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Determination of mono- and polyaromatic hydrocarbons in diesel fuels with HPLC using RI detection

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SUMMARY

The content of aromatic hydrocarbons in diesel fuel has an influence on exhaust emission and its combustion characteristics. Here we present the determination of aromatic hydrocarbons under normal phase conditions with an isocratic AZURA® Analytical HPLC system and detection via refractive index detector AZURA RID 2.1L.

INTRODUCTION

It is well known that the best performance and maximum lifetime of an engine can be reached, when the amount of aromatic hydrocarbons in diesel and aviation turbine fuels is as low as possible. Since the aromatic hydrocarbon content can affect the cetane number of fuels and cause emissions due to incomplete burning, there are different regulations to protect the environment and public health. Below, we describe a method according to DIN EN 12916 [1] for the the determination of mono- and polyaromatic hydrocarbons, like 1,2-dimeth ylbenzene, fluorene, and phenanthrene in diesel fuel samples.

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RESULTS

The chromatographical results show that all three aromatic hydrocarbons in standard solutions were successfully separated under normal phase conditions and current instrumental settings. **Fig 1** shows the overlay of chromatograms from three repetitions. The standard deviation value for retention time and peak area is 0.05 % – 0.06 % and 0.09 % – 0.22 %, respectively **(Tab 2)**. The correlation factor for all compounds, obtained due analysis of three concentration levels (standard solutions A, C, and D) is > 0.9999. The corresponding overlay chromatograms are presented in **Fig 2**. In the chromatogram of the diesel fuel sample all three compounds could be identified **(Fig 3)**. The highest amount of aromatic hydrocarbons was detected for 1,2-dimethylbenzene. The calculated value is 19.26 %. The values for all three hydrocarbons are presented in **Tab 3**.

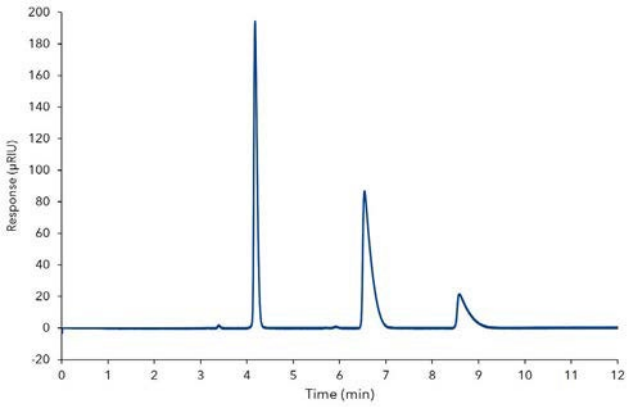


Fig. 1 Overlay chromatogram of three replicates of standard solution C

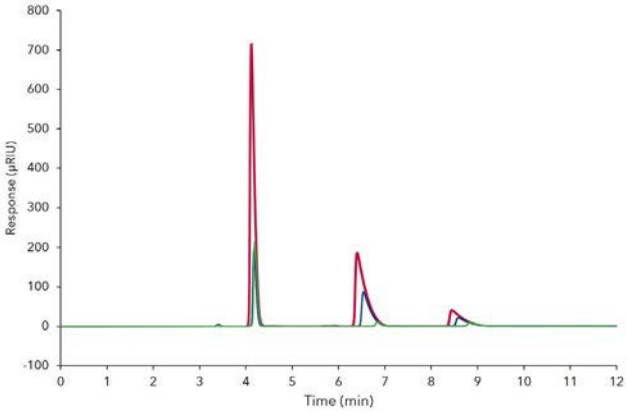


Fig. 2 Overlay chromatogram of two replicates each for standard solutions A (red), C (blue), and D (green)

Tab. 1 Amount of components in m% of standard solutions A, C, and D

Compound name	Solution A	Solution C	Solution D
1,2-Dimethylbenzene	1.515	1.348	6.557
Fluorene	0.062	0.785	2.017
Phenanthrene	0.072	0.221	0.479

Tab. 2 Reproducibility of standard solution C

Compound name	Ret. time (min)	RSD (%)	Area (µRIU·s)	RSD (%)
1,2-Dimethylbenzene	4.18	0.06	967.67	0.22
Fluorene	6.54	0.06	1067.25	0.09
Phenanthrene	8.59	0.05	355.25	0.17

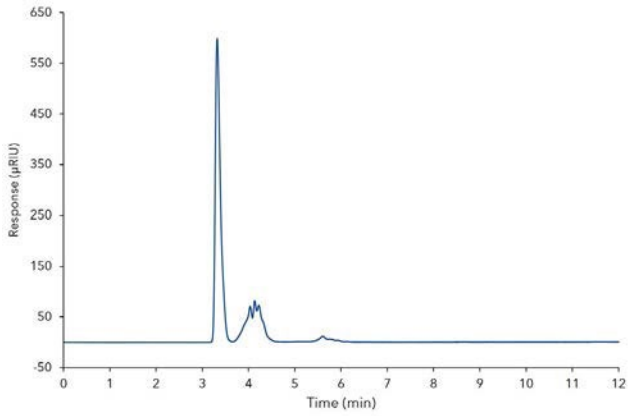


Fig. 3 Chromatogram of a diesel fuel sample

Tab. 3 Calculated amount of identified components in diesel fuel

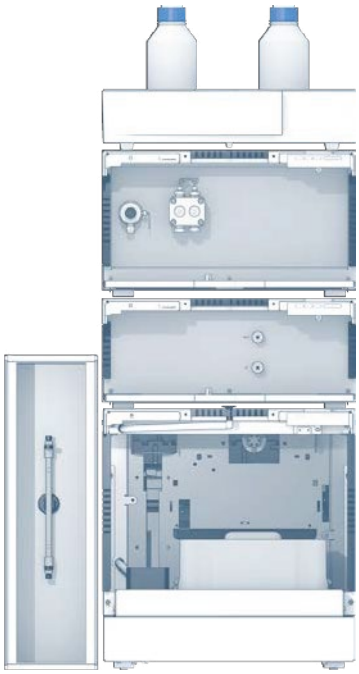
Compound name	Amount (m%)
1,2-Dimethylbenzene	19.26
Fluorene	1.53
Phenanthrene	0.04

MATERIALS AND METHODS

For the analysis of mono-, and polyaromatic hydrocarbons we used the following HPLC system setup: isocratic AZURA P6.1L pump with 10 mL pump head, AZURA AS 6.1L autosampler, AZURA RID 2.1L detector and AZURA CT 2.1L thermostat. The separation was performed on normal phase column ZORBAX®, NH2 250 x 4.6 mm. The used mobile phase was n-heptane. For calibration three concentration levels were used. The amounts of 1,2-dimethylbenzene, fluorene and phenanthrene in corresponding solutions A, C and D are presented in **Tab 1**. The samples from the respective diesel fuel batches were diluted to 10 % with n-Heptan and analyzed.

CONCLUSION

This application demonstrates, that the AZURA® isocratic analytical HPLC system in combination with AZURA RID 2.1L detector suitable for determining of mono- and polyaromatic hydrocarbons in diesel fuel according to DIN EN 12916.



REFERENCES

[1] DIN EN 12916:2016 Petroleum products – Determination of aromatic hydrocarbon types in middle distillates – High performance liquid chromatography method with refractive index detection, German version

ADDITIONAL MATERIALS AND METHODS

Tab. A1 Method parameters

Eluent	n-heptane		
Gradient	isocratic		
Flow rate	1.2 mL/min	Run time	12 min
Column temperature	25 °C	Injection mode	Full loop
Injection volume	5 µL	Data rate	10 Hz
Detection	RI		

Tab. A2 System configuration

Instrument	Description	Article No.
Pump	AZURA® P6.1L	APH30ED
Autosampler	AZURA® AS 6.1L	AAA00AA
Detector	AZURA® RID 2.1L	ADD31
Column	ZORBAX®, NH2 250 x 4.6 mm	
Thermostat	AZURA® CT 2.1	ATC00
Software	ClarityChrom 7.2	A1670-11

RELATED KNAUER APPLICATIONS

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