

Determination of Benzene in Reformulated Gasoline

Using a Supelco[®] SLB[®]-IL111 Ionic Liquid GC Column

The amount of benzene in gasoline is a concern because it is a known human carcinogen, and exposure to it has been linked to detrimental health effects. The challenge with the analysis lies in the complex composition of gasoline, which consists of hundreds of different compounds. Reformulated gasoline also contains additives to produce more complete combustion and subsequent lower emissions of harmful compounds. These additives accomplish this by boosting the oxygen content, and are commonly referred to as "oxygenates". Ethanol is a commonly used oxygenate. Therefore, to measure benzene in reformulated gasoline, it must be resolved from the C5-C11 aliphatic portion, other aromatics, ethanol, plus any internal standards. This typically requires the use of a two-column switching procedure.¹

Figure 1 shows the analysis of a reformulated gasoline sample on the SLB[®]-IL111. The extremely polar selectivity of this column resulted in the elution of benzene after the aliphatic portion, and also resolution of benzene and ethanol. Additionally, the phase stability of the SLB[®]-IL111 column exhibits a stable baseline when subjected to a temperature ramp. Because this column can be used up to 270 °C, it also allows the timely elution of the heavy aromatic constituents in gasoline. These observations indicate that the SLB[®]-IL111 may be an effective alternative to the two-column switching procedure currently required for the determination of benzene and other aromatics in reformulated gasoline.

Reference

1. ASTM D3606, Benzene and Toluene in Unleaded Gasoline and Aviation Fuel.

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|------------------------------------|--------------------------------|
| 1. C5-C11 Hydrocarbons | 9. m-Xylene |
| 2. Ethanol | 10. o-Xylene |
| 3. Benzene | 11. 1,2,4-Trimethylbenzene |
| 4. 2-Butanol (int. std.) | 12. 1,2,3-Trimethylbenzene |
| 5. Methyl ethyl ketone (int. std.) | 13. 1,2,4,5-Tetramethylbenzene |
| 6. Toluene | 14. Naphthalene |
| 7. Ethylbenzene | 15. 2-Methylnaphthalene |
| 8. p-Xylene | 16. 1-Methylnaphthalene |

Peak IDs (black = aliphatic; Purple = aromatic; Yellow = alcohol; green = int. std.)

column:	SLB [®] -IL111, 60 m x 0.25 mm I.D., 0.20 µm (28928-U)
oven:	50 °C (3 min), 15 °C/min to 265 °C (5 min)
inj. temp.:	250 °C
detector:	FID, 275 °C
carrier gas:	helium, 30 cm/sec
injection:	0.5 µL, 200:1 split
liner:	4 mm I.D., split type, single taper wool packed FocusLiner™ design
sample:	Premium unleaded gasoline, plus ethanol at 20% (v/v) and two internals each at 4% (v/v)

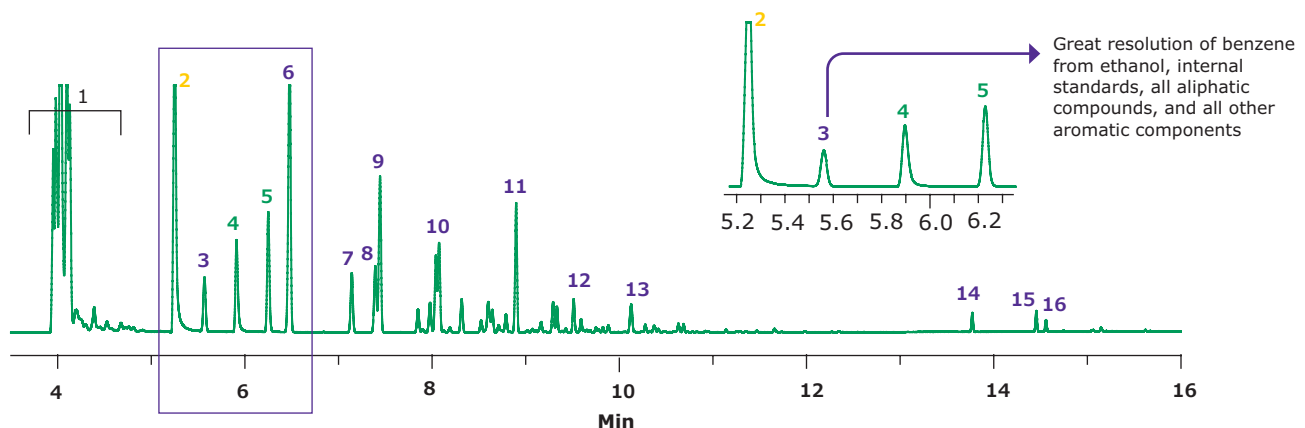


Figure 1. Gasoline with 20% Ethanol and 4% Internals on the 60 m SLB[®]-IL111

SLB®-IL111 Column Specifications

- **Application:** World's first commercial column to rate over 100 on our GC column polarity scale. Selectivity most orthogonal to non-polar and intermediate polar phases, resulting in very unique elution patterns. Maximum temperature of 270 °C is very impressive for such an extremely polar column. Great choice for separation of polarizable analytes (contain double and/or triple C-C bonds) from neutral analytes. Also a good GCxGC column choice.
- **USP Code:** None
- **Phase:** Non-bonded; 1,5-Di(2,3-dimethylimidazolium) pentane bis(trifluoromethylsulfonyl)imide
- **Temp. Limits:** 50 °C to 270 °C (isothermal or programmed)

Ordering Information

Description	Qty.	Cat. No.
SLB®-IL111 Ionic Liquid Columns		
30 m x 0.25 mm I.D., 0.20 µm	1	28927-U
60 m x 0.25 mm I.D., 0.20 µm	1	28928-U
100 m x 0.25 mm I.D., 0.20 µm	1	29647-U

To view our ionic liquid GC column resources, visit SigmaAldrich.com/il-gc

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