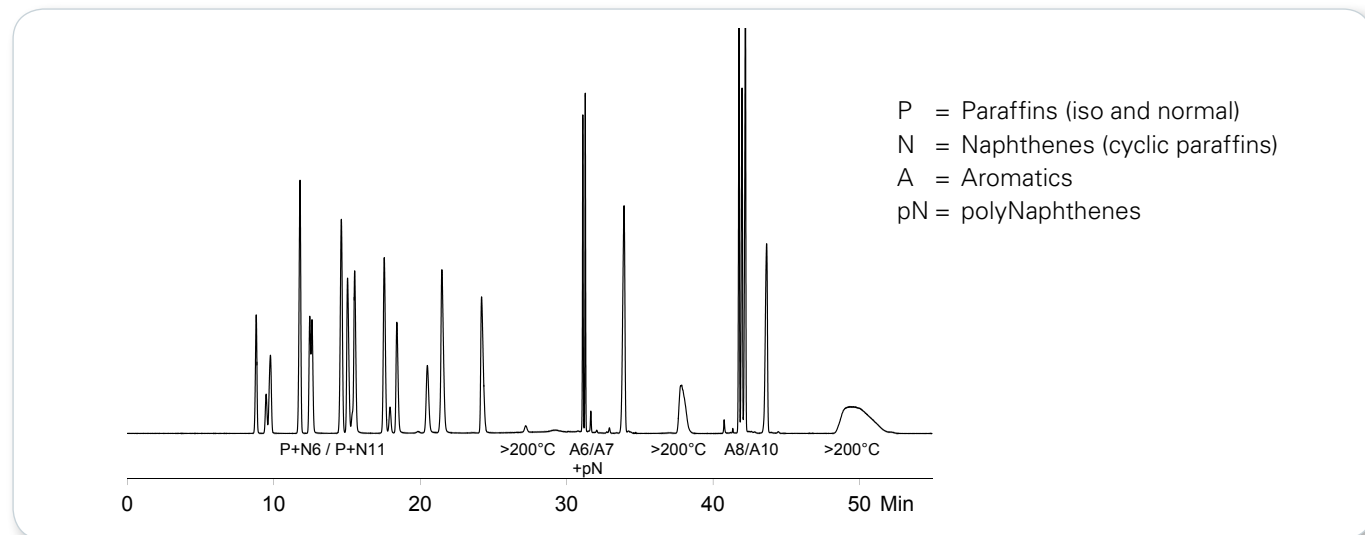
Conditions

The analysis/separation is achieved through the use of carefully chosen columns and traps. All analysis parameters are set by Bruker at the factory to achieve optimal separation for the specified analysis mode, in this case, PNA. The analysis scheme used to determine the sample’s PNA composition is detailed in Table 1.

Table 1: Elution scheme for PNA.

From	To (min)	Components	Column route
0	30.0	C1 to C12 N + P	1 st OV-275 fraction 13x
30.0	35.0	C6 to C8 A and pN	2 nd OV-275 fraction via arom/eth to non-polar column
35.0	40.0	>200 °C fraction	Back flush non-polar column of 2 nd OV-275 fraction
40.0	46.5	C8 to C10 A	3 rd back flush OV-275 fraction via arom/eth to non-polar column
46.5	55.0	>200 °C fraction	Back flush non-polar column of 3 rd OV-275 fraction

Figure 1: Chromatogram of test sample 1.



Results and discussion

A test sample was analyzed on the PIONA+ Analyzer in PNA mode. A representative chromatogram is shown in Figure 1. The Bruker PIONA+ Analyzer includes a number of report/type options. For this application, the summary by weight% and summary by volume% options were selected and examples are shown in Tables 2 and 3. The results are well within the requirements of methods, such as DIN 5148, ASTM D 5443, UOP 870 and IP 382.

In the next example, a naphtha sample was analyzed in PNA mode. A representative chromatogram is shown in Figure 2. It is apparent that, as with the first example, there is very clear group separation making identification and quantification straightforward. The weight% and volume% results by carbon number and total reports are shown in Tables 4 and 5.

Weight and volume% profile reports were generated as before. In these reports, grouping of naphthenes, paraffins and aromatics is shown per carbon number as well as the totals of the different groups and the totals per carbon number.

Conclusion

The Bruker PIONA+ Analyzer provides the required mass% and volume% reports fully in accordance with DIN 5148-1, ASTM D 5443, UOP 870 and IP 382.

Table 2: Mass% results of the calibration sample.

Normalized Weight Percent Profile				
Carbon	Naphthenes	Paraffins	Aromatics	Total
2				
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00
6	2.40	3.15	2.88	8.43
7	5.69	5.11	2.86	13.65
8	5.80	8.71	10.38	24.88
9	4.65	3.62	6.70	14.97
10	2.30	5.51	5.09	12.95
11	0.00	4.30	0.00	4.30
Total	20.89	30.39	27.91	79.18
Fraction >200 °C		14.19		
Polynaphthenes		6.63		

Table 3: Volume% results of the calibration sample.

Normalized Volume Percent Profile				
Carbon	Naphthenes	Paraffins	Aromatics	Total
2				
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00
6	2.45	3.70	2.53	8.68
7	5.80	5.76	2.55	14.11
8	5.77	9.54	9.24	24.55
9	4.55	3.86	5.93	14.34
10	2.25	5.83	4.42	12.50
11	0.00	3.97	0.00	3.97
Total	20.82	32.66	24.67	78.15
Fraction >200 °C		14.89		
Polynaphthenes		6.96		

Figure 2: Chromatogram of a naphtha sample.

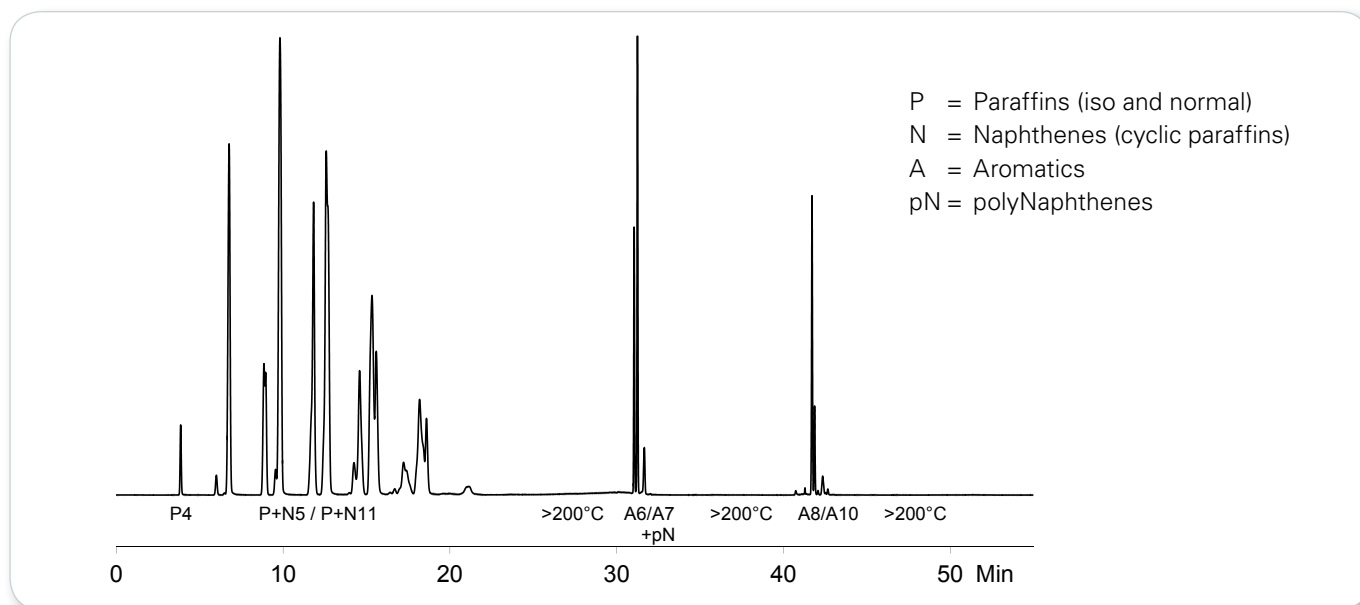


Table 4: Weight% results of the naphtha sample.

Normalized Weight Percent Profile				
Carbon	Naphthenes	Paraffins	Aromatics	Total
3	0.00	0.01	0.00	0.01
4	0.00	2.24	0.00	2.24
5	1.28	17.51	0.00	18.79
6	12.41	22.66	0.83	35.91
7	15.62	20.52	1.89	38.03
8	2.18	2.06	0.20	4.44
9	0.10	0.15	0.10	0.35
10	0.03	0.03	0.02	0.08
11	0.00	0.02	0.00	0.02
Total	31.63	65.21	3.05	99.87
Fraction >200 °C		0.11		
Polynaphthenes		0.02		

Table 5: Volume% results of the naphtha sample.

Normalized Volume Percent Profile				
Carbon	Naphthenes	Paraffins	Aromatics	Total
3	0.00	0.02	0.00	0.02
4	0.00	2.69	0.00	2.69
5	1.18	19.38	0.00	20.56
6	11.32	23.74	0.65	35.71
7	14.22	20.67	1.50	36.39
8	1.94	2.01	0.16	4.11
9	0.09	0.15	0.08	0.31
10	0.02	0.03	0.02	0.07
11	0.00	0.02	0.00	0.02
Total	28.76	68.70	2.42	99.88
Fraction >200 °C		0.10		
Polynaphthenes		0.02		

References

ASTM D 5443-04, "Paraffin, Naphthene and Aromatic Hydrocarbon Type Analysis in Petroleum Distillates Through 200°C by Multi Dimensional Gas Chromatography," ASTM International, West Conshohocken, PA, www.astm.org.

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Keywords

DIN 5148
 ASTM D 5443
 UOP 870
 IP 382
 Naphtha
 PNA mode

Instrumentation & Software

Bruker PIONA+ Analyzer
 compassCDS Chromatography software
 PIONA+ plug-in software

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