

## Analysis of Iso- and n-Paraffins, Naphthenes and Aromatics (PIPNA) in Naphtha , Reformate and Reformer feeds using Reformulyzer<sup>®</sup> M4

- **Fast Analysis in 30 minutes**
- **In compliance with key methods EN ISO 22854 and ASTM D6839**

**Keywords:**

**Reformulyzer , Group-Type Analysis, PIPNA, Reformer Feed, Reformate**



### INTRODUCTION

With the introduction of the 4<sup>th</sup> generation AC Analytical Controls (AC) Reformulyzer M4, group type analysis of gasolines and its precursors & blend streams has become easier and much faster than before.

The Reformulyzer M4 benefits from the use of capillary/Micropacked columns and traps, resulting in unprecedented speed of analysis, the widest analytical range and excellent precision. It complies with key methods EN ISO 22854 and ASTM D6839 and derived methods.

Depending on the sample stream or product, a range of analytical modes can be used, ensuring shortest possible runtimes, and data as required for that specific product. See Table 1.

This application note describes the quantitative determination of hydrocarbon types in Naphtha, Reformate and Reformer Feed streams using the AC Reformulyzer M4.

Typical Modes Used:	PNA	OPNA	PIPNA	PONA	PIONA	PIANO	OPIONA	GASOLINE	FAST GROUP TYPE	E85
Light Straight Run Naphtha	X		X			X				
Heavy Straight Run Naphtha	X		X			X				
Depentanized Bottom Reformate	X		X			X				
FCC Light/Med/Heavy Visbreaker				X	X					
Alkylate / Isomerate			X							
Gasoline Blend							X	X	X	
Gasoline w. Oxygenates		X					X	X		
E85, E20, E10										X
<b>Analysis Time</b>	<b>25</b>	<b>30</b>	<b>30</b>	<b>30</b>	<b>55</b>	<b>40</b>	<b>60</b>	<b>39</b>	<b>15</b>	<b>39</b>

Table 1: Reformulyzer M4 Analysis Modes vs Product Streams

## INSTRUMENTAL

The determination of hydrocarbon types in refinery streams is achieved by separation and elution on a series of designed traps and columns. The flow diagram for Reformulyzer M4 is shown below in Figure 1, and the analysis schedule used for this specific method is in Table 2. The Polar Column separates the Paraffins and Naphthenes from the Aromatics while Heavy Aromatics are retained on the Pre-Column. Paraffins and Naphthenes pass the 5A trap where nParaffins are trapped. Further separation of Saturates is on the 13X Column resulting in a carbon number distribution.

By using multiple valves and columns the Aromatics and PolyNaphthenes are analyzed on a Boiling Point Column in two different Aromatic fractions. Between two aromatic fractions the 5A trap is desorbed and nParaffins are separated on 13X column. The Micropacked traps and columns are located in the left side and have separate heater elements for individual temperature programming. This allows heating and/or cooling of traps simultaneous, resulting in total analysis runtime of 30 minutes.

From (min)	To (min)	Components	Column route
0	13	C4 to C11 N+iP	1 <sup>st</sup> Polar column fraction on 13X Column
13	14.5	C6 to C8 A and pN	2 <sup>nd</sup> Polar Column fraction via E/A-trap to Boiling Point Column
14.5	16	Saturates > 200°C	Backflush Boiling Point Column of 2 <sup>nd</sup> Polar Column fraction
16	26	C4 to C11 nP	Desorption of 5A trap on 13X Column
26	28	C8 to C10 A	3 <sup>rd</sup> Polar Column fraction via E/A-trap to Boiling Point Column
28	30	Aromatics > 200°C	Backflush Boiling Point Column of 3 <sup>rd</sup> Polar Column fraction

Table 2: Reformulyzer M4 PIPNA method

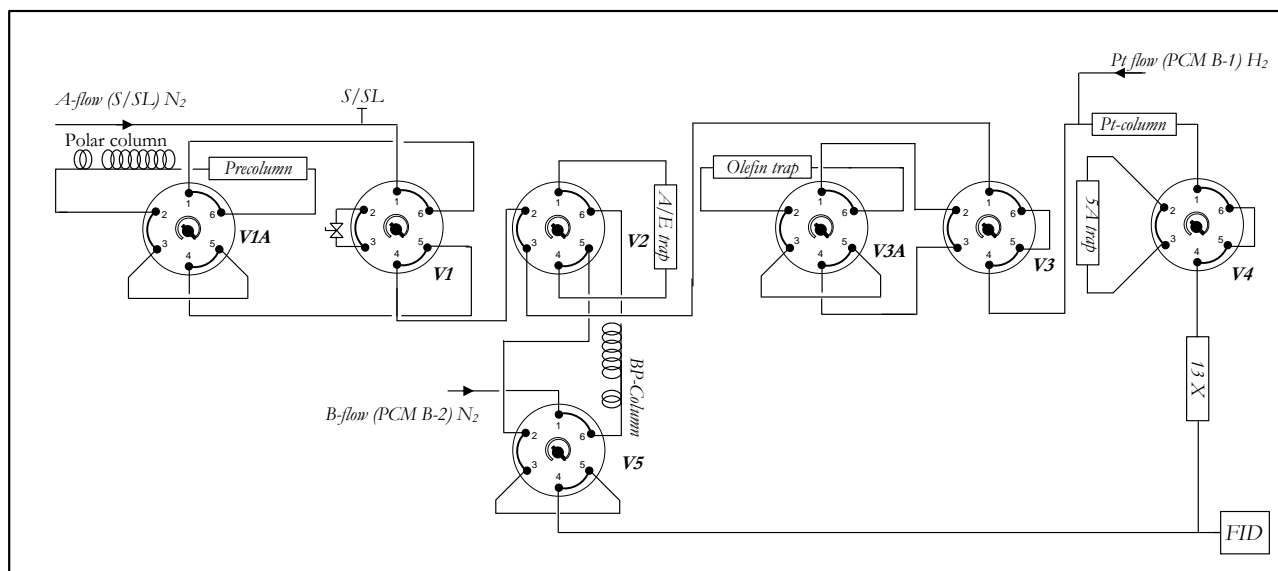


Figure 1: Reformulyzer M4 Flow Diagram

Gravimetric Blends and a Reformer Feed Certified Reference Materials (CRM) were analyzed using the Reformalyzer M4 in PIPNA mode.

Representative chromatograms are shown below and typical report outputs from the analysis for the CRM are in Tables 3 and 4. Chromatograms show clear group separations for Iso- and nParaffins, Naphthenes and Aromatics, and %Weight and %Volume by carbon numbers are well within specifications for this particular CRM.

Reported are compositions in Weight% and Volume% and list component class by carbon number as well as the totals for the different groups and the totals per carbon number

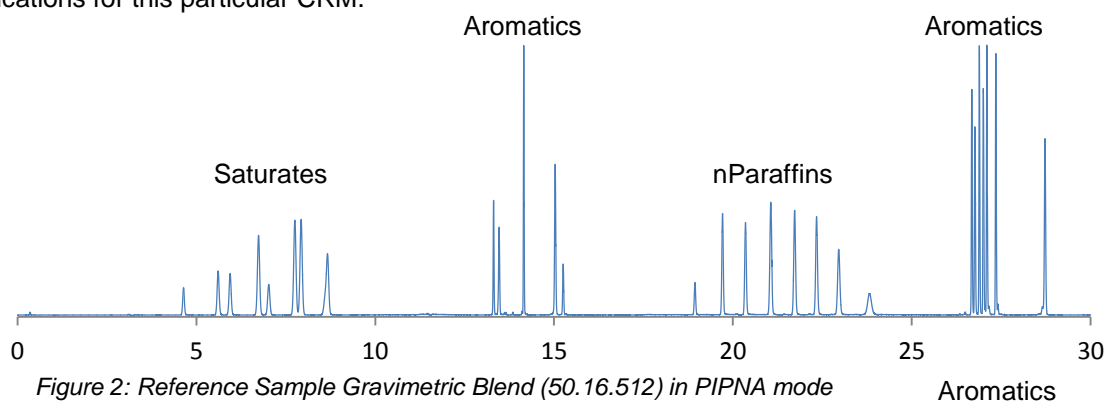


Figure 2: Reference Sample Gravimetric Blend (50.16.512) in PIPNA mode

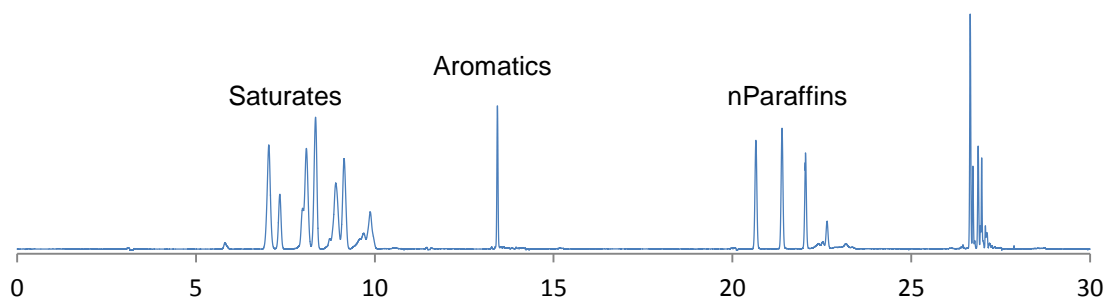


Figure 3: Reformer Feed CRM (00.02.040) in PIPNA mode

### Normalized weight percent results

Cnr	Naph.	i-Par.	n-Par.	Arom.	Total
4					
5		0.03	0.04		0.07
6	0.78	0.11	0.29	0.07	1.25
7	9.53	5.42	6.74	3.85	25.54
8	11.43	10.63	6.86	7.80	36.72
9	7.89	8.13	4.62	5.19	25.83
10	2.55	5.04	1.54	0.29	9.42
11		0.82	0.11		0.93
12+		0.03			0.03
Poly	0.23				0.23
Total	32.41	30.21	20.20	17.20	100.00

Table 3: Reporting Reformer Feed Weight%

### Normalized volume percent results

Cnr	Naph.	i-Par.	n-Par.	Arom.	Total
4					
5		0.04	0.04		0.08
6	0.78	0.12	0.33	0.06	1.29
7	9.47	5.96	7.42	3.34	26.19
8	11.08	11.36	7.35	6.77	36.56
9	7.54	8.45	4.85	4.47	25.31
10	2.37	5.19	1.58	0.24	9.38
11		0.84	0.11		0.95
12+		0.03			0.03
Poly	0.20				0.20
Total	31.44	31.99	21.68	14.88	100.00

Table 4: Reporting Reformer Feed Volume%

## CONCLUSION

The Reformulyzer M4 provides reports group type data in full accordance with key methods EN ISO 22854 and ASTM D6839.

Weight% and Volume% profile reports are generated grouping naphthenes, iso- and n-paraffins and aromatics by carbon number as well as the totals of the different groups and the totals by carbon number.

Through the use of Capillary and Micropacked columns and Traps The Reformulyzer M4 takes only 30 minutes to produce reliable results in PIPNA mode.

### Specifications

Scope / Separation Range	Finished gasoline Reformer feed Reformate Straight naphtha FCC naphtha/Olefins Isomerates Alkylate E20/E85	Paraffins C4-C11 Isoparaffins C4-C11 Olefins C4-C11 Naphthenes C5-C11 Aromatics C6-C11 Oxygenates C1-C6 (includes Methanol, Ethanol, n-Propanol, i-Propanol, t-Butanol, i-Butanol, 2-Butanol, tert-amylalcohol, MTBE, ETBE, DIPE, TAME)
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### Method Compliance

According Methods      ASTM D6839, EN-ISO22854, ASTM D5443, IP566, SH/T 0741, GB/T 28768-2012

### Ordering Information

CCG3500A	Reformulyzer M4 120V
CCG3500B	Reformulyzer M4 200V
CCG3500C	Reformulyzer M4 230V

Table 5: Reformulyzer M4 Specifications & Ordering Information

AC Analytical Controls® has been the recognized leader in chromatography analyzers for gas, naphtha and gasoline streams in crude oil refining since 1981. AC also provides technology for residuals analysis for the hydrocarbon processing industry. Applications cover the entire spectrum of petroleum, petrochemical and refinery, gas and natural gas analysis; ACs Turn-Key Application solutions include the AC Reformulyzer®, SimDis, Hi-Speed RGA and Customized instruments.