PEAK SCIENTIFIC

Your local **gas generation** partner

Hydrogen Safety

A PEAK gas generation brand

Why a generator is safe

- **Low stored gas volume** (<300cc) – Cylinders can contain >9000L
- **Low pressure operation** (up to 100psi) – Cylinders pressurized to 200+Barg
- **Real-time leak monitoring both internally and externally** – prevents excessive release of H2 into lab or GC if a leak occurs
- **Days of supply following failure would be required to reach LEL** – Cylinders contain sufficient gas volume to reach LEL in seconds

Consecutive failures required for critical build-up of H2

1. **Hydrogen vent blockage** – causing H_2 build-up in generator
2. **Oxygen vent blockage** – causing O_2 build-up in generator
3. **Hydrogen exhaust blockage** – causing build-up of H_2 in PSA dryer
4. **Proportional valve failure** – preventing delivery of H_2 from generator
5. **Pressure sensor failure** – 3 sensors would need to fail simultaneously
6. **Valve failure** – 4 valves would need to fail simultaneously
7. **Non-return valve failure** – 3 non-return valves would need to fail
8. **Separation tank blockage** – Hydrogen forced into internal water tank

Ignition source would be required in addition to steps 1-8. System would also need to be hermetically sealed to reach the 4.1% LEL.

Single Cylinder failures required for Health risk

1. **Internal stress corrosion** cracking of the cylinder
2. **Cylinders can fail if over-pressurised** or weakened by the application of heat
3. **Cylinders are structurally weakened by the application of any heat source**
4. **Cylinders that may 'rocket'** if the regulator and valve assembly is damaged
5. **Cylinders protected by pressure relief valves**, fusible plugs or bursting discs that may not work correctly in a fire situation, or if damaged
6. **Accidental application of a compressed gas** or jet into eyes or into an open wound

8 Consecutive Failures + Combustion + Sealed Environment

VS

1 Failure

Consequences of a Cylinder Failure

The nature of the failure of a cylinder and its consequences depends on the combination of cylinder design, age and gas type. Flammable gases present greater risk but all cylinder failures can have significant safety consequences.

In a fire a cylinder can release its entire combustion energy. A cylinder of up to 1000L or 40kg bursting may result in a combination of the following:

- **Blast pressure** wave
- **Fireball** of up to 25 metres
- **A Projectile** traveling over 100 metres
- **Flying fragments** may travel up to 200 metres with high looping trajectories
- **Structural damage** to buildings in the vicinity

Generator safeguards

- **Full internal pressure decay test performed on start-up**
  - Any leak would prevent further production of H_2 and internal pressure would be vented. Audible and visual alarms via HMI
- **Forced air ventilation**
  - Fans prevent build-up of H_2 and O_2 internally if leaks were to occur
- **Continuous monitoring of internal gas pressure**
  - Pressure sensor monitoring to prevent under/over pressure
- **Mechanical fail-safe in case of high pressure**
  - Automatic isolation and shutdown of the cell

- **When generator is in alarm status the following occurs:**
  - current to cell stopped
  - system depressurized
  - audible and visual alarms alert user of problem and fault information is displayed via the HMI

Gas generators provide a number of benefits

Convenience
Gas on-demand, no cylinders to change or maintain supply stocks

Consistency
Consistent gas quality and supply, no impurities or running out of gas

Economy
Eliminate on-going costs of cylinders, manage lifetime running costs

Safety
No pressurized compressed gas cylinders in your lab

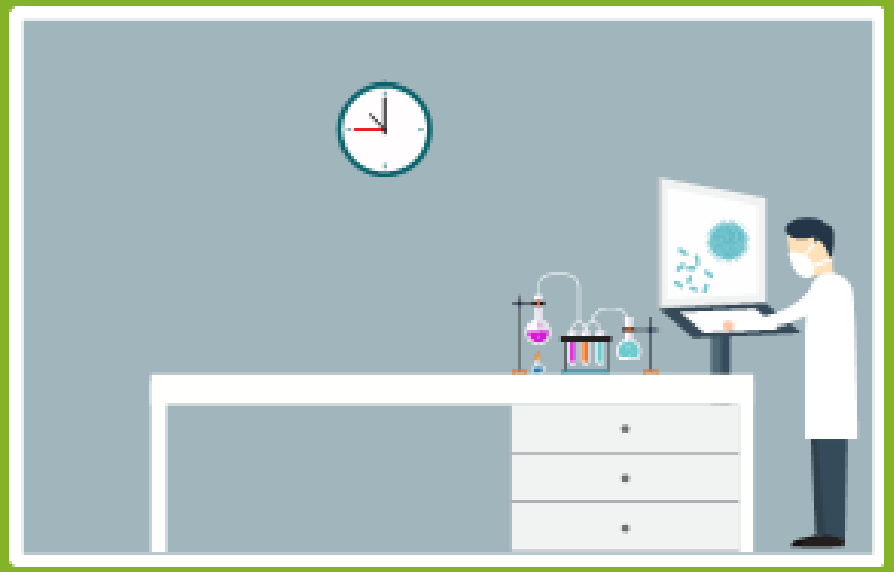
Green
No repeated gas deliveries, energy efficient

Hydrogen Generators A Safer Option for You, Your Colleagues, Your Workplace and the Environment

“there’s no need for us to have helium cylinders on site and no need to change air or helium cylinders at all, so that reduces instrument down time and cylinder manual handling risks.”

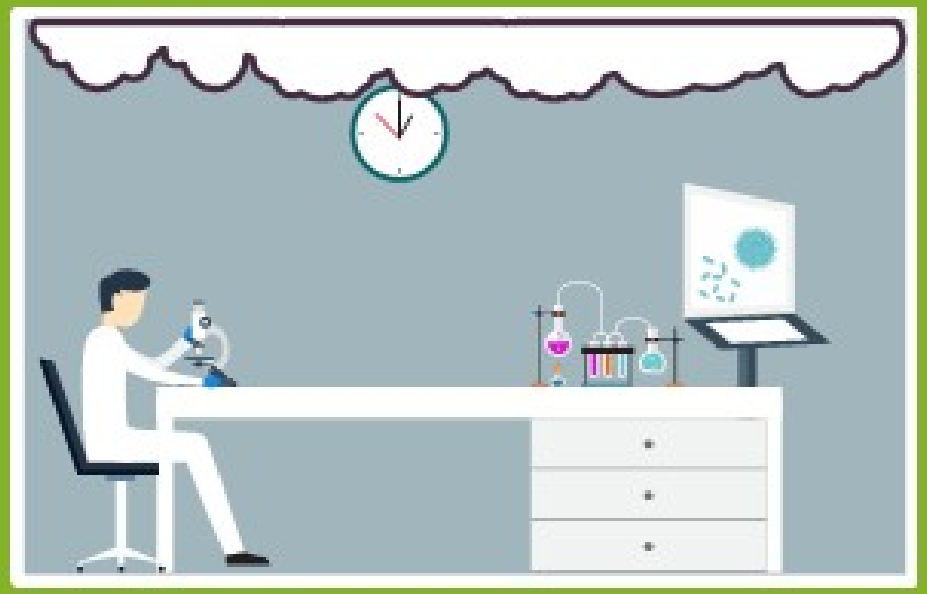
Ian Bennington, Senior Analyst, Nerudia, UK

Safety - Hydrogen **Cylinder** vs Hydrogen **Generator**



A laboratory measuring **5m x 4m x 2.5m** has a volume of 50m3, or **50,000 litres**

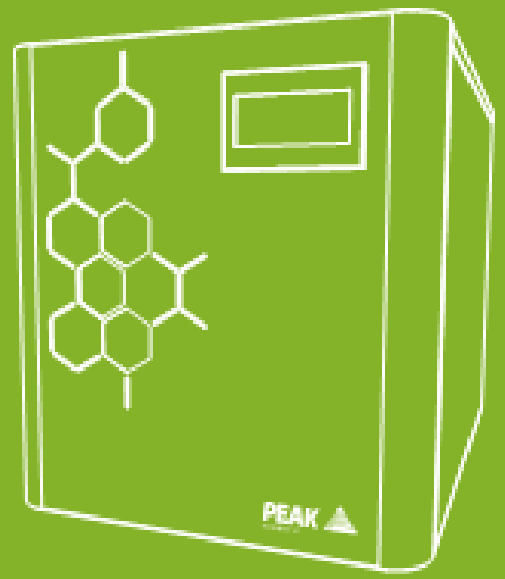
The lower explosive level **(LEL)** of H2 is only **4.1%**



We would only need **2050 litres of H2** to reach the lower limit of **LEL**

A **50L gas cylinder** contains around **9000 litres** of hydrogen. Therefore releasing **25%** of the contents would **reach LEL**

A Precision **H2 generator** produces up to **500 cc/min** and would take **almost 3 days to** reach the LEL (and this assumes no escape of hydrogen during this time)



Hydrogen Safety

“I recommend Peak Scientific generators to other laboratories due to safety issues, and eliminating the possible risks of using and handling cylinders.”

Askin Kayabasli, Laboratory Manager, Era Pharma, Turkey

Safeguard your hydrogen supply by using a generator

“a key benefit for us has been the elimination of the safety hazards associated with compressed gas cylinder handling.”

Kerri Heckrow, NPD Lab Manager, Evergreen Packaging, NC, USA

Certification

Evaluated and Certified to ensure compliance with both EMC and electrical safety of the system in the laboratory environment

Certified to ensure it can be safely operated, without risk of radiation frequencies causing interference/damage

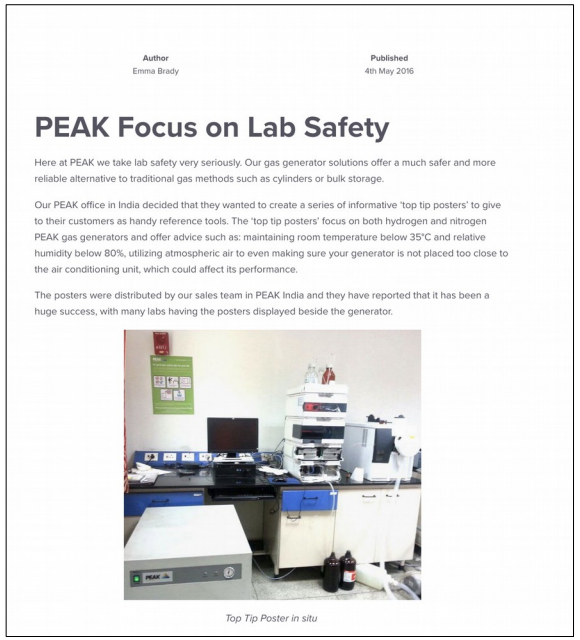
Peak hydrogen generators meet the stringent demands of one of the World's most respected safety marks

Ensures that both the generator and its packaging are designed to minimise any damage in transit so that it will arrive at the lab in full working order

Peak H_2 generators meet IEC standards for laboratory use.

Dilution tests showed that the risk of explosion does not exist, even if all internal H_2 leaked and fans are not operational

More on Lab Gas Safety



Author
Emma Brady

Published
4th May 2016

PEAK Focus on Lab Safety

Here at PEAK we take lab safety very seriously. Our gas generator solutions offer a much safer and more reliable alternative to traditional gas methods such as cylinders or bulk storage.

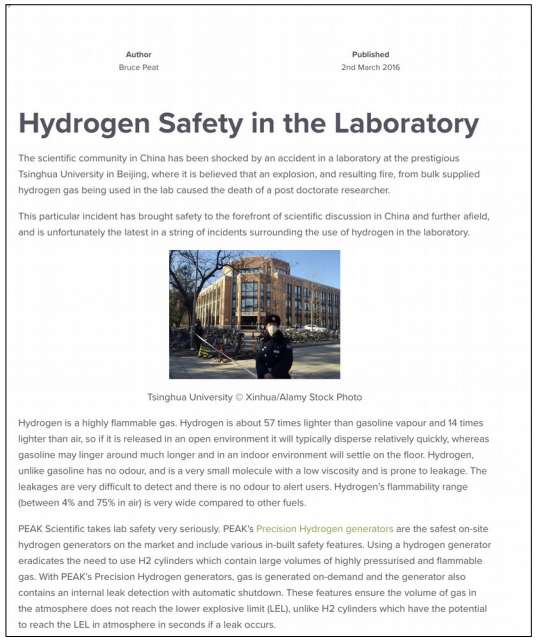
Our PEAK office in India decided that they wanted to create a series of informative 'top tip posters' to give to their customers as handy reference tools. The 'top tip posters' focus on both hydrogen and nitrogen PEAK gas generators and offer advice such as: maintaining room temperature below 35°C and relative humidity below 80%, utilizing atmospheric air to even making sure your generator is not placed too close to the air conditioning unit, which could affect its performance.

The posters were distributed by our sales team in PEAK India and they have reported that it has been a huge success, with many labs having the posters displayed beside the generator.

Top Tip Poster in situ

[H2 Safety]

Blog



Author
Bruce Peat

Published
2nd March 2016

Hydrogen Safety in the Laboratory

The scientific community in China has been shocked by an accident in a laboratory at the prestigious Tsinghua University in Beijing, where it is believed that an explosion, and resulting fire, from bulk supplied hydrogen gas being used in the lab caused the death of a post doctorate researcher.

This particular incident has brought safety to the forefront of scientific discussion in China and further afield, and is unfortunately the latest in a string of incidents surrounding the use of hydrogen in the laboratory.

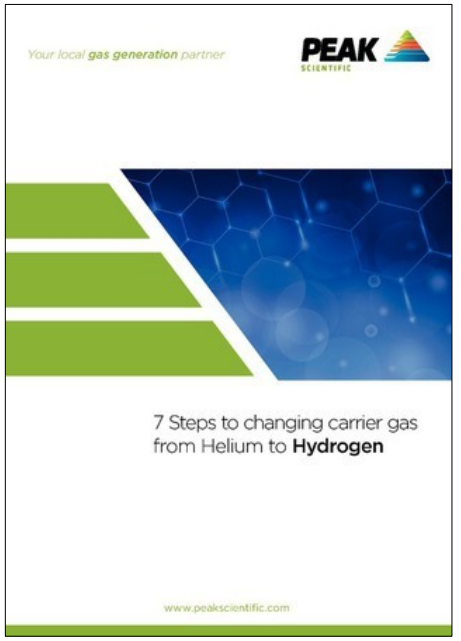
Tsinghua University © Xinhua/Alamy Stock Photo

Hydrogen is a highly flammable gas. Hydrogen is about 57 times lighter than gasoline vapour and 14 times lighter than air, so if it is released in an open environment it will typically disperse relatively quickly, whereas gasoline may linger around much longer and in an indoor environment will settle on the floor. Hydrogen, unlike gasoline has no odour, and is a very small molecule with a low viscosity and is prone to leakage. The leakages are very difficult to detect and there is no odour to alert users. Hydrogen's flammability range (between 4% and 75% in air) is very wide compared to other fuels.

PEAK Scientific takes lab safety very seriously. PEAK's Precision Hydrogen generators are the safest on-site hydrogen generators on the market and include various in-built safety features. Using a hydrogen generator eradicates the need to use H2 cylinders which contain large volumes of highly pressurised and flammable gas. With PEAK's Precision Hydrogen generators, gas is generated on-demand and the generator also contains an internal leak detection with automatic shutdown. These features ensure the volume of gas in the atmosphere does not reach the lower explosive limit (LEL), unlike H2 cylinders which have the potential to reach the LEL in atmosphere in seconds if a leak occurs.

[Lab Safety Focus]

Blog



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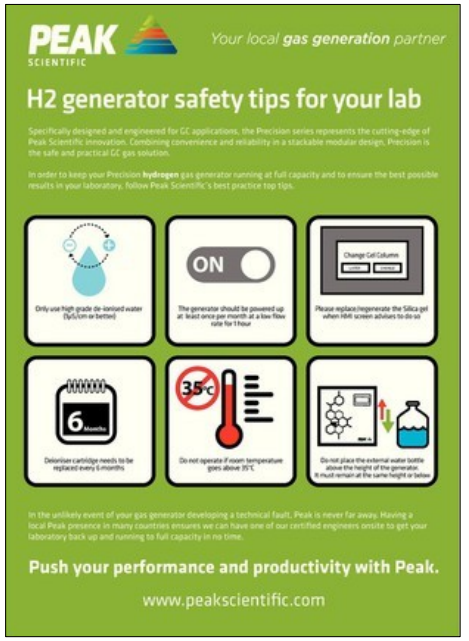
7 Steps to changing carrier gas from Helium to **Hydrogen**

www.peakscientific.com

[Changing carrier gas f rom He to H2]

App note



PEAK SCIENTIFIC

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H2 generator safety tips for your lab

Specifically designed and engineered for GC applications, the Precision series represents the cutting-edge of Peak Scientific innovation. Combining convenience and reliability in a stackable modular design, Precision is the safe and practical GC gas solution.

In order to keep your Precision **hydrogen** gas generator running at full capacity and to ensure the best possible results in your laboratory, follow Peak Scientific's best practice top tips.

ON

Change Gel Columns

6 Months

35°C

In the unlikely event of your gas generator developing a technical fault, Peak is never far away. Having a local Peak presence in many countries ensures we can have one of our certified engineers onsite to get your laboratory back up and running to full capacity in no time.

Push your performance and productivity with Peak.

www.peakscientific.com

[Hydrogen Lab Safety]

Poster

Thank you

www.peakscientific.com

Our Vision:

To exceed the expectation of our Customers, Colleagues and Suppliers

Our Values:

- **Respect** customer, supplier, colleague
- **Restless** constantly striving to improve
- **Freedom with responsibility**
- **Fun & passion** in everything we do