

# 7 reasons on why you should go for in-situ gas generation!

## Introduction

Laboratories require gases for several purposes. Among different applications, analytical systems are maybe the most important group with specific requirements for flow and purity up to grade 6.0 (99.9999%).

During the last decades the move for in-situ gas generators has been intensified and generators are now widely used for chromatography and general applications in the laboratory. They are several reasons which explain this success which will be described below.

## 1. Costs reduction

First application candidate for cost reduction is the LCMS where nitrogen consumptions can reach several liters per minute. On second place comes hydrogen for systems using FID technology. When considering cylinders, the overall cost involves transport of the empty and full cylinders, the cylinder rental cost, the stocking and handling charges and finally the labor cost for the stocking and the installation, replacing of the cylinders. With an in-house generator they are no extra costs for storage, transport and handling, beside, the operating cost is very low. Maintenance involves changing filters a year or even less. Typically an hydrogen generator pays for itself within 18 months to 36 months depending on the use. ROI calculations can be requested to suppliers.

## 2. Availability

Main sources for nitrogen, hydrogen and pure air are free and available everywhere: air and water (for hydrogen generation only). No worries for logistics organisation, gas supply runs on 24 / 7 basis.

## 3. The move from Helium to Hydrogen

Even if helium is the second most abundant element in the universe, it's relatively rare on earth, cannot be produced, is trapped underground with natural gas and mined by the natural gas industry. Prices have risen steadily in the last decade. In just one year (2012-2013) the increase has been the same than during the first 2000 decade (Fig. 1).

Helium is essential on laboratory use, but an available alternative exist for gas chromatography with high purity hydrogen.

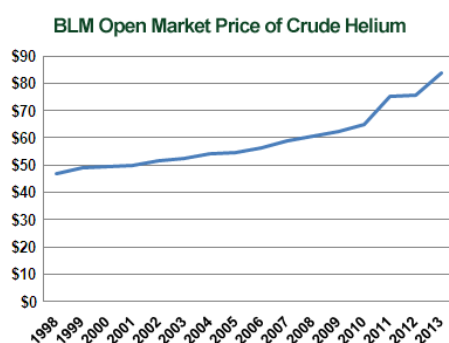


Fig. 1 Price of helium rising

Hydrogen is a less expensive carrier gas alternative and users won't have to support any cost increase like for helium. On-site hydrogen generation is even more economical. Switching from helium to hydrogen has a twofold effect on GC systems:

**Increased analytical speed:** Increasing the linear flow rate allows for shorter run times. This is explained by the lower viscosity of the hydrogen versus the helium. For helium the optimum flow rate is 20-30 cm/sec when for hydrogen it is 25-65 cm/sec. The consequence is a higher sample analyses throughput and a higher lab productivity.

**Longer column life:** Lower temperatures lead to less column bleed, can reduce analyte decomposition and improve column life.

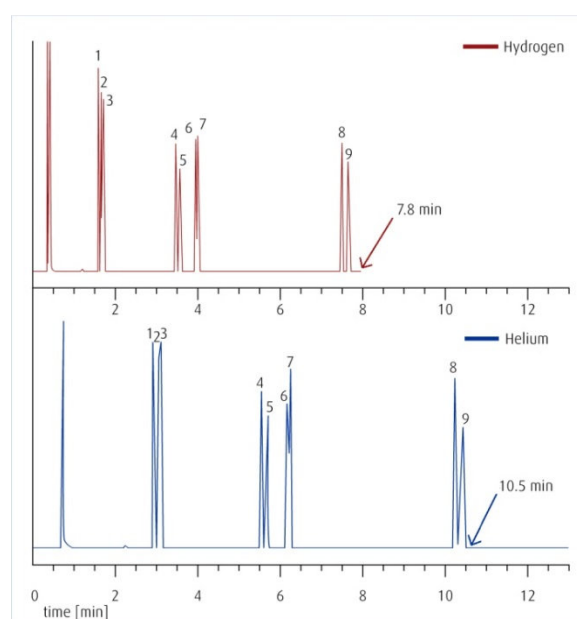


Fig. 2 GC speed and peak increase with hydrogen

#### 4. Safety improvement

A main argument against hydrogen on site generation concerns safety because it can build an explosive mixture with air. For nitrogen generators, large amount of this gas released in the environment can lead to a lack of oxygen in the breathing air.

In fact gas generators improve the lab safety through different ways:

**Minimal storage of hydrogen** - From 2000 liters of gas at 200 bar in a cylinder, down to only 40 ml of internal gas storage in a generator, this is low enough that in the laboratory no explosive mixtures can never be build up.

**Minimal storage of nitrogen** – A nitrogen generator has a small buffer of only 5 liters. There is no risk on oxygen availability in case of leakage.

**Gas on demand** - Generator provides only the necessary amount of gas that is send directly to the GC.

**Self-monitoring and automatic shutdown** – In order to prevent any risk, modern generators includes several warnings and alarms with automatic shut-off.

Parameters controlled include: cell voltage, current, gas overpressure, temperature, internal and external leak (through pressure control). Even earthquake / shock sensor are installed in some models.

**No transport** - Tanks are bulky and transport to the laboratory may lead to an accident. Moving a 100 kg gas cylinder is not an easy task and exposes lab operators to mechanical safety challenges (fingers, feet's, etc). More to say, think about the bottle which is on the corner, behind the group, swapping it requires to move several cylinders.

**Continuous H<sub>2</sub> control in air**– Optional remote hydrogen sensors can be added which will monitor continuously the hydrogen concentration in the atmosphere. In case of alarm the sensor can shut down the generator.

**Statistics** - Finally in the USdatabase "H<sub>2</sub>incidents" (<http://www.h2incidents.org/>), it appears that since about 20 years, the majority of incidents were generated mainly by fittings (leaks) and cylinder storage. No incidents have been reported and caused by hydrogen generators!

#### 5. Ergonomics and convenience improvement

Convenience improvement is another benefit recognized by users of gas generators. Separate gas generators for

each laboratory increase the flexibility. It is not necessary to interrupt system operation to exchange tanks and to keep extra tanks in inventory, order new tanks, etc. Overall up-time is much higher than with gas tanks, no risk to introduce contaminants when gas tanks are exchanged. At the end this means also an improvement on both ergonomics and productivity.

#### 6. Space recovering

The footprint of a modern gas generator is many times less than a rack of cylinders. For instance a 1 L/min hydrogen gas generator fits into the same surface than a personal computer tower.

#### 7. Carbon footprint reduction of your lab

As nitrogen is in the atmosphere and hydrogen source may be generated from tap water, generating gases on site from these sources is definitively a sustainable attitude now becoming a trend. This comes mainly by shortening the path between production and use which are both at the same location. Engage your lab to undertake carbon footprint reduction focusing on the future ISO 14067 standard and demonstrate your organization's commitment to the environment.

#### Take away

Going for in-situ gas generation provide several benefits: costs reduction, increased lab, and improved safety. Check by yourself if your lab can also take advantage of these benefits.



Fig. 3 The H<sub>2</sub> generator HG6.0 grade 6.0 up to 1.3L/min