Strategies to contend with Helium supply shortages, including a survey of semi-volatile analyses (EPA 8270) with Helium, Hydrogen and Nitrogen

Alexis Wiley[1], Eric Fausett[1], Angela Smith-Henry[1], Bruce Quimby[1] and Anastasia Andrianova[1]
[1]Agilent Technologies Inc., Wilmington, Delaware 19808 USA

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Introduction

Strategies are needed to deal with risk associated with limited helium supply

- Helium supply shortages have been a recurring problem for analytical laboratories. Many laboratories are experiencing an existential need to reduce or even eliminate the consumption of helium.

Techniques for conserving Helium

- Use the Gas Saver function to reduce total inlet flow to 20 mL/minute
- Test gas supply lines to eliminate leaks
- Use a Helium conservation module[3] which switches to Nitrogen carrier when the GC is idle

Hydrogen carrier gas

- Hydrogen supports faster chromatography
- Hydrogen is not inert and chemical reactions can occur in the source which reduce spectral fidelity
- The HydroInert EI source has been shown to greatly reduce these chemical reactions

Nitrogen carrier gas

- Nitrogen is not expected to introduce chemical reactions in the GC/MS source
- Nitrogen offers less flexibility in column flow if resolution is to be maintained
- Previously, very little work has been available which successfully uses nitrogen carrier gas in GC/MS

Survey of SVOC experiments with He, H_2 and Nitrogen

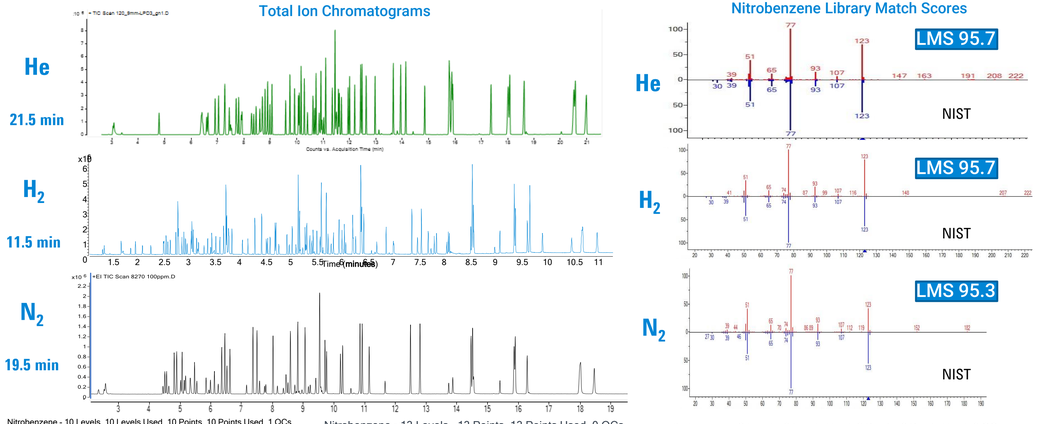
- This is a compilation of 3 separate experiments to compare results using Helium, Hydrogen and Nitrogen
- No manual tuning was required for Nitrogen when the flow rate was kept below 0.4 mL/min
- The Hydrogen work contained many extra compounds to test the HydroInert source with a wide variety of complex analytes.

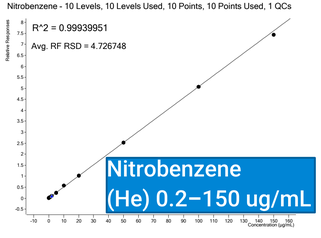
Experimental

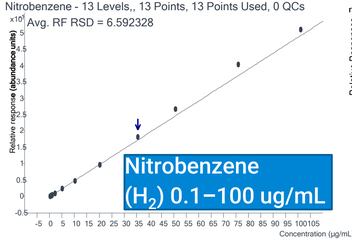
	Helium[1]	Hydrogen[2]	Nitrogen[NEW]
GC	Agilent 8890	Agilent 8890	Agilent 8890
MS	Agilent 5977C	Agilent 5977B	Agilent 5977B
Inlet	Split 10:1	Split 10:1	Split 25:1
Liner	UI Split with glass wool (5190-2295)	UI Split with glass wool (5190-2295)	UI Split with glass wool (5190-2295)
Column	DB-8270D UI 30m, 0.25mm, 0.25um	DB-5MS UI 20m, 0.18mm, 0.36um	DB-5MS UI 20m, 0.18mm, 0.18um
Carrier Gas Flow Rate (mL/min)	1.2	1.2	0.3
GC/MS Source	Extractor 9mm	HydroInert 9mm	Extractor 9mm
Source Temperature	300°C	300°C	300°C
Autotune	Etune	Etune	Etune

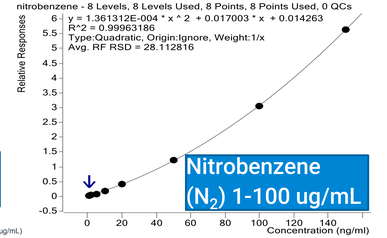
Calibration Curve Fit Criteria for EPA 8270E			
	Helium[1]	Hydrogen[2]	Nitrogen[NEW]
Dynamic Range (ug/mL)	0.2–150 or 0.01–10	0.1–100	1-150
Compounds	76	119	70
Average Library Match Score	96.3	96.1	94.2
Quadradic Fit	2	1	29
Linear fit	0	14	3
Average RF %RSD < 20%	74	104	38
% Meeting Average RF Fit Criteria	97.3 %	87.4 %	54.3 %
% Meeting either average RF or alternate fit	100%	100%	100%

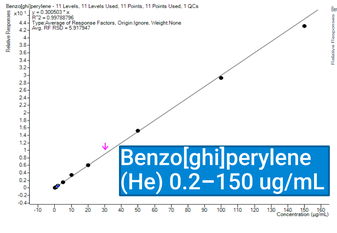
Results and Discussion

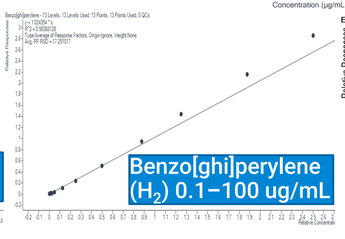


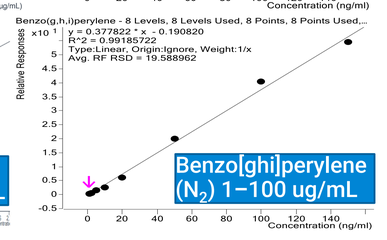












Conclusions

Helium carrier gas is the best choice for SVOC analysis by GC/MS

- Helium provides unsurpassed sensitivity
- Calibration performance with Helium is best
- Techniques are available to reduce Helium consumption

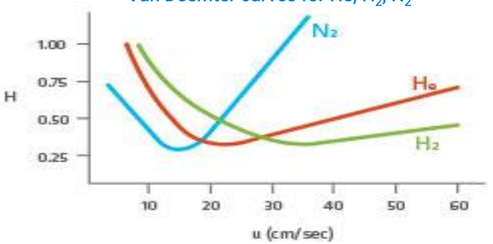
Hydrogen offers good practical alternative

- Hydrogen supports faster analysis
- Spectral fidelity is excellent with hydrogen if using the HydroInert source which reduces in source reactions
- Calibration performance is good but, not as excellent as with Helium
- Sensitivity (Signal:Noise) is generally 2-5 times less than with Helium

Nitrogen provides acceptable results with limited sensitivity and calibration performance

- Nitrogen also provides excellent spectral fidelity
- Careful selection of inlet and flow parameters is required with nitrogen
- Sensitivity is significantly diminished
- Calibrations tend more towards quadradic fits

Van Deemter curves for He, H_2, N_2



References

1 Smith Henry, A., Analysis of Semivolatile Organic Compounds Using Hydrogen Carrier Gas and the Agilent HydroInert Source by Gas Chromatography/Mass Spectrometry, *Agilent Technologies application note*, publication number 5994-1500EN, **2020**.

2 Ciotti, R. EPA 8270E with Pulsed Split Injection and Retention Time Locking on an 8890 GC with a 5977 Series MSD, *Agilent Technologies application note*, publication number 5994-4890EN, **2022**. for helium method. Data presented in this poster forthcoming.

3 Save Helium, Save Money. https://www.agilent.com/en/product/gas-chromatography/gc-systems/helium-conservation-module-for-gc (accessed 2023, July 17)