

# How a hydrogen generator can improve efficiency in GC analysis

## Application Note -Complex Mixture Using Hydrogen as a Carrier Gas

**Abstract:** *The following technical brief aims to demonstrate the performance of GC-MS using hydrogen as a carrier gas. Here we compare the performance of hydrogen and helium for the analysis of a complex mixture. The results show that by using hydrogen, chromatographers can achieve superior results to helium, with faster run times and taller, sharper peaks.*

### Introduction

Owing to the worldwide shortage of Helium, many GC-MS users are now using hydrogen for carrier gas in their GC-MS analyses, however there are still fears about the safety of hydrogen and its reactivity with analytes. This study aims to show that hydrogen carrier gas produced by a hydrogen generator is suitable for GC-MS analyses and that use of hydrogen can give improved chromatographic results compared with helium as carrier gas.

### Experimental

<b>Reagent:</b>	0.5 $\mu$ L of a 76-compound mixture (Restek Megamix cat. No. 31850) in DCM
<b>MS:</b>	Bruker SCION-SQ GC-MSD MS source: 330 °C Mass Range: m/z 45-500 2 min solvent delay, 120 ms scan time
<b>GC:</b>	Column: BP-5MS column (20m x 0.18mm with 0.18 $\mu$ m film thickness) Oven: 45 °C (1 min hold) ramped at 30 °C/min to 310 °C (5 min. hold) Injection: Pulsed-split injection (inlet temperature 290 °C , pressure 40 psi for 0.3 min, 70:1 split)
<b>Carrier:</b>	Peak Precision Trace Generator Hydrogen, 1 mL/min

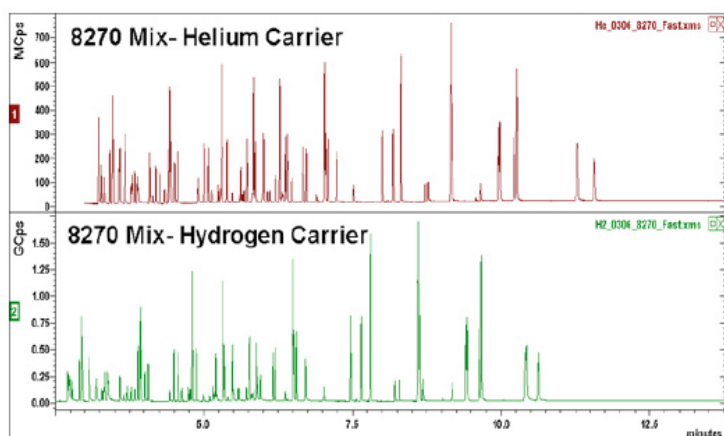
### Results

The results of this technical brief show that by using hydrogen as a carrier gas, chromatographers can shorten run times compared with helium without compromising peak separation (Figure 1.). The results also show that hydrogen can improve not only run time efficiency, but signal strength and resolution.

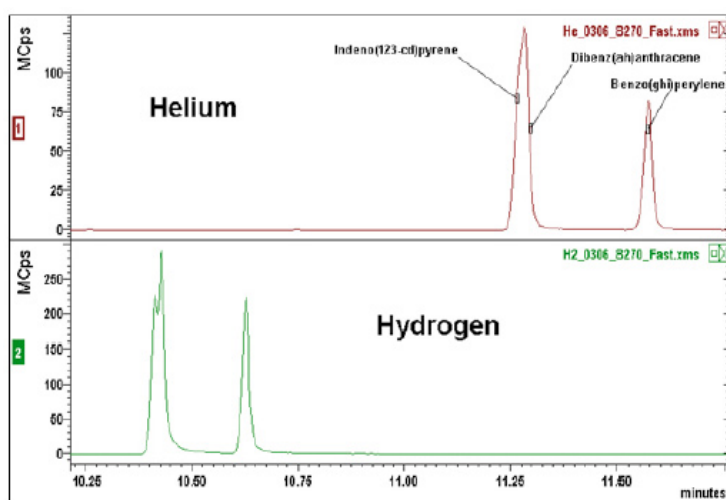
## Discussion

Hydrogen produced by a hydrogen generator is a safe and suitable alternative to helium for GC-MS carrier gas. With the installation of an in-oven hydrogen leak detector, along with the fail safe mechanisms in place within the generator, lab users can work safely with hydrogen.

EPA method 8270 allows for the use of both helium and hydrogen for carrier gas and results from the analysis of the complex mixture show that hydrogen can give superior separation of analytes despite operating at higher linear velocities. The lower viscosity and resulting higher efficiency of hydrogen compared with helium allows for the use of narrower bore columns, which gives chromatographers the opportunity to further improve separation.



**Figure 1.** Results showing faster elution of compounds and greater peak height when using Hydrogen as a carrier gas.



**Figure 2.** Shows that separation of Indeno(123-cd)pyrene and Dibenz(ah)anthracene was slightly improved by using Hydrogen despite faster elution times with Hydrogen as carrier gas.

## Notes

1. For more information on the Bruker SCION-SQ™ GC-MS, please visit <http://www.bruker.com/en/products/mass-spectrometry-and-separations/gc-ms/scion/overview.html>
2. For more information on the Peak Precision Hydrogen Trace generator, please visit <http://www.peakscientific.com/peak-precision/>



**Ed Connor DR.SC.** is a Application Specialist for Peak Scientific. Prior to joining Peak in February 2013, Ed completed his Dr.Sc. at ETH Zurich in Switzerland using GC-MS to look at herbivore induced plant volatiles and their interaction with beneficial insects. He then joined the University of Zurich where his work focused primarily on volatile collection methods and analyses using GC-MS and GC-FID

## User Story - Copenhagen University - Department of Plant and Environmental Sciences



The new Copenhagen University building where the Department of Plant and Environmental Science is based

### **Copenhagen University use Peak Hydrogen generator as carrier gas for Shimadzu GC-MS**

The Department of Plant and Environmental Sciences at Copenhagen University focus on researching plants, microorganisms, animals and the environment for the wider goal of finding solutions for the sustainable production of food and other biological products. Their mission is to stimulate fundamental research and the synergy between basic and applied research in biology and environmental science.

Federico Cozzi is the Laboratory Manager for the Section for Molecular Plant Biology and has replaced his lab's gas cylinder supply with Peak Scientific Precision Series gas generators for GC and GC-MS for their analysis.

In a recent study, using Peak's Precision Series supplying Shimadzu's QP-2010 Plus GC-MS with hydrogen carrier gas, Trine Bundgaard Andersen, Federico Cozzi and Henrik Toft Simonsen carried out analysis on sesquiterpenoids, a subgroup of terpenoids in their research paper "Optimization of Biochemical Screening Methods for Volatile and Unstable Sesquiterpenoids Using HS-SPME-GC-MS". The aim of their research was to decipher an efficient method for analyzing these volatile compounds. Knowing that the choice of fiber material and injector temperature could have a profound effect on the sample profile due to chemical rearrangements which can occur with the fiber materials, the team were able to discover the optimal fiber material and temperature for a fast, reproducible HS-SPME GC-MS method increasing accuracy in results. They found that an absorbent fiber material, PDMS, significantly reduced the likelihood of chemical rearrangement as opposed to adsorbent fibers such as PDMS/DVB, PDMS/CAR and PDMS/CAR/DVB. The likelihood of chemical rearrangement was further reduced with an injection temperature of 160°C. You can read the full paper [here](#).

We asked Federico about the benefits Peak's Precision series had brought his lab:

### **Typically, what is the focus of your GC analysis - what sort of applications?**

"The main focus of our line of research is Plant Metabolites."

### **What Peak Scientific generators do you have in your laboratory and what GC instruments do they supply?**

"We have a Precision stack with the following generators: Precision Hydrogen 200, Precision Hydrogen Trace 500, Precision Air Compressor, Precision Nitrogen & Precision Zero Air. These are used to supply carrier gas and detector gas to our Shimadzu QP-2010 Plus GC-MSs."

### **What prompted you to choose a Peak generator and how long have you used them?**

"We were looking for an alternative to cylinder gas supply. The Peak generators were highly recommended by Shimadzu and were sold as a package with the GC-MS. We have been using these generators for over a year now."

### **What has been the key benefit of deploying Peak generators as opposed to your previous gas supply solution?**

"We decided to make the switch from cylinders to hydrogen gas generators as we wanted to reduce the costs associated with helium cylinders such as regular cylinder deliveries and saving time by not needing to change over cylinders."

### **How would you describe your purchasing experience with Peak in terms of speed of response, ease of ordering, catering for your needs and timing of delivery?**

"Although the generators were purchased alongside our mass specs through a third party as opposed to being purchased directly from Peak, the delivery of my order was satisfactory."

### **Have you ever had a site visit from a Peak engineer, if so, could you describe your experience of this support?**

"Although we purchased our gas generators via a third party, Peak look after the service and support of our generators. I would say overall I have received very good support from Peak."

## **Summary**

Federico's experience with Peak is, in many ways, a typical one. Peak's Precision series gas generators are very often sold alongside Shimadzu's GC-MS as a trusted source of carrier and detector gas. This is due to the product's reliability and the unrivalled support that is provided by Peak's global team of Field Service Engineers who perform generator maintenance and servicing on-site regardless of location.

Another common theme highlighted by Federico was his reason for switching from helium cylinders to an on-site supply of gas. The costs associated to helium cylinders, to which Federico refers, are the continual delivery costs, the administrative costs of ordering and reordering cylinders and the efficiency costs of lab workers needing to stop analysis to changeover cylinders as well as to handle stock levels. The other benefit of using Precision generators over helium cylinders is that the consistent purity achieved by a gas generator cannot be matched by a gas cylinder as impurities can corrupt cylinder purity as it reaches the lower end of its capacity. More and more labs are choosing to switch their helium cylinders to on-site gas generators due to the inconsistencies and costs associated with bulk supplied gas.

The Department of Plant and Environmental Sciences' vision is to carry out distinctive and internationally recognized basic and applied research which will contribute to solve the challenges that global society is facing in relation to the production of food and other biological products and the environment. Peak are pleased to be their local gas generation partner, providing the gas to their analytical equipment.