VICI DBS

WHY IS THE HELIUM SHORTAGE IMPORTANT TO US?

HELIUM SUPPLIES DIMINISHING — PRICES RISING

Helium is running out, and worldwide demand is exceeding current production levels. This global shortage means that the price of helium is increasing significantly, and the healthcare industry is being given priority in an effort to ration the limited supply.

HELIUM FACTS

French and English astronomers Pierre Janssen and Norman Lockyer are jointly credited with discovering helium after spectral analysis of sunlight following a solar eclipse in 1868. Helium is so named because it was first detected in light patterns in the sun (Helios the Greek word for Sun) before it was detected on earth. It is the second most common element in the Universe (after hydrogen), making up around 24% of its mass. It is:

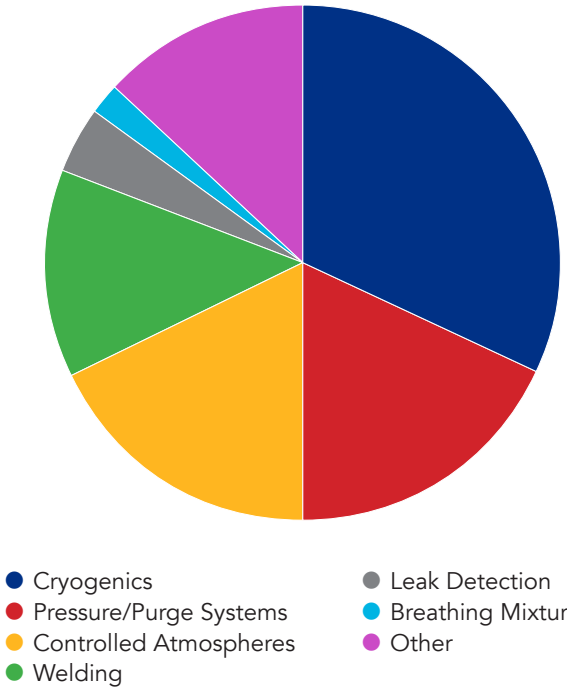
- **INERT** – doesn't react with other elements
- **NON-TOXIC** – can be used by humans in a variety of applications
- **LIGHTER THAN AIR** – ability to lift
- **MELTING POINT** – 272°C – liquid at ultra-cool temperatures allowing superconductivity
- **SMALL MOLECULE SIZE** – can be used to find the smallest of leaks

AS SUPPLIES OF HELIUM REDUCE, THE COST IS STEADILY AND IRREVERSIBLY RISING

Helium has the lowest boiling and melting point of all the chemical elements, and liquid helium is the only liquid that cannot be solidified by lowering its temperature. These properties make helium so irreplaceable in cryogenics and critical in applications such as hospital MRI scanners, superconductors, and the world-famous Hadron Supercollider in Switzerland. Other key applications include leak testing, arc welding, and silicon wafer manufacturing.

Chromatography and laboratory applications are way down the priority list and are increasingly affected by rationing and increasing costs.

HELIUM USE IN THE UNITED STATES



Source: 2011 USGS

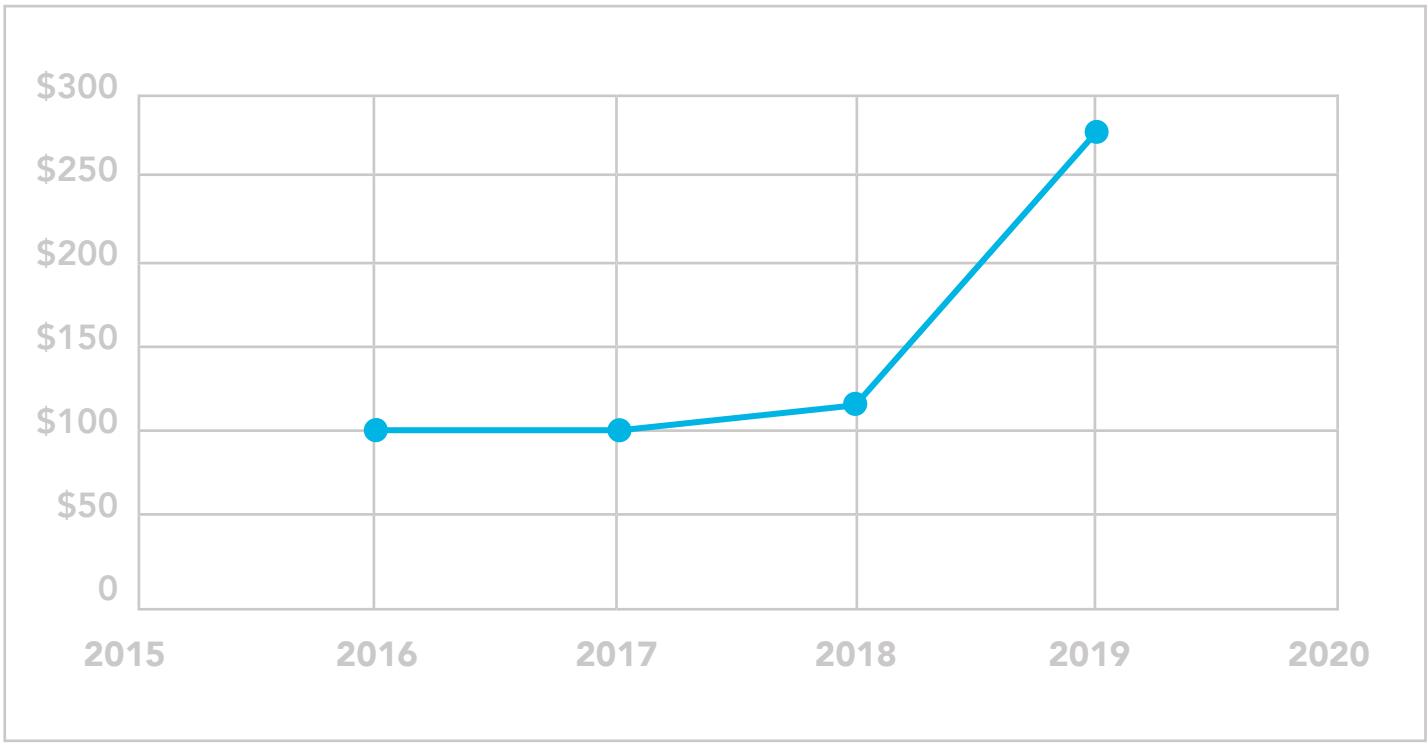
What effect is this having on costs?

As the supplies of helium diminish, the cost is increasing and the availability for minor applications such as gas chromatography are being rationed, as priority is given to more critical applications such as hospital MRI scanners.

The current 2020 crude helium price per thousand cubic feet (Mcf) is approx $100 and continues to increase from the low of $47 in 2000.

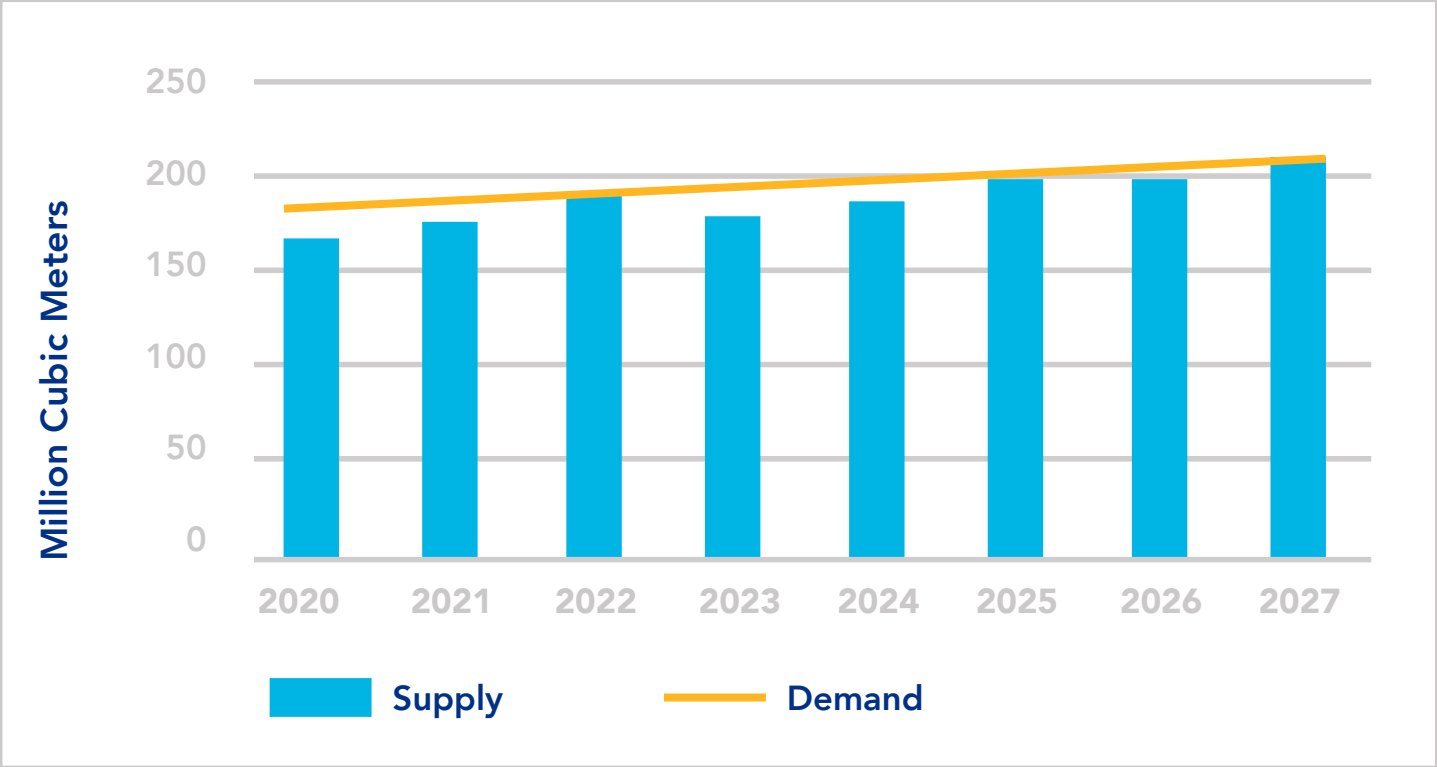
So, what does this mean for an analytical laboratory using GC grade helium?

A typical standard helium cylinder costs approximately € 450 ($530), plus rental and delivery charges. With rationing, it is becoming increasing difficult to guarantee regular deliveries of helium which is causing disruption to laboratory through put and efficiency.



Crude helium prices ($/30,000 cubic meters, 1 million cubic feet) achieved by US Bureau Land Management 2016-2019 (Helium - Macro View Update, February 2019, Edison Investment Research).

Source: http://www.chromatographyonline.com/view/truth-about-global-helium-shortage



Helium supply and demand projections 2020-2027 (U.S. Geological Survey, Mineral Commodity, Summaries, February 2019, data correct as of 2018).

Source: http://www.chromatographyonline.com/view/truth-about-global-helium-shortage

VIABLE ALTERNATIVES

The most widely used gases for gas chromatography are helium, hydrogen and nitrogen.

As a carrier gas, nitrogen is the most efficient, but only does this over a low and narrow linear velocity range. This make it very slow as a carrier gas, particularly for temperature programmed use. In general nitrogen is the most effective make-up gas.

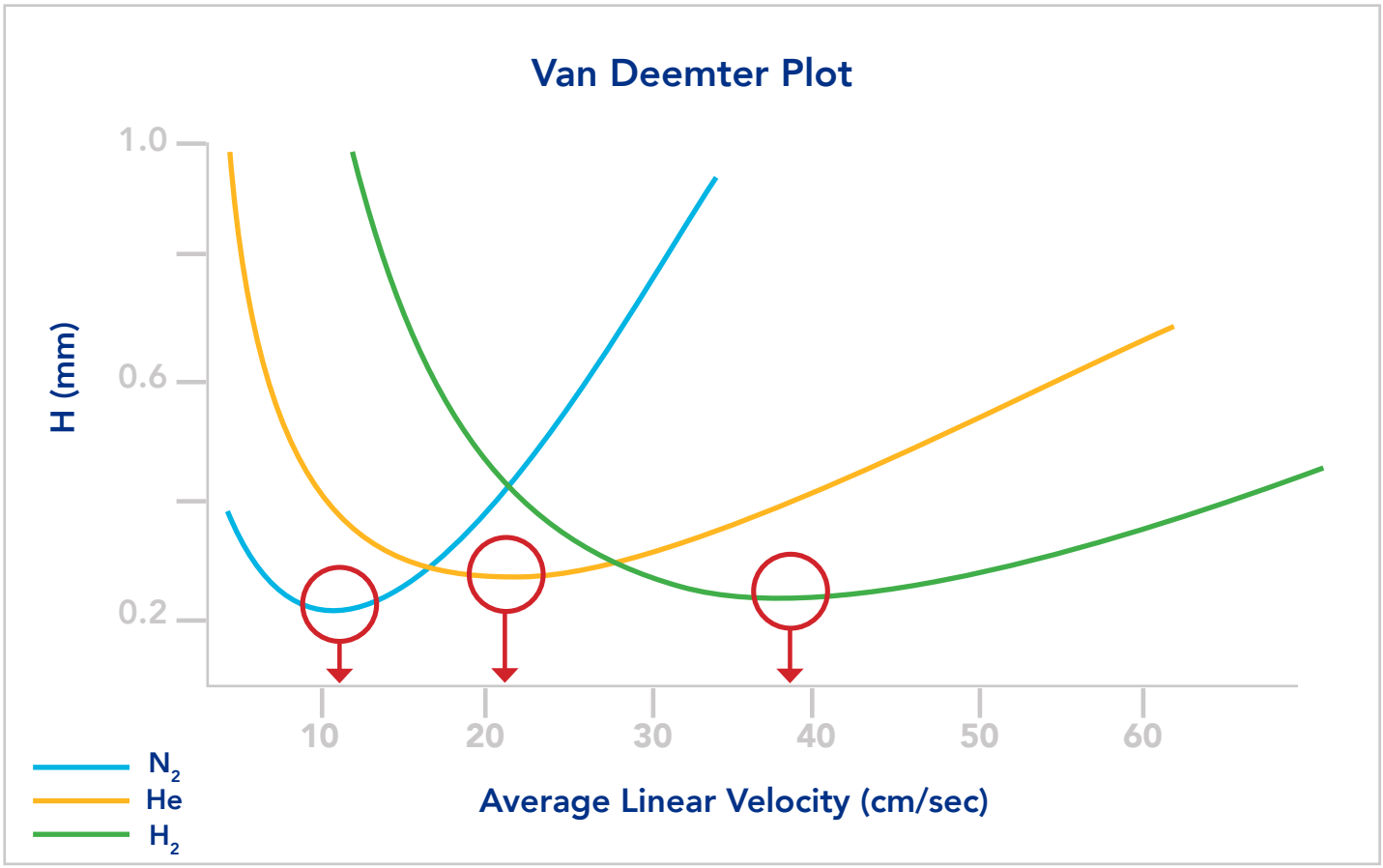
From an efficiency perspective, helium is a good compromise between nitrogen and hydrogen. However, current market conditions make the costs and availability impractical, leaving hydrogen a clear and creditable alternative.

Is hydrogen a suitable alternative to helium as a carrier gas?

The Van Deemter curves, which show the relative carrier efficiencies of nitrogen, hydrogen and helium, indicate that helium and hydrogen perform similarly at medium gas velocities with hydrogen outperforming helium at high velocities. The performance of hydrogen at higher carrier gas velocities provides clear advantages for laboratories to decrease run times and therefore increase sample through put without compromising on sample quality.

In addition, hydrogen frequently allows for the use of a lower oven temperature for separation, thereby increasing column longevity.

However, due to perceived safety concerns with hydrogen, since the 1950's helium's inert nature has made it the carrier gas of choice for the majority of gas chromatography (GC) applications. This is despite; all GC-FID instruments using hydrogen, typical from a cylinder, as the flame gas for the FID (flame ionization detector).



Hydrogen can be used as an effective replacement for helium in most GC and GC/MS applications. It has a wide range of applicability, provides good efficiency and separations are faster than helium.

VICI DBS HYDROGEN GENERATORS — THE SAFE ALTERNATIVE

There is an alternative that can both save you money and protect you from future disruption cause by helium shortages. Hydrogen generators manufactured by VICI DBS® offer a safe, cost effective supply of GC carrier gas 24/7.

Whilst EPC, flow limiting frits and oven sensor provide vital safety steps, installing a hydrogen generator gives the users the ultimate control over their gas supply. VICI DBS hydrogen generators produce gas only when required. Utilizing an intelligent pressure system, the generator closely monitors the demand and balance the production to meet the exact gas requirements, with no internal or external storage required.

VICI DBS hydrogen generators have multiple fail-safe flow and pressure sensors that are located throughout the flow stream, to monitor the system for leaks and pressure build up. Safety alarms are linked to sensors for internal leaks, low pressure, over run, over pressure and blocked vents. If there is an internal or external leak the generator will automatically shut down.

Should there be a power outage the VICI DBS generators will stop producing gas immediately. Once power is restored the generator can be pre-programmed to either start automatically or via manual reset.

FEATURES

- Produces a continuous supply of hydrogen
- On-demand supply 24/7
- Ideal for all GC detector applications
- PC monitoring for maintenance, diagnostics and remote connection
- Proprietary 100% titanium cell technology
- Unique permeation membrane drying system
- USB connectivity
- 2-year complete cell and product warranty
- Meets and exceeds the requirements for the most demanding GC applications

USING HYDROGEN DOES NOT COMPROMISE SAFETY

The common concern about using hydrogen is the perceived danger. At 4%-75% volume in air, hydrogen will burn and there is a potential risk explosion.

However, being less viscous than helium, it more readily escapes, therefore unless a large quantity is suddenly released into the environment, the danger of reaching the LEL (lower explosive limit) is very low. Hydrogen rises two times faster than helium at a speed of 20 m/s (45 mph). In a laboratory with regular air turnover it would be very difficult to achieve the explosive limits.

Are GC and GC/MS systems safe to use with hydrogen carrier gas?
The most common concern when considering using hydrogen as a carrier gas, is a leak inside the GC oven either from a broken column or at the fitting. GC's are designed using EPC (Electronic Pressure Control) to control all gas supplies. This limits the total flow of gas into the GC oven and if low pressure is detected, the sign of a leak, the gas flow is turned off and all heated zones cooled.

Other mitigating measures include inserting a snubber or flow limiting frit or better still a flow controller, into the carrier gas supply line. If a leak occurs inside the oven the flow rate will be limited to that needed for the chromatography.

BENEFITS OF HYDROGEN CARRIER GAS

The benefits of using hydrogen as a GC carrier gas are proven. Hydrogen is a safe, cost-effective alternative and offers faster analysis, greater resolution and longer column life.

- **REDUCING COSTS** – helium is becoming increasingly expensive - € 450 per cylinder. Generating your own hydrogen is a more cost-effective alternative, with minimal maintenance and low ongoing costs.
- **AVAILABILITY** – as supplies diminish, it is becoming increasingly difficult to depend on regular helium deliveries. Ultra-high purity hydrogen can be generated safely onsite with a VICI DBS hydrogen generator
- **SAFETY & CONVENIENCE** – helium is only available in pressurized cylinders. These have several safety concerns with manual handling and storage. Ultra- high purity hydrogen can be generated safely onsite 24/7
- **CHROMATOGRAPHIC RUN TIMES** – chromatograms from a GC using hydrogen carrier gas can be generated in a much shorter time than those using helium. More analyses can be performed in less time resulting in higher sample throughput.

North America & South America contact:

VICI DBS USA
tel: +1 713-263-6970
fax: +1 832-565-5790
web: www.vicidbs.com

Europe, Asia, Africa, & Australia/Oceania contact:

VICI AG INTERNATIONAL
tel: + 41 41 925-6200
fax: + 41 41 925-6201
web: www.vicidbs.com

YOUR DIRECT CONTACT:

Scantec Nordic
Analys & Mätteknik
031 336 90 00 • www.scantecnordic.se

VICI DBS

www.vicidbs.com