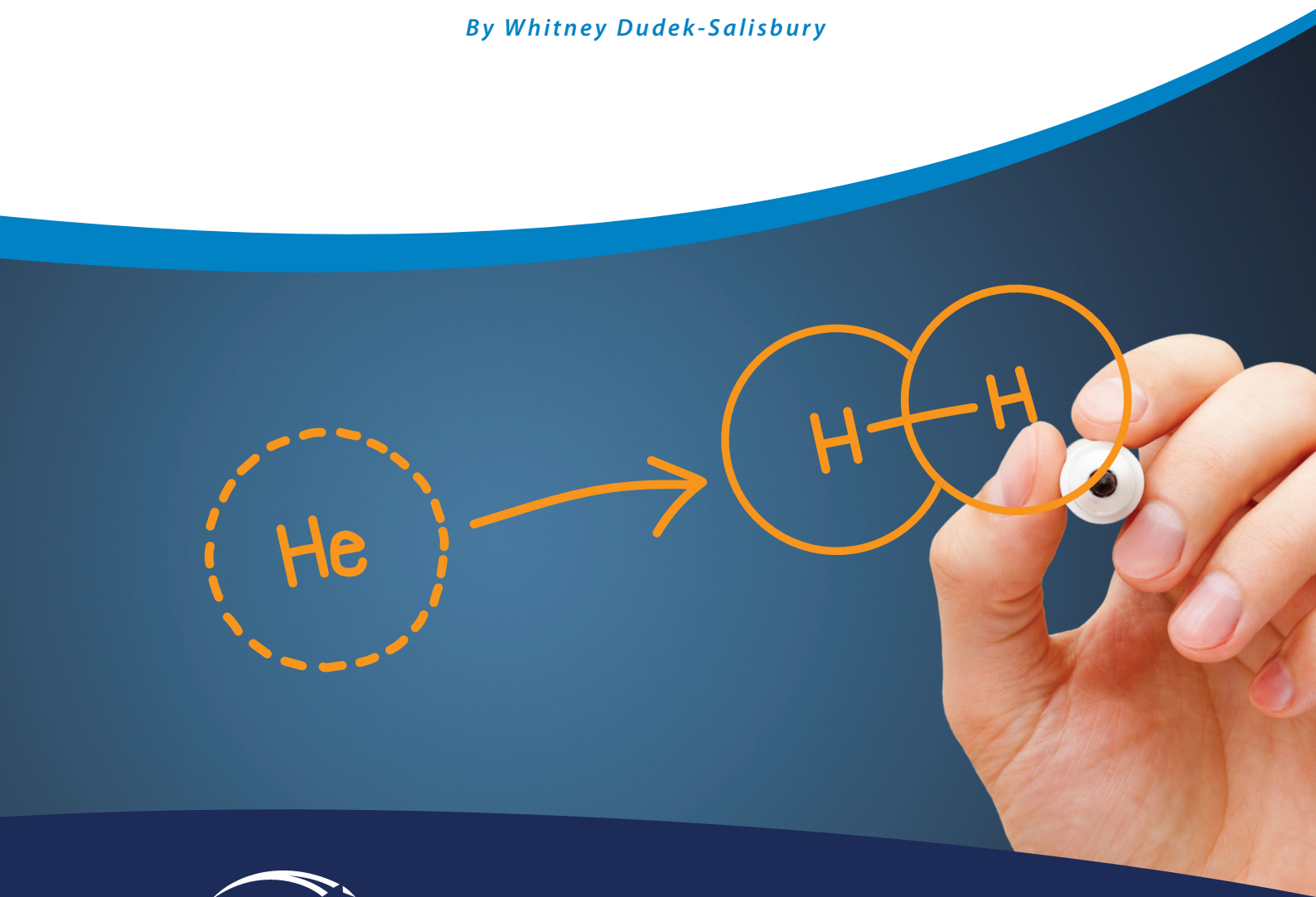
The Hydrogen PLAYBOOK

A Practical Guide for GC Labs on How to
Reduce Helium Dependency

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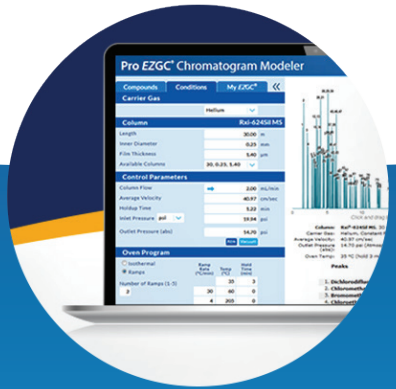
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INTRODUCTION

Let's Talk About HELIUM

You know the feeling. The purchase order that comes back 30% higher than expected; the supplier notice that opens with "due to allocation constraints…"; or the unexpected scramble because your helium delivery got pushed back again. The current helium shortage has created major pain points for labs that aren't going away anytime soon.

Helium is a nonrenewable resource that's gone through five distinct global shortages since the early 2000s, three of them in just the last eight years [1], and prices have soared accordingly, and in some cases, even doubled [2]. In addition, suppliers have cut customer allocations to as little as 45% of normal volumes, making reliable sourcing quite challenging [3]. Every shortage has left the market at a new, higher-cost, less-certain baseline, so waiting for helium to go back to "normal" isn't a long-term strategy.

The good news for GC labs is there's a well-documented, widely adopted solution: switching your carrier gas to hydrogen. In this guide, you'll learn why hydrogen is the best option, how to make the switch, and how to reduce helium consumption for methods that can't be migrated.

CHAPTER 1

Why Hydrogen Is Your Best Move

If you could cut costs by avoiding the helium market, generating carrier gas on demand, and running samples faster, would you? **Here's how hydrogen delivers those practical benefits.**

Stop Buying Helium

One of the biggest benefits of using hydrogen is that you can generate it on site and on demand, so you're no longer dependent on the shrinking global helium supply. And, with a benchtop hydrogen generator, your lab can produce its own ultra-high-purity hydrogen from deionized water and electricity as you need it, so there's no need to buy and store large quantities of gas. Once your methods are converted, your lab is protected from the next helium price spike or supply disruption because it no longer needs helium at all.

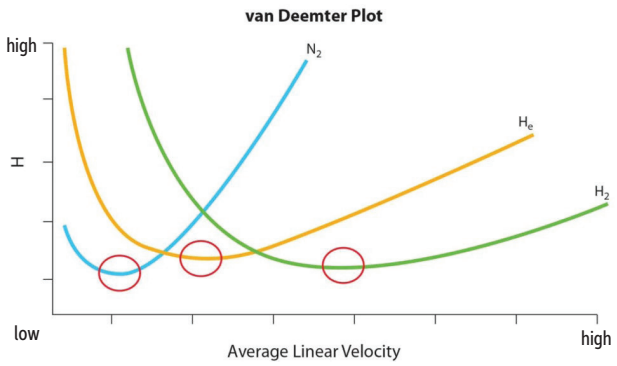
Prioritize Safety

Safety is a top concern when considering a switch to hydrogen carrier gas. Fortunately, hydrogen generators mitigate most of the risk by engineering safety into their design. For example, since generators produce hydrogen on demand, they generally store much less gas than free-standing, high-pressure gas cylinders. Generators also include important safety features, such as leak sensors and automatic shut-off capabilities that can prevent gas buildup by turning the generator off.

Speed Up Sample Analysis

Sample throughput is a top priority for most labs, and converting methods to hydrogen carrier gas lets you achieve the same separation in much less time. The reason for this is best illustrated by van Deemter curves, which plot efficiency (higher efficiency is indicated by lower plate height [H]) versus linear velocity. In this comparison of common carrier gases, it's clear that hydrogen carrier gas allows high-efficiency separations under faster conditions and over a wider range of linear velocities than can be achieved with helium or nitrogen [4].

Optimum efficiency (indicated by red circles) is achieved at faster speeds when using hydrogen compared to other carrier gases.



In practice, using hydrogen carrier gas means you can operate at higher flow rates and achieve similar separations in much less time, which translates into real-time resource and cost savings. For example, a documented detailed hydrocarbon analysis (DHA) analysis ran in half the time using hydrogen compared to helium [5]. Faster runs mean more samples can be analyzed by your existing instruments per day, so you can increase sample throughput and lab profitability.

None of this means hydrogen is a drop-in replacement for every method on every instrument. But it's a powerful solution where it fits, so the next chapter explores how to determine when hydrogen is the right choice and when it isn't.

CHAPTER 2

Is Hydrogen Right for You?

Hydrogen may be the best long-term solution for many GC labs facing high helium cost and supply pressure, but it isn't the right choice in all situations. Before you decide if hydrogen is right for your lab, run through this checklist.

PLAY 1 Method Compatibility

Start by determining if your method and target analyte lists are compatible with hydrogen.

Does your method explicitly require helium as the carrier gas?

If so, you'll need to leave it on helium and use the gas reduction tactics in Chapter 4.

Does your method include halogenated, chlorinated, or highly reactive unsaturated compounds?

Hydrogen can react with some of these under certain conditions, so these methods need extra consideration before converting.

PLAY 2 Instrument Compatibility

Your detector is the main consideration when evaluating a move to hydrogen carrier gas. Review these guidelines and check with your instrument manufacturer for specific recommendations.

- Electron capture detectors (ECD) are not good candidates because hydrogen can react with electrophilic compounds and reduce sensitivity.
- Mass spectrometer (MS) detectors (except for ion trap instruments) generally can be switched to hydrogen, but some hardware optimization may be needed (e.g., use of a specialized source). In addition, you need to confirm that the pumping capacity of your MS detector is sufficient for hydrogen since it is a lower viscosity gas than helium. *Note that smaller bore columns (e.g., 0.18 mm ID) are required to reduce the volume of hydrogen entering the source.*
- Flame ionization detectors (FID); thermal conductivity detectors (TCD); and many other common detectors are strong candidates for conversion to hydrogen.

While the detector may be the deciding factor, keep in mind that even for compatible detectors some system changes will be needed for optimal performance. For example, when converting to hydrogen carrier gas, you should also replace copper tubing with stainless-steel tubing to prevent analyte degradation. In addition, GC method parameters will need to be translated from helium to hydrogen, which is a simple task using the free, online *EZ*GC method translator that is covered in Chapter 3.

PLAY 3 Organizational compatibility

Hydrogen must be used with caution because it is an explosive gas, but your organization may already be set up to handle it if you operate FIDs. Check with your facility and safety teams to determine if there are any infrastructure or training requirements before you switch to hydrogen.





Make The Call

If you've got green lights in all three areas—method, instrument, and organizational compatibility—you're ready to convert your methods in Chapter 3. If not, that's not a dead end, jump to Chapter 4 for what you can do right now to reduce helium consumption in your lab.



CHAPTER 3

Ready to Convert? Here's How

Prioritize Your Methods

Don't try to convert everything at once. Rank your candidate methods—the ones that passed the Chapter 2 checks—based on the following factors.

- **Helium consumption and run frequency:** your highest-volume methods will return savings fastest.
- **Ease of validation:** a nonregulated or internal method makes a lower-risk pilot than a fully validated regulatory method.
- **Business impact:** choose the methods that will most improve sample turnaround or free up instrument time.

Pick one or two pilot methods and convert and validate them fully. Then, use that experience to build your lab's own internal playbook before scaling up.

2 Build In Safety by Using Generators

The safest way to run hydrogen carrier gas is also the most practical one: generate it on demand instead of storing it. A benchtop hydrogen generator produces ultra-high-purity hydrogen from deionized water and electricity, holding only a small working volume at any given time, which is fundamentally a much safer design than a bank of pressurized cylinders [6,7].

Generator SPOTLIGHT

Restek's current hydrogen generator lineup spans two series, H2F and H2C, with ten capacity options between them, so you can match output closely to your lab's flow demand instead of over- or underbuying.

Model	Output	Purity	Compliance	Cat Number
H2F-100NA	100 cc/min	99.9995%	NFPA 50A / OSHA 1910.103	29278
H2F-165NA	165 cc/min	99.9995%	NFPA 50A / OSHA 1910.103	29279
H2C-150	150 cc/min	99.99999%	NFPA 50A / OSHA 1910.103	23478
H2F-260NA	260 cc/min	99.9995%	NFPA 50A / OSHA 1910.103	29280
H2C-300	300 cc/min	99.99999%	NFPA 50A / OSHA 1910.103	23479
H2C-500	500 cc/min	99.99999%	NFPA 50A / OSHA 1910.103	23480
H2F-510NA	510 cc/min	99.9995%	NFPA 50A / OSHA 1910.103	29281
H2C-700	700 cc/min	99.99999%	NFPA 50A / OSHA 1910.103	23481
H2C-1000	1000 cc/min	99.99999%	NFPA 50A / OSHA 1910.103	23482
H2C-1300	1300 cc/min	99.99999%	NFPA 50A / OSHA 1910.103	23483

What Size Generator Do I Need?

Between the two series, it's easy to find a generator with the capacity you need, whether you are supplying a single GC or multiple instruments. Most generators can feed multiple GCs at once, so sizing is typically a single-generator decision for a small-to-mid-size lab, not a one-generator-per-instrument purchase [8].

1. **Add it up.** Tally the peak hydrogen flow rate for every instrument you plan to feed. Be sure to include carrier gas, FID fuel gas, and any hydrogen exiting the split vent.
2. **Total it across instruments.** Sum those numbers for every GC that will draw from the same generator.
3. **Add a buffer to your estimate.** Multiply by a buffer factor of 1.5–2.0x to ensure you get the actual output you need. For example, if you estimate needing 300 mL/min total, you should choose a generator rated between 450–600 mL/min.

Pro Tip: Round out your generator setup with the right safety hardware. Use a hydrogen flash-back arrestor on the line and verify every fitting is leak tight with an electronic leak detector before you bring the system online. Restek's "Dynamic Duo" bundle pairs the leak detector with a flowmeter, so you get the tools you need to confirm both leak-tightness and correct flow rate.

3 Convert Your Methods

Once your hydrogen generator and safety setup is in place, converting the method itself is a straightforward process and can be done accurately and efficiently using free, online *EZ*GC software [9,10]. With Restek's *EZ*GC tools, you can simply translate a method directly or further optimize it depending on your goals. Both tools allow you to easily modify methods in minutes from your desk rather than tying up instrument time in the lab. Keep in mind that smaller bore columns must be used when using hydrogen with MS detectors. For example, to convert an MS method using a 0.25 mm ID column, the conditions will need to be translated to a 0.18 or 0.15 mm ID column. Contact technical service for more information.

TRANSLATE AN **EXISTING METHOD**

With the *EZ*GC Method Translator and Flow Calculator

If you want to keep using your current stationary phase and simply translate your method conditions to hydrogen, follow these steps:

- Enter your existing column dimensions, carrier gas, and conditions.
- Select hydrogen as the new carrier gas and enter the dimensions of the column you want to use.

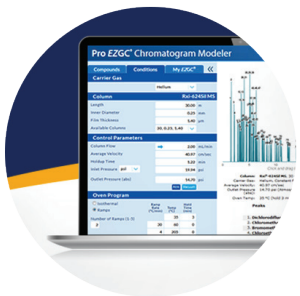
The *EZ*GC software instantly recalculates flow, linear velocity, holdup time, and a rescaled oven program for you. [11,12].



OPTIMIZE FURTHER OR DEVELOP A **NEW METHOD**

With the Pro *EZ*GC Chromatogram Modeler

Switching to hydrogen already requires revalidation, so you may want to use the opportunity to optimize your method by exploring different stationary phases. The Pro *EZ*GC chromatogram modeler lets you simulate separations on different phases and optimize other parameters, so you can compare retention times and resolution results with hydrogen and helium virtually before you decide on final parameters [13,14,15].



Once you have your final method, it's time to take it to the lab. Always verify method performance prior to analyzing samples.

- **Condition your system.** Initially, you are likely to see a slightly elevated baseline or tailing peaks, but these should be resolved after conditioning your GC under hydrogen.
- **Confirm performance.** Follow your lab's method verification protocol to ensure all performance requirements are met before approving the method for routine use.

CHAPTER 4

Not Ready for Hydrogen Yet?
Here's How to Reduce Your Helium Footprint

If you aren't currently able to make the switch to hydrogen, you don't have to just absorb rising helium costs. Here are real-world strategies for cutting consumption for the methods that use helium.

Start These Best Practices Today

- **Leak check consistently and use the right tool.** A worn ferrule or loose fitting can bleed helium for weeks before anyone notices. Always use an electronic leak detector to track down leaks rather than a liquid leak detector, which can damage your column's stationary phase and compromise results [16]. Restek's electronic leak detector (cat.# 28500) is rated for helium, hydrogen, nitrogen, argon, and CO_2, so it's an effective tool for whichever gas you're using.
- **Turn on Gas Saver Mode.** Most modern GCs support a gas-saver setting that reduces split-vent flow shortly after injection. In one documented example, activating it about a minute post-injection cut helium consumption by roughly 79% across a set of 100 analyses with no change to the separation itself [17].
- **Shut it down when you're not using it.** Don't leave carrier gas flowing through an idle instrument overnight or over a weekend. A quick purge-and-shutdown routine paired with a proper restart procedure costs only minutes and provides real savings [17].

Consider an Advanced Strategy: LPGC

If you need to stick with helium and general best practices aren't enough on their own, low-pressure GC (LPGC) is a technique you can use to reduce helium consumption dramatically [18,19]. LPGC leverages the MS detector vacuum to lower pressure and increase flow. Lower pressure means less helium is consumed per run and the analysis is also much faster. Here are the real-world savings one lab achieved by implementing LPGC.

LAB SPOTLIGHT: SATRA

SATRA, a UKAS-accredited independent testing and research organization, adopted LPGC for its arylamine analysis (testing for restricted dyes in textiles and leather) and reported [20]:

- 89% reduction in helium consumption for that analysis.
- Run time cut from about 40 minutes down to just over 15 minutes.
- Estimated savings of more than £1500 per year in helium costs alone.

Those results aren't outliers either, Restek's published application notes show similar patterns across other compound classes: 67% less helium and 1.4x faster for phthalates analysis; 69% less helium and 2x faster for MCPD analysis; and 60% less helium with sub-4-minute run times for fluorotelomer alcohols [21,22,23].

Is LPGC right for you? Restek's Quick-Start Guide to LPGC helps you determine if the technique will work for your application and walks you through how to get set up, so you can significantly reduce helium usage while increasing sample throughput [18].

CONCLUSION

You Now Have a PLAYBOOK

Pressure from the helium shortage isn't going away on its own. But you now have a real plan to avoid the pain: check whether hydrogen fits your methods and instruments; set up for safety by using a hydrogen generator; and use free tools like *EZ*GC software to convert your methods. And, if you can't switch a method, you can still lean on proven helium conservation tactics, such as leak checking, gas-saver mode, and LPGC to significantly reduce your consumption.

Labs that make the move and switch to hydrogen carrier gas now aren't just saving money. They're also removing themselves from a market that has proven it isn't stable. And that's a much better position to be in the next time a helium shortage makes headlines.

Want Help Switching to Hydrogen?

Restek's technical service team can help you choose the right setup and walk through the method transfer process with you.

Contact Us at www.restek.com/contact-us





References

1. Peak Scientific, Helium shortage 5.0. April 21, 2026, https://www.peakscientific.com/discover/news/helium-shortage-50/ (accessed September 25, 2026).
2. ChemAnalyst, Helium price trend and forecast in top 10 leading countries worldwide. June 2026, https://www.chemanalyst.com/Pricing-data/bulk-helium-1100 (accessed September 25, 2026).
3. T. Taylor, Not another helium crisis!, LCGC Int. June 9, 2022, https://www.chromatographyonline.com/view/-not-another-helium-crisis- (accessed September 25, 2026).
4. Guide to GC column selection and optimizing separations, Technical article, GNAR1724, Restek Corporation, 2021. https://discover.restek.com/articles/gnar1724/guide-to-gc-column-selection-and-optimizing-separations (Jan 28, 2021)
5. B. Burger, J. Pijpelink, Faster detailed hydrocarbon analysis (DHA) using hydrogen, Technical article, PCAR2891, Restek Corporation, 2020. https://discover.restek.com/articles/pcar2891/faster-detailed-hydrocarbon-analysis-dha-using-hydrogen
6. J. de Zeeuw, J. Whitford, Benefits and considerations of converting to hydrogen carrier gas, Technical article, PCTJ1729, Restek Corporation, 2020. https://discover.restek.com/articles/pctj1729/benefits-and-considerations-of-converting-to-hydrogen-carrier-gas
7. A. Sensue, Gas generators–part 1–hydrogen generators, Blog, Restek Corporation, 2023. https://discover.restek.com/blogs/gnbl4670/gas-generators-part-1-hydrogen-generators
8. Gas management supplies for GC labs, Technical article, GNSS1758, Restek Corporation, 2020. https://discover.restek.com/articles/gnss1758/gas-management-supplies-for-gc-labs
9. *EZ*GC online tools, Technical article, GNOT3445, Restek Corporation, 2025. https://discover.restek.com/articles/gnot3445/ezgc-online-tools
10. S. Ruiz Perez, How to switch your GC methods from helium to hydrogen—without disrupting your lab, Blog, Restek Corporation, 2026. https://discover.restek.com/blogs/gnbl5748/how-to-switch-your-gc-methods-from-helium-to-hydrogen-without-disrupting-your-lab
11. *EZ*GC Method Translator and Flow Calculator help, Technical article, GNOT3469, Restek Corporation, 2020. https://discover.restek.com/articles/gnot3469/ezgc-method-translator-and-flow-calculator-help
12. Restek Corporation, *EZ*GC Method Translator and Flow Calculator. https://ez.restek.com/ezgc-mtfc (accessed September 25, 2026).
13. Pro *EZ*GC Chromatogram Modeler help, Technical article, GNOT3468, Restek Corporation, 2020. https://discover.restek.com/articles/gnot3468/pro-ezgc-chromatogram-modeler-help
14. Restek Corporation, Pro *EZ*GC Chromatogram Modeler. https://ez.restek.com/proezgc (accessed September 25, 2026).
15. Will Pro *EZ*GC chromatography modeling software work for you? We put it to the test!, Technical article, GNAR2714, Restek Corporation, 2020. https://discover.restek.com/articles/gnar2714/will-pro-ezgc-chromatography-modeling-software-work-for-you-we-put-it-to-the-test
16. T. Bloom, Leak checking a GC system, Technical article, GNAR3221, Restek Corporation, 2020. https://discover.restek.com/articles/gnar3221/leak-checking-a-gc-system
17. Restek, 3 ways to reduce your helium usage, Video, (2022), https://discover.restek.com/videos/gnav3671/3-ways-to-reduce-your-helium-usage (accessed September 25, 2026).
18. Quick-start guide to LPGC, Technical article, GNAR4241, Restek Corporation, 2025. https://discover.restek.com/articles/gnar4241/quick-start-guide-to-lpgc
19. An introduction to low-pressure GC-MS (LPGC-MS), Technical article, GNAR3505, Restek Corporation, 2021. https://discover.restek.com/articles/gnar3505/an-introduction-to-low-pressure-gc-ms-lpgc-ms
20. How a SATRA lab used LPGC to cut helium use by 89% and run times by 50%, Technical article, GNAR4414, Restek Corporation, 2025. https://discover.restek.com/articles/gnar4414/how-a-satra-lab-used-lpgc-to-cut-helium-use-by-89-percent-and-run-times-by-50-percent
21. Faster LPGC-MS phthalates analysis uses 67% less helium, Featured application note, GNFA4234, Restek Corporation, 2025. https://discover.restek.com/articles/gnfa4234/faster-lpgc-ms-phthalates-analysis-uses-67-less-helium
22. Fast analysis of MCPDs by LPGC-MS, Featured application note, GNFA4239, Restek Corporation, 2025. https://discover.restek.com/articles/gnfa4239/fast-analysis-of-mcpds-by-lpgc-ms
23. Fast analysis of fluorotelomer alcohols, Featured application note, EVFA4311, Restek Corporation, 2025. https://discover.restek.com/articles/evfa4311/fast-analysis-of-fluorotelomer-alcohols

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