

Detailed Separation of C₁-C₅ Light Hydrocarbons on CP-Al₂O₃/Na₂SO₄ PLOT GC Column

Application Note

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Introduction

Aluminum oxide PLOT columns are specifically designed for detailed C₁-C₁₀ hydrocarbon analysis in chemical and petrochemical industries. Due to the high selectivity of CP-Al₂O₃ PLOT columns, it is possible to analyze ppm to percent levels of any C₁-C₅ impurities, including isomers, in main stream C₁-C₅ products. CP-Al₂O₃ PLOT columns offer a higher level of analytical selectivity and efficiency compared to super-thick film non-polar liquid stationary phase columns.



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The aluminum oxide column carries a sodium sulfate (Na_2SO_4) deactivation layer. The deactivation provides a reproducible and stable selectivity up to 200 °C. Sodium sulfate deactivation results in a more polar surface than potassium chloride (KCl)-treated alumina, retaining unsaturated compounds such as ethylene, acetylene (ethyne) and methyl acetylene (propyne) more strongly than their unsaturated peers.

The analysis of light hydrocarbons is performed in refinery gas, liquefied petroleum gas (LPG) and natural gas. Refinery gas is a mixture of gases generated during refinery processes used to process crude oil into various petroleum products as intermediate products or high grade end-products. The composition of refinery gas may vary. Common components include butanes, butenes (butylenes), methane, ethane and ethene (ethylene). The aluminum PLOT column offers added value in separating all of the components.

Natural gas consists of methane, light hydrocarbons such as ethane, propane and butane, and small quantities of derivatives such as carbon dioxide and nitrogen. The precise composition of natural gas may differ from region to region. LPG is a mixture of light hydrocarbons. It occurs naturally in crude oil and natural gas production fields and is also produced in the oil refining process. The main component gases of LPG are propane and butane.

The CP- $\text{Al}_2\text{O}_3/\text{Na}_2\text{SO}_4$ GC column provides separation of the main components and gives detailed quantitative data on the impurities.

This application note shows the analysis of 18 light hydrocarbons on a CP- $\text{Al}_2\text{O}_3/\text{Na}_2\text{SO}_4$ GC column.

Materials and Methods

Technique: GC-FID
 Column: CP- $\text{Al}_2\text{O}_3/\text{Na}_2\text{SO}_4$, 50 m x 0.32 mm, df=5 μm (part number CP7565)
 Temperature: 70 °C, 3 °C/min, 170 °C
 Carrier Gas: Hydrogen, constant pressure, 100 kPa (1.0 bar, 14.5 psi)
 Injection: 250 °C, split 1:50
 Detection: FID, 275 °C
 Sample: Gas mixture, for concentrations see Table 1
 Injection Volume: 5 μL

Results and Discussion

Figure 1 shows the chromatogram of the detailed analysis of 18 hydrocarbons within 20 minutes. The CP- $\text{Al}_2\text{O}_3/\text{Na}_2\text{SO}_4$ column provided very good peak shape and baseline separation. The alkynes, acetylene and propyne, show some tailing. This tailing is typical for Na_2SO_4 deactivated Al_2O_3 PLOT and is caused by the higher interaction of the polar alkynes with the polar Na_2SO_4 deactivation layer.

Table 1. Peak Identification

Peak	Compound	Concentration % (moles in He)
1	Methane	24.9
2	Ethane	5.0
3	Ethene (ethylene)	24.9
4	Propane	5.0
5	Cyclopropane	0.50
6	Propene (propylene)	5.1
7	Isobutane	0.50
8	n-Butane	1.00
9	Propadiene	0.60
10	Ethyne (acetylene)	1.01
11	<i>trans</i> -2-Butene	0.50
12	1-Butene	0.50
13	Isobutene	1.00
14	<i>cis</i> -2-Butene	0.50
15	Isopentane	0.50
16	n-Pentane	0.199
17	1,3-Butadiene	1.00
18	Propyne (methyl acetylene)	1.01

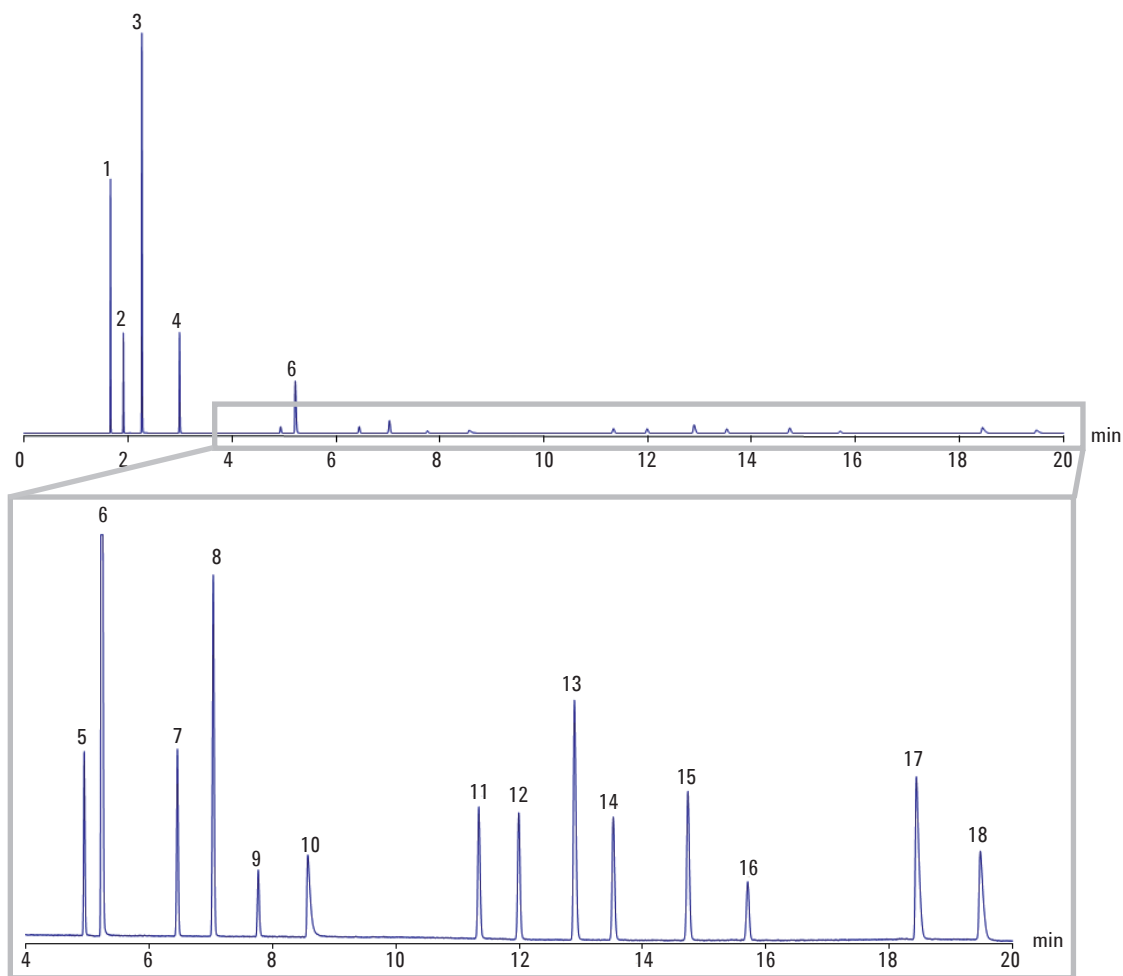


Figure 1. C_1 - C_5 hydrocarbons analyzed on a $CP-Al_2O_3/Na_2SO_4$ column

Conclusion

The $CP-Al_2O_3/Na_2SO_4$ column is very suitable for the analysis of light hydrocarbons. The sodium sulfate deactivation provides additional resolution for separating all C_4 isomers.

The robustness of the column allows temperatures up to 200 °C to be used, enabling bake-out of the column at the end of the analysis without changes in selectivity.

References

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