Lab Manager

GAS GENERATOR RESOURCE GUIDE

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Questions to Ask When Buying a Gas Generator

Gas generators offer a reliable, cost effective solution for laboratories that require nitrogen, hydrogen, calibration gas, zero air, and more.

What level of purity do you require?

The level of purity required will influence which style of gas generator is required. For those requiring a lower purity of 95 percent or less, a membrane style gas generator would be the best fit. This style cannot provide the highest level of purity but is much more dependable and requires less maintenance. For high purity gases – up to 99.9995 percent – a pressure swing adsorption unit should be used.

What volume of gas do you require?

Many instruments that require gas to run have a specific operating range. If the amount of gas generated cannot keep up with demands, it could result in costly downtime. Many companies offer a variety of solutions to ensure that the correct level of gas is being produced.

Are long-term cost savings important to your project?

Beyond convenience, gas generators save on shipping costs, time-related costs for changing tanks, and managerial costs for managing the safety and supply of tanks.

Is noise a factor in your lab?

Noise can be both bothersome and present a real health concern for those exposed. If low-noise is desirable, consider a gas generator with detachable or low-noise compressors.

What service proposition comes with the gas generator?

There are a number of options available when managing a generator, whether that's getting an education in self-maintenance, knowing a service representative will be able to maintain the unit regularly, or having the ability to send a unit back to the manufacturer.

MAINTENANCE TIP

There are a few signs to look for that indicate it is time to service or replace your gas generator. A loud compressor, clogged air filter, or malfunctioning leak detection alarms mean it is time for service. To keep your generator functioning optimally, it is important to conduct annual preventive maintenance that includes changing filters. If working with compressed gas cylinders, check the cylinders for rust or pitting upon delivery.

Safer, Reliable, and More Economical: the Benefits of Gas Generators

Convenient, cost-effective and more accurate

By Mike May

Lug a tank of gas to an experiment station, break the connection to the old tank, unhook the device that keeps the tank in place, pull out the empty tank and wrestle in a full one, secure the tank in place, attach the regulator and repeat, repeat, repeat. In some circumstances, a station can go through a tank—even multiple tanks—of gas every day. Beyond the mere hassle of all that tank swapping, it gets costly and even dangerous in some cases. Moreover, all the gas-line changing can contaminate the gas. To get around these challenges, gas generators can replace the tanks.

There are several reasons for turning to a gas generator. First, using gas generators can be safer than using tanks. The MythBusters episode of sheering off a tank valve depicts the danger when the tank plows clear through a concrete block wall and bores partway through a second one before it stops.Many lab managers turn to generators for convenience, as the opening analogy suggests. Cost also plays a part. In addition to paying for the delivery of the gas, there are other related costs, including the time required to change the tanks and the managerial costs of maintaining the necessary supply of tanks.Based on the hard costs alone – just the cost of the gas cylinder– most generators will pay for themselves in two years.

Gas generators can also make a better product. Gas generated at a plant begins to degrade as soon as you start doing anything with it, even as the producer starts to fill a tank from a big supply. A generator can produce ultrahigh-purity gas that is consistent and reliable.

A generator for every job

The range of gas generators available keeps expanding. One class, the zero air gas generator, doesn't even sound as though it makes gas at all. This kind of generator makes air that is free of hydrocarbons, which is the kind of gas needed for many processes, including gas chromatography.

Other processes also need specific kinds of gas. For example, the Fourier transform infrared spectroscope, which is commonly used in quality assurance labs, runs better on gas that is free of carbon dioxide. So users need a gas generator that makes CO_2-free air.

Customers can also buy generators that make a specific gas, such as hydrogen or nitrogen. In fact, many users are looking to replace helium gas with hydrogen gas. Helium is a non-renewable resource that is running out. In some places, helium is rationed. Although hydrogen can replace helium in many applications, customers often select a hydrogen-gas generator over tanks because of this gas's flammable nature. Hydrogen gas generators include only a small volume of gas and produce only what you need, decreasing the risks associated with hydrogen use. Gas generators can also make specialty blends, which can be required for some applications such as vehicle-emissions monitoring. This is thanks to the purification, filtration, and gas generation technologies included in gas generator units.

Reliability represents a key trend across all gas generators. Extra features and upgrades are nice to have, but most users are looking for reliability. To some manufacturers, this means years of trouble-free performance. For example, in zero air gas generators, you should need to change the filter only once a year.

Feeding forensic platforms

Gas generators also help out in some areas of applied technology. For example, forensics combines the expertise of medical research and law enforcement. This field uses liquid chromatography/mass spectroscopy (LC-MS) to analyze a wide range of samples, and one government lab manager mentioned using nitrogen gas generators with this technology platform. He added that he and his colleagues include gas generators in a range of other systems, including hydrogen generators for flame-ionization detectors and for nitrogen and phosphorous detectors. Here the lab manager pointed out the safety benefits of a hydrogen-gas generator that make it preferable to a large tank.

This expert also noted that today's gas generators don't cause many problems, and they run and run. In fact, he laughed as he compared modern gas generators to the Energizer bunny.

Expanding capabilities

Another reason for more customers to use gas generators is that some instruments now require higher volumes of gas. The biggest growth in the gas generator market, though, comes from LC-MS platforms. In that case, the generators often need to be smaller. Labs using LC-MS are usually small and space is limited – generators take up less space than tanks of gas.

In a gas generator with an integrated compressor, the noise can be bothersome. So manufacturers are developing gas generators with compressors that can be detached and moved outside the lab. Noise reduction can help reduce health concerns in the lab.

Some customers need gas generators that capture performance data. This is especially true for industries that must comply with strict standards, such as the pharmaceutical industry.

As gas generators meet more needs and grow increasingly reliable, more applications could arise. Users will find even more reasons to swap out tanks for a generator. It can make lab life simpler, safer, more economical, and more successful.

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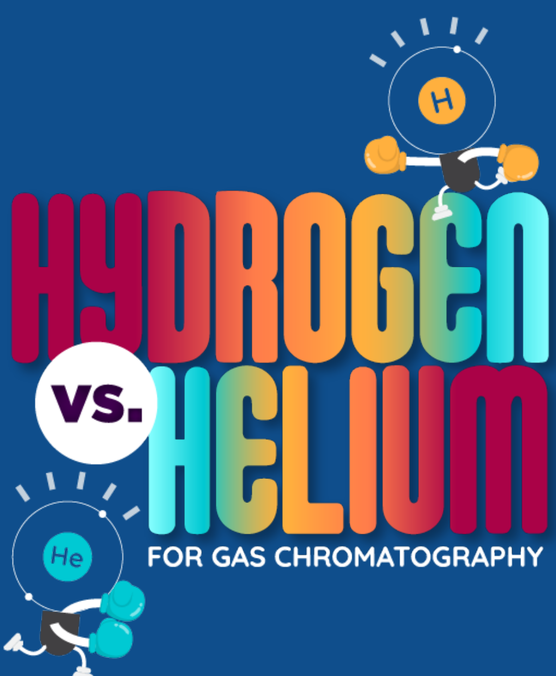
Hydrogen vs. Helium for Gas Chromatography **Infographic**

This infographic will show you the differences between hydrogen and helium in gas chromatography.

Download the full infographic compliments of *Lab Manager*



Gas Generators and the Benefits of Preventive Care

Labs are increasingly doing away with gas cylinders and acquiring on-site gas generators instead

By Erica Tennenhouse

A number of factors, including cost, safety, and the environment, are motivating the change to onsite gas generators. The lower maintenance demand of gas generators versus gas cylinders is another key reason why so many labs are eager to get themselves set up with an on-site gas solution.

Cylinder maintenance woes

Gas cylinders can require regular and intensive maintenance. The high maintenance demands of gas cylinders come down to the fact that cylinders have a finite supply of gas. Because of this limited supply, cylinders need to be monitored and tracked, replacement cylinders need to be ordered before supplies run low, the cylinders need to be received, and then they must be moved to the laboratory and installed. Cylinders also require gas regulators, which should be inspected annually and replaced every five years.

Along with requiring time and logistical planning, the maintenance cycle of a gas cylinder can also impact the purity of the gas and the safety of lab personnel. Whenever the cylinder is disconnected, humidity, air gases, and any other impurities in the surrounding environment can enter the piping. The use of compression fittings also means two metals are being crushed together, creating particulates that end up in the gas supply.

Simply moving around a heavy cylinder filled with flammable gas is a considerable safety hazard, especially given the fact that the task typically gets relegated to graduate students or research scientists who might not have received sufficient safety training.

Gas generators keep it simple

A gas generator, on the other hand, requires far less maintenance and avoids many of the safety and gas purity issues associated with maintaining a cylinder. An annual preventive maintenance procedure is normally sufficient for a gas generator. Users should conduct all regular maintenance outlined in the user manual for their particular gas generator. As for other general maintenance tips, experts suggest using high-quality deionized water for hydrogen gas generators as anything of lower quality could damage the machine. They also advise users to ensure that their generator is exposed to the right environmental conditions: temperature below 35 degrees Celsius and humidity below 80 percent.

Annual preventive maintenance for gas generators mainly consists of changing air filters, if it's a nitrogen or zero air gas generator, or changing water filters or gas filters in the case of a hydrogen gas generator. The maintenance cycle, regardless of what type of gas is being produced and how large the unit is, should take approximately one to two hours annually.

No time? No problem

Lab members can perform their own maintenance, but many manufacturers offer service contracts. In this case, service providers will organize the maintenance and schedule it at a time that is convenient for the user, so you don't need to worry about scheduling downtime.

Whether users take care of their own maintenance or outsource it, gas generators offer more tangible benefits than gas cylinders in terms of ease of maintenance.

Product Spotlight:

The H-Genie is the first intelligent, high-pressure hydrogen gas generator explicitly designed for chemistry and GC applications. It can generate hydrogen gas at pressures up to 100 bar (1450 psi) safely from water at a rate of up to 1 L/min. The system is designed to work with balloons, batch reactors, flow reactors, and GCs. It utilizes an integrated mass flow controller and can monitor gas consumption, plot your usage, and even let you know when a reaction has completed. The data can then be exported for report analysis and write-up.

Learn More

Hydrogen and Nitrogen Gas Generators in GC-MS and LC-MS

Both analytical methods require a reliable supply of highly purified gas, of one kind or another based on preference for the sake of variables such as efficiency, expense, and safety

By Brandoch Cook

The expanding roles of proteomics and metabolomics in precision medicine and drug discovery highlight the power of mass spectrometry-based techniques to identify, define, and quantify novel biomarkers, molecular interactions, and expression patterns. The popularity of these fields has consequently brought the associated technology to the individual laboratory both in terms of accessibility and cost.

A prerequisite to an accurate analysis of the proteins in a sample is thorough separation, which is most frequently accomplished via gas chromatography (GC) or liquid chromatography (LC). Both methods require a reliable supply of highly purified gas, of one kind or another based on preference for the sake of variables such as efficiency, expense, and safety.

In GC, the mobile phase consists of a carrier gas through which the solute can move from the stationary phase. Several gases are appropriate—including hydrogen, nitrogen, and helium—but each has intrinsic diffusivity and viscosity properties that make it more or less ideal as a carrier. The comparatively low diffusivity of nitrogen impacts efficiency and therefore throughput, while the high viscosity of helium necessitates high inlet gas pressure and therefore longer separation columns. Additionally, although helium is atmospherically abundant, it is largely released as a byproduct of commercial natural gas exploration, and dissipates rapidly upward into space unless purposely sequestered. As the Federal Helium Reserve curtails its operations, a worldwide shortage is becoming dire and its price is becoming dear, while nitrogen and hydrogen are all around us, all the time, for the taking.

Hydrogen also serves as a fuel gas for flame ionization detection in GC-MS. A small laboratory intermittently running a single GC-MS setup can often justify using a single, interchangeable hydrogen cylinder. In larger operations that dedicate significant space, time, and resources to multiple GC-MS devices running simultaneously, the use of cylinder gas requires oncurrent employment of multiple bundled tanks. Such elaborate setups necessitate automatic manifold-based switching mechanisms. They are often subject to zoning laws and principles of common-sense self-preservation placing them outside the laboratory space, making them prone to leakage and other disruptions that require the input of professional repair services. Bundling several hydrogen tanks under high pressure can be disastrous because of the potential for explosion or rapid displacement of ambient oxygen and possible asphyxiation.

Operational costs even for one apparatus can add up quickly. For example, if a 100-liter hydrogen cylinder lasts 10 days and costs \$200, then replacement costs alone will exceed \$7,000 per year, without factoring in equipment rental and delivery. Moreover, supply is disrupted when a cylinder empties, potentially affecting experimental planning and results.

Hydrogen generators mitigate many problems with cylinder-based supplies. They retail from around $10,000 upwards, potentially realizing a savings within a year of use, even to replace a single tank. Generators can run constantly, producing an uninterrupted and highly pure source of hydrogen, usually with minimal operational and repair costs beyond continued use of an electrical outlet and a supply of deionized water. Additionally, they produce and store only small amounts of hydrogen at comparatively low pressures, eliminating the catastrophic hazards associated with cylinders. Finally, a diminutive footprint allows them to be maintained within the laboratory space, often on or under benchtops.

Hydrogen generators function via water electrolysis or methanol reformer processes, although most commercially available units for GC applications use electrolysis. The essential engine of the generator is an electrolysis cell, across which a constant voltage drives a reaction that removes electrons from water at the anode and adds them back to hydronium ions at the cathode across a proton exchange membrane. This membrane is approximately worth its weight in gold, because it is most often composed of palladium, a transition metal listed on commodities exchanges. Additional use of a platinum catalyst increases the purity of the resulting H_2 gas to levels above 99.999 percent, a baseline for many GC-MS applications.

If hydrogen generators can improve GC-MS in terms of cost, efficiency, and safety, then what about gas supply solutions for LC-MS? Although LC-MS is used to examine liquid or solid analytes, a gas source is required to eliminate solvent in a sample before it enters the detector from an ion source. Nitrogen most frequently serves this purpose and acts as an ionization aid in both electrospray and atmospheric pressure-based LC-MS setups, and serves as a curtain gas to enclose nebulized ions at high temperature as they enter the detector. In a nitrogen generator, N_2 is purified from ambient air, which is compressed and subjected to pressure swing adsorption. This procedure functions on the principle that gases are attracted to adjacent surfaces under high pressure. After adsorption, swinging the system to low pressure releases the collected gas of interest. Because different surface materials have intrinsic attractions for different gases, constituent gases can be selected using different adsorbents.

Because the volumetric demands for nitrogen in LC-MS can exceed a cylinder per day with constant use, switching to a generator system can provide a savings benefit within less than a year after purchase, similar to a hydrogen generator for GC-MS. Nitrogen generators cost more, however, starting at around $15,000, and often come separate from attachments such as air compressors. There are several leading suppliers that offer a range of generators of both types, in addition to zero air generators, which remove hydrocarbon impurities from ambient air. Zero air has common applications in both GC-MS and LC-MS, especially in analysis of aromatic hydrocarbons.

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