Generation of Laboratory Gases in the Age of Coronavirus

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About the authors

Peter Froehlich is President of Peak Media located in Franklin, Massachusetts. He received the Ph.D. in chemistry from Purdue University, West Lafayette, Indiana, and has over 40 years of experience in the scientific instrument industry, with an emphasis on a broad range of chromatographic techniques including GC and LC.

Jack Mahan is the National Sales Manager, Analytical Gas Systems for the Industrial Gas Filtration and Generation Division of Parker Hannifin. He received a B.S. in Business Administration and Marketing from Fitchburg State University, Fitchburg, MA and an MBA from Nichols College, Dudley, MA. Jack has over 30 years of experience in the life science market focusing on laboratory instrumentation including Liquid Chromatography/Mass Spectrometry, Gas Chromatography, Nuclear Magnetic Resonance, Fourier Transform Infrared Spectroscopy and Total Organic Carbon Analyzers.

Introduction

The impact of Coronavirus has forced organizations to significantly reduce the interaction between individuals and objects that they are in contact with to minimize the transmission of the virus. As the workforce returns to the analytical laboratory, it is critical that they are provided with a safe working environment. Each operation that is required to meet the mission of the facility must be carefully examined to ensure that the number of touch points is minimized; this will reduce the possibility of the transmission of the virus. Clearly contact with an individual with the virus is to be avoided, but it should be noted that the US Centers for Disease Control report that approximately 35% of Coronavirus sufferers are asymptomatic. In addition, it should be noted that the virus is detectable for up to three hours in aerosols, up to four hours on copper, up to 24 hours on cardboard and up to 2-3 days on stainless steel and plastic. These are all common materials delivered to businesses each day.

Supplying Gases to the Laboratory

The multiple touch points of bottled gas

Many analytical laboratories employ a variety of gases including nitrogen. zero air, pure air and hydrogen that are used to support instrumentation such as gas chromatographs, mass spectrometers, Fourier Transform-spectrometers (FT-IR), AA systems, and NMR systems. In many labs, dry boxes and other equipment that requires special atmospheric conditions are likewise employed.

In many labs, bottled gas is used to supply the requisite gas; in a large laboratory the bottled gas usage is frequently as high as 50 bottles per month.

The use of bottled gas requires that a large number of persons are involved with the supply of the gas to the entire organization.

The bottles must be received and stored, transported to the laboratory and then installed into the analytical system. When the contents of the bottle have been used up, the procedure is reversed and the empty bottle is returned to the supplier.

A cursory consideration of the number of touch points involved include a physical inspection of the tank when it arrives, moving the tank from the receiving area to the storage area, and finally to the laboratory using a hand cart, or a crane (for large tanks).

The movement of the tank will also involve touch points such as opening doors. Each operation entails a number of individuals to handle the gas cylinder; if just one person is asymptomatic it is very likely that the virus will spread as each one of these steps increases the possibility that the virus is transmitted to a surface. If any individuals employed for these operations is asymptomatic, it is possible that the virus is transmitted to the other individual; If the virus were transmitted to another individual, there could be a significant loss of manpower and the throughput of the lab would be dramatically curtailed, with the potential to impact customer demands and laboratory profitability.

In-house gas generation

Minimizes touch points

The use of a stand alone, in-house gas generator is a powerful alternative to the use of bottled gas as it eliminates the myriad number of personnel interactions involved with the use of gas bottles in the laboratory. As examples, when a gas system is installed, pure hydrogen is generated by the on-line hydrolysis of de-ionized water, while nitrogen, zero air and instrument air can be produced from an existing laboratory compressed air source or by utilizing a model with an integrated compressor. Once the unit is installed in the facility, it can produce the desired gas on a 24 hour/7 day a week basis with a minimum of user interaction, thereby eliminating the possibility of asymptomatic transmission of the corona virus. Once the unit is installed, only minimum maintenance is required.

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>
> — Peter Froehlich, Ph.D., Peak Media

Generating Hydrogen in the Lab

A safe, low maintenance solution

A Parker Hydrogen Generator (Figure 1) is based on the electrolysis of water and includes using a state of the art proton exchange membrane. This design eliminates the use of liquid electrolytes commonly employed with many hydrogen generators. The only maintenance required is to change filters every six months as automatic water filling is provided.

Systems are available from Parker that can provide an output capacity of up to 1300 cc/minute at a pressure of 175 psig to supply 99.99999+% pure hydrogen from 1 to 20+ gas chromatographs or GC-MS systems.

Many users have found that the savings obtained by in-house generation of hydrogen pays for itself in less than a year while dramatically improving safety.

Fig. 1. Parker Hydrogen Generator produces up to 1,300 cc/minute of 99.99999+% pure fuel and carrier gas at up to 175 psig.

How the system works

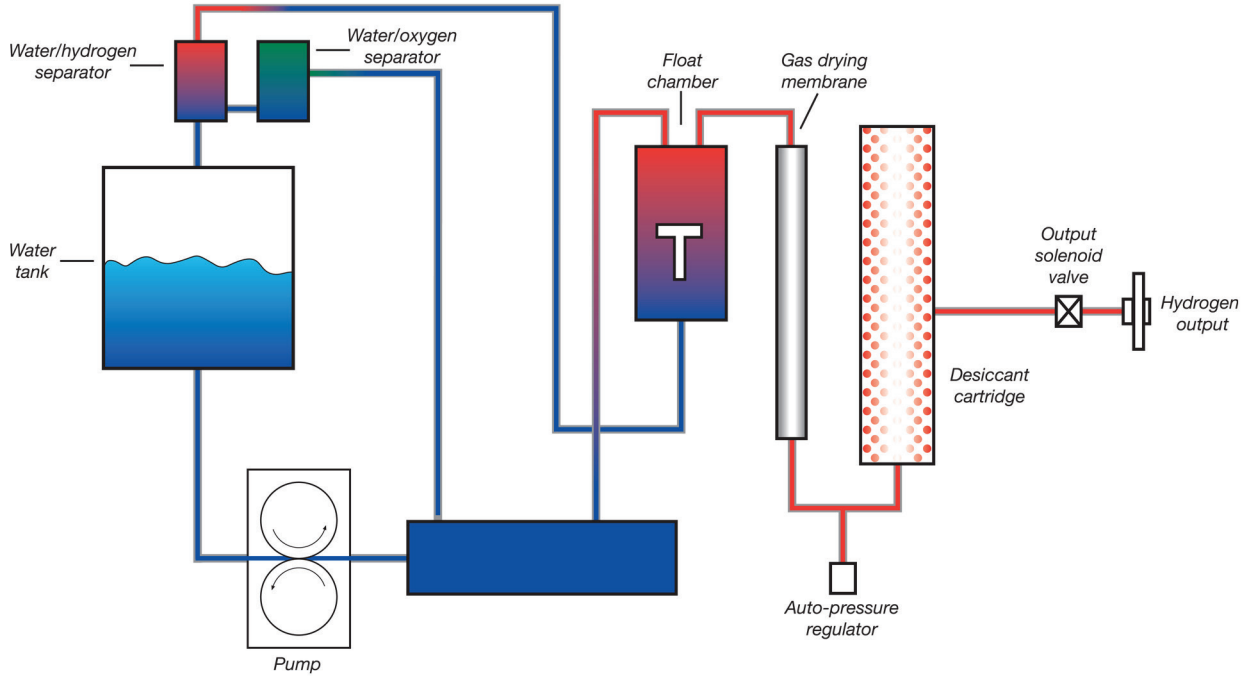

Fig. 2. Hydrogen gas is produced by electrolytic dissociation of water. The purity of the output gas is guaranteed to be 99.99999+% consistently..

Generating Nitrogen in the Lab

An uninterrupted supply at desired purity

Nitrogen can be generated in the laboratory via hollow fiber membranes or pressure swing adsorbtion.

Hollow fiber membrane-based system involves the separation of the components of compressed air by passing through a bundle of semi-permeable fibers. These fibers allow oxygen to permeate the fiber wall at a much more rapid rate then nitrogen. At the end of the fiber, the oxygen has been depleted. When sufficient number of fibers are employed, thousands of liters per hour of nitrogen of the desired purity can be obtained.

Pressure Swing Adsorption (PSA is based on the use of carbon molecular sieve (CMS), which is used to (adsorb) oxygen under high pressure, then release it under low pressure. A typical system contains two towers; one tower operates to remove the oxygen under pressure, while the other tower is held at low pressure where the oxygen is released. Then, on a predetermined cycle, the towers switch so that the one that was at high pressure holding oxygen is re-generated at low pressure while the other tower takes on the job of capturing the oxygen under pressure. This cycle progresses back and forth for many years of uninterrupted operation. A pre-filtration system keeps the CMS beds clean so the regeneration is not contaminated.

Generating Nitrogen, Zero-Grade and Dry Air for MS Systems

A Mass Spectrometry laboratory requires a constant supply of nitrogen, zero-grade air and clean dry air. If bottled gas is used, laboratory personnel must handle a significant number of tanks for normal operation, thereby significantly increasing the number of touch points that could promote the transmission of coronavirus.

The new ALIGN™ Multi-gas generator is a groundbreaking system that provides the necessary gases for MS using Parker's core technologies. The system eliminates the need for bottled gases there by eliminating the possibility that coronavirus is transmitted in the process of maintaining the constant supply of the necessary gases.

The gases supplied by the ALIGN multi-gas system meet the stringent Gas Quality Specification ISO 8573-1, Class 1.2.1 and supports the operation of MS systems from major manufacturers including all SCIEX systems and PerkinElmer QSight systems.

Fig. 3. The gases supplied by the ALIGN™ Multi-Gas Generator meet the stringent Gas Quality Specification ISO 8573-1, Class 1.2.1.

Ancillary Benefits of In-house Generation of Laboratory Gas

In addition to the very significant reduction of the number of personnel interactions involved in supplying laboratory gas and reducing the possibility of Coronavirus transmission, there are several additional benefits of supplying the required gas via an in-house generator.

- Lower costs, higher purities, delivered at safer pressures.
- Reduces Greenhouse Gas generation eliminating transport of heavy gas tank from supplier to laboratory and vice versa.
- 24 hr/7 day a week unattended operations.
- No need to change tanks-eliminates the possibility of introducing impurities.
- Parker Gas Generators have earned the approval for use by major instrument producers.

For additional information on in-house laboratory gas systems, contact Parker Hannifin at 1-800-343-4048 or visit www.parker.com/labgas.

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