

# The LC Side of “Do More with Less”

Agilent InfinityLab LC Solutions



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## There's Nothing Routine about Today's Laboratory Environment

This year marks the 19th year I have walked the halls of what are sometimes referred to as “routine” laboratories—the ever-precious labs that continually ensure our water, food, medicine, and consumer goods are safe, effective, and authentic. These labs are filled with heroic and talented scientists and analysts, all of whom go to great lengths to do good science while under tremendous pressure, whether it is due to a deluge of samples from a recent food scandal or the check of a synthesis process that must be perfectly monitored.

Over the years I have seen these pressures only increase: resources are getting more expensive (energy, gases, reagents, solvents, lab space, talent) and analytes are becoming more and more complex (for example, antibody-drug conjugates, per- and polyfluoroalkyl substances, cannabis). The good news is that the vendors who supply laboratory equipment, consumables, software, and services are rising to the challenge; constantly innovating so these labs can continue to deliver the highest quality of data while making what used to be very manual and error-prone, more automated and efficient.

In these pages, you will read how we at Agilent Technologies have strived to make the most sophisticated, sometimes space-travel worthy, technology available to the laboratory environment in ways that increase sample throughput, boost uptime, and maximize space utilization, all while being a joy to use.

Another area of increasing pressure in the analytical lab is that of ever-changing technology and the vast amount of information that is readily available; these dynamics simply were not around when I ran my first test

on a finished drug product almost 20 years ago. Though the “consumption gap” was certainly present, it wasn’t a common term in discussion and it definitely did not apply to liquid chromatography. This too has changed—we know from our constant interactions with users and customers that even the most valuable features are underutilized; the capabilities that are embedded in Agilent liquid chromatographs to make the lives of these chemists easier are not always known and appreciated.

This eBook is an effort to change that—it provides a detailed overview of the unique approaches Agilent has developed to solve the everyday, but certainly not “routine”, problems in the modern laboratory.

**Jade C. Byrd,**  
**Director of Industry Marketing, Agilent Technologies, Inc.**

Jade has worked with laboratory-driven organizations implementing LC and LC/MS solutions for 13 years, first as an applications chemist and then as a product manager. Prior to working for LC vendors, Jade worked in the pharmaceutical space doing routine analysis and software-assisted chromatographic method development and validation. Today, Jade works to ensure that Agilent InfinityLab LC Solutions meet both the technical and business needs of her user communities, which include the (bio-) pharmaceutical, environmental, research, food, chemical, and energy markets and she is passionate about LC and LC/MS.



# Chapter 1

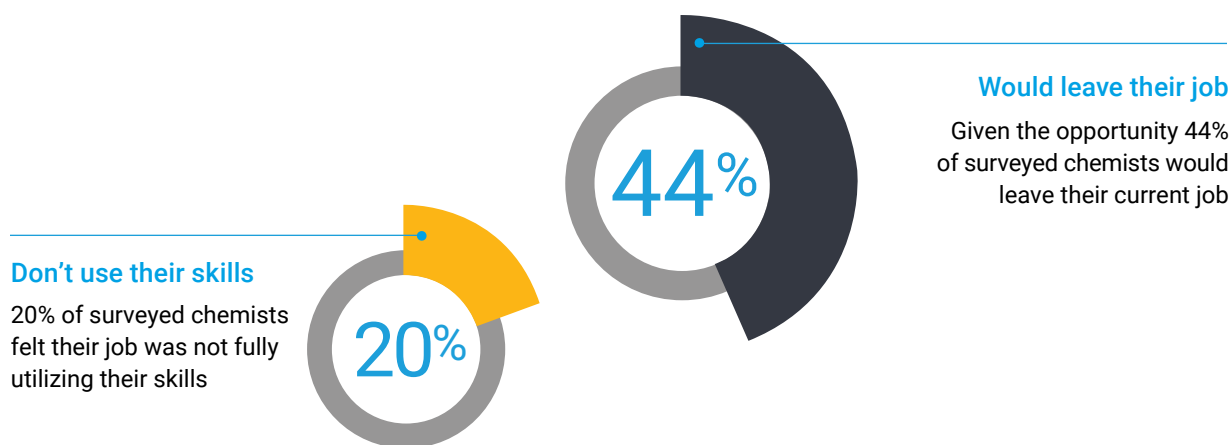
The Secrets to a Happy Lab  
Allow your staff to focus on what's important





## Employee Engagement

In a recent survey of analytical chemists, 44% were open to leaving their jobs given the opportunity and only 80% of respondents felt that their job was fully utilizing their skills.<sup>1</sup> While the nonscientific community struggles more with disengaged employees, it is clear to every lab manager that the quality of the results generated by the lab is affected not just by the skill of the laboratory staff but also by their loyalty and commitment.<sup>2</sup>

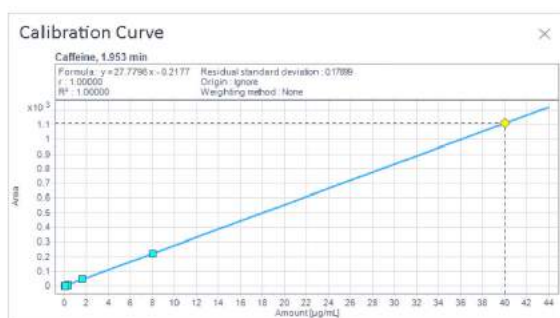


**Figure 1.** Flask half full? Modern LC instrumentation can help scientists feel more fulfilled in their work by reducing the burden of manual labor.<sup>1</sup>

## Removing Tedium

A major source of dissatisfaction in the laboratory is the need to spend time on monotonous tasks such as performing serial dilutions for calibration curves. Fortunately, modern LC instrumentation can reliably and reproducibly perform this task. The **Agilent 1260 Infinity II Multisampler**, for example, can perform precise dilutions within the autosampler device that correlate very closely to manual preparations, see Figure 2 (below).

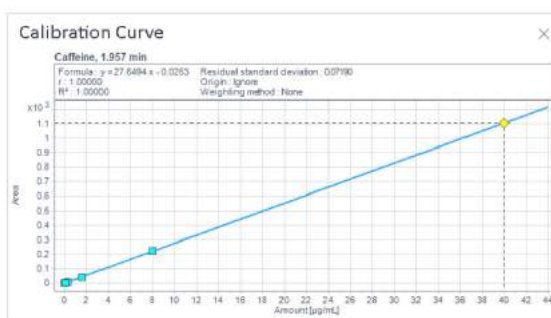
### Injector program:



#### Calibration table

Level	Avg.response	Avg.amount	Residual per level	Rel.residual	Rel.residual %	Response	Amount
1	0.392	0.013	0.2545	1.8463	184.6270	0.392	0.012800000
2	1.492	0.064	-0.0686	-0.0440	-4.4002	1.492	0.064000000
3	8.434	0.320	-0.2373	-0.0274	-2.7367	8.434	0.320000000
4	44.243	1.600	0.0134	0.0003	0.0303	44.243	1.600000000
5	222.065	8.000	0.0458	0.0002	0.0206	222.065	8.000000000
6	1110.958	40.000	-0.0078	0.0000	-0.0007	1110.958	40.000000000

### Manual dilution:



#### Calibration table

Level	Avg.response	Avg.amount	Residual per level	Rel.residual	Rel.residual %	Response	Amount
1	0.320	0.013	-0.0087	-0.0265	-2.6456	0.320	0.012800000
2	1.701	0.064	-0.0434	-0.0249	-2.4865	1.701	0.064000000
3	8.748	0.320	-0.0748	-0.0085	-0.8475	8.748	0.320000000
4	44.259	1.600	0.0458	0.0010	0.1035	44.259	1.600000000
5	221.273	8.000	0.1028	0.0005	0.0465	221.273	8.000000000
6	1105.928	40.000	-0.0217	0.0000	-0.0020	1105.928	40.000000000

**Figure 2.** A comparison of manually prepared standards to those made *in situ* within the 1260 Infinity II Multisampler using the injector programming capabilities.





### **Mind behind the Science**

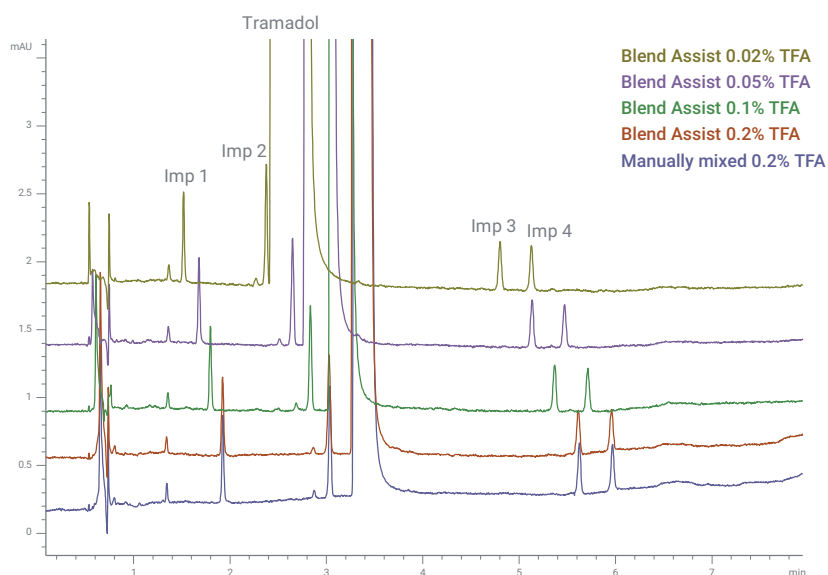
*"With the multisampler, there were plenty of engineering challenges that we overcame: the hotel approach, putting multiple plates in a vertical configuration in the same space as the injector, had not been done before. At first, I was doubtful we could cope with that, but we had some brilliant engineers on the team, and after some very encouraging feasibility studies, we moved forward with it. What we can do with one transport device required the combination of creating clever new mechanical parts and very sophisticated algorithms in the firmware, especially the calibration of the robot [position]. The firmware team really did a tremendous job!"*

**– Matthias Wetzel, PhD,**

Senior Engineering Director, Agilent Technologies, Inc.

## Eliminating Low-Value Activities

Additionally, the **Agilent 1260 Infinity II Flexible Pump** and the **Agilent 1290 Infinity II Flexible Pump** can create various concentrations and mixtures of mobile phase using software commands alone, a feature in the instrument control software called Blend Assist. These capabilities lead to a more pleasant laboratory environment because your highly trained staff is not wasting time on low-value, mundane activities.



**Figure 3.** The 0.2% TFA chromatogram (in red) shows the best separation of the main component and Impurity number 2. The mixing accuracy of the mobile phase composition created by BlendAssist software matches well with the manual preparation of the mobile phase (in blue).



There are also additional cost savings related to a reduction in the use of volumetric glassware and mobile phase bottles.

Learn more



**Watch a video** to learn more about the 1260 Infinity II LC with BlendAssist software.

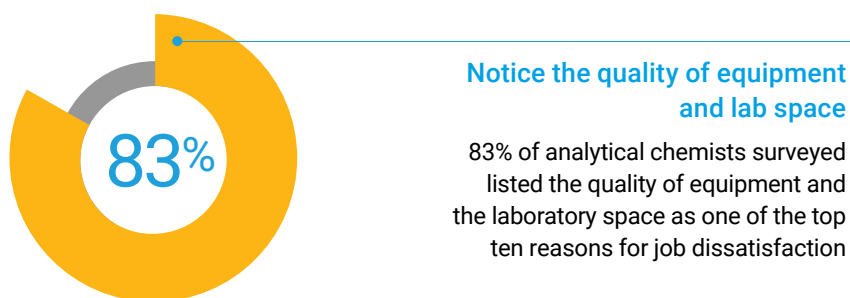


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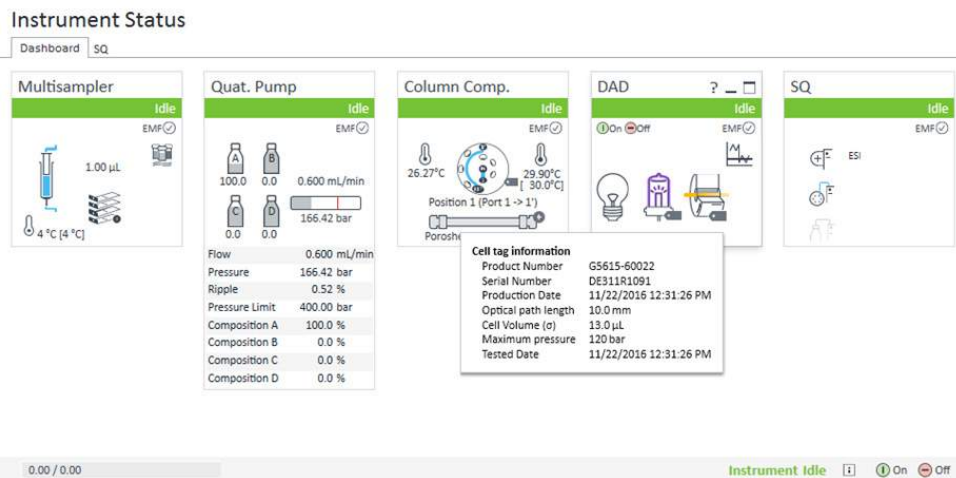
## Simplifying the Complex

The quality of equipment and laboratory space was reported by 83% of the analytical chemists that participated in the study (mentioned beforehand in the chapter “Employee Engagement”) as one of their top ten reasons for job dissatisfaction.<sup>1</sup> This directly correlates to the reliability of instruments and their ease-of-use.

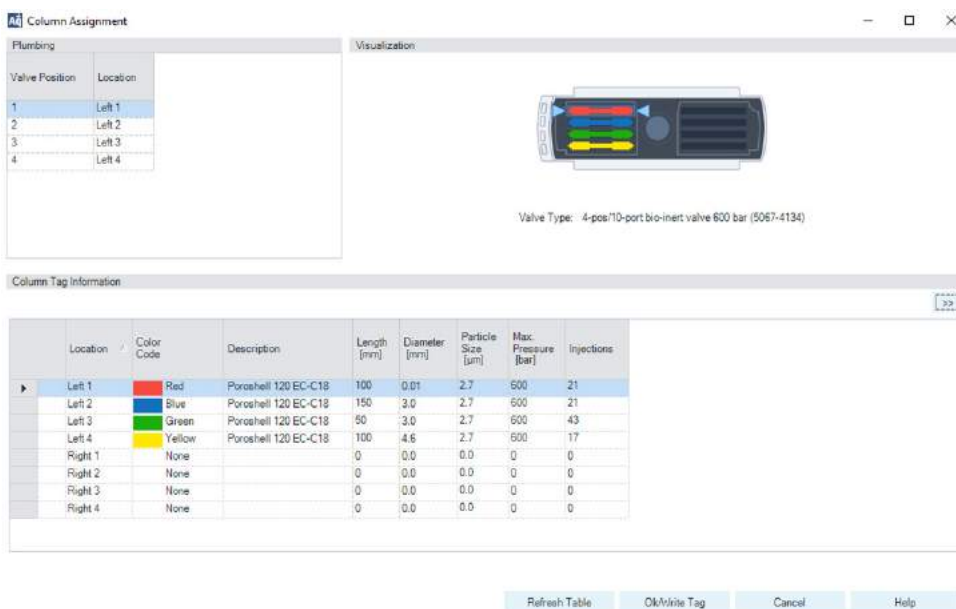


**Figure 4.** What’s in your toolbox? Quality instruments make scientists happy.<sup>1</sup>

As LC instrumentation advances, more and more configuration options become available (for example, multiple columns or different flow cells within an optical detector). In order to encourage a more error-free environment, it is important to provide the tools for both new and experienced analysts to run assays with a clear understanding of what is installed within the LC modules. Refer to Figures 5 and 6 for an example, where a user-centric software design has been fully implemented to allow analysts to understand the configuration of their instrument with a glance.



**Figure 5.** The instrument dashboard within the instrument control software clearly shows which type of flow cell is installed. This view is the same in a non-Agilent data system as in an Agilent data system.



**Figure 6.** Color-coded references of the installed columns in the instrument control software make it easy to understand what is installed in the instrument.

## One Interface in Many Chromatography Data Systems (CDSs)

The user-centric approach shown in Figures 5 and 6 has been implemented within Agilent's RC.NET interface and **Instrument Control Framework**, enabling the same user experience and training approaches for using Agilent LCs within a non-Agilent data system as with a data system in the OpenLab CDS suite. When an instrument is straightforward to use, experienced chromatographers can focus their talents on high-value (and more interesting) tasks.

*"The Agilent 1290 Infinity II is extremely useful because even nonanalytical researchers can easily perform measurement tasks."*

**– Kazuaki Kanai, PhD,**  
President & CEO of JITSUBO

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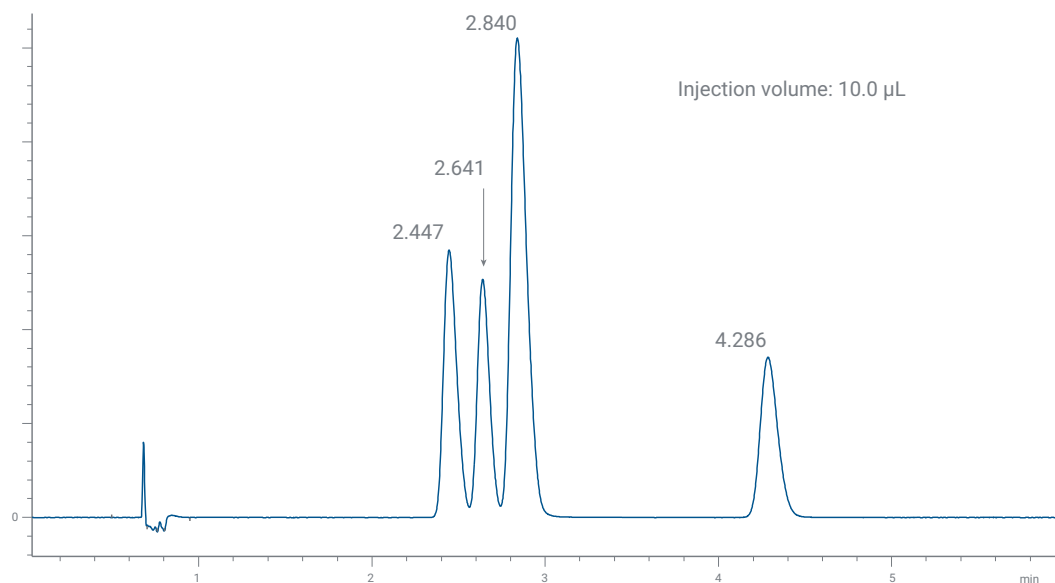
### **Mind behind the Science**

*“The one thing that I’m most proud of considering our instrument control strategy, is that with the advent of the RC.NET interface and Instrument Control Framework (ICF) and the generalization that we made there, we are now able to quickly deliver a new product or an enhancement to a new product with its complete functionality to multiple data systems at the same time... our users who are in non-Agilent data systems can enjoy the power of the Agilent LC systems as we intend them to; we can take care that whatever experience a user is having, either in our data system or from someone else, the experience is at the quality standards that we set, as Agilent.”*

**– Peter Nill, PhD,**  
Product Manager, LC Instrument Control

## Taking the Touchy to the Routine

For example, the adoption of truly orthogonal approaches, like Supercritical Fluid Chromatography (SFC), in labs that support production has largely been stymied by the perception that the technique is not appropriate for routine use. While there have been several publications where SFC has been shown to provide reliable and excellent results analyzing enantiomers, surfactants, explosives, essential oils, and lipids, the **Agilent InfinityLab SFC Solutions** have been specially-designed to be robust even for labs with the highest sample throughput demands.<sup>3</sup>



**Figure 7.** SFC separation of theophylline, caffeine, thymine, and theobromine using the novel FEED injection principle from Agilent. This injection principle provides additional robustness to SFC experiments because large injection volumes can be used without the degradation of the chromatography, which would normally occur from strong solvent effects.

*"The Agilent 1260 Infinity II Analytical SFC System is reliable and robust."*

**– Li Lin, PhD,**  
Director of Analysis, Bellen Chemistry Co., Ltd.

Learn more



**Download our SFC application compendium** with examples from the application fields of pharma, biopharma, food, and forensics as well as from chemicals and energy.

## No One Enjoys Broken Instruments

No matter how easy an instrument is to use, the instrument uptime is a critical parameter that leads to employee satisfaction. Unpredicted downtime can add additional stress to the lab environment and can lead to major conflict. Extensive troubleshooting is an additional waste of talent.

*"We don't have any idle instruments so for us it's especially critical to have instruments that just function and are something that I don't need to worry about."*

**– Julie Kowalski, PhD,**  
Chief Scientific Officer, Trace Analytics



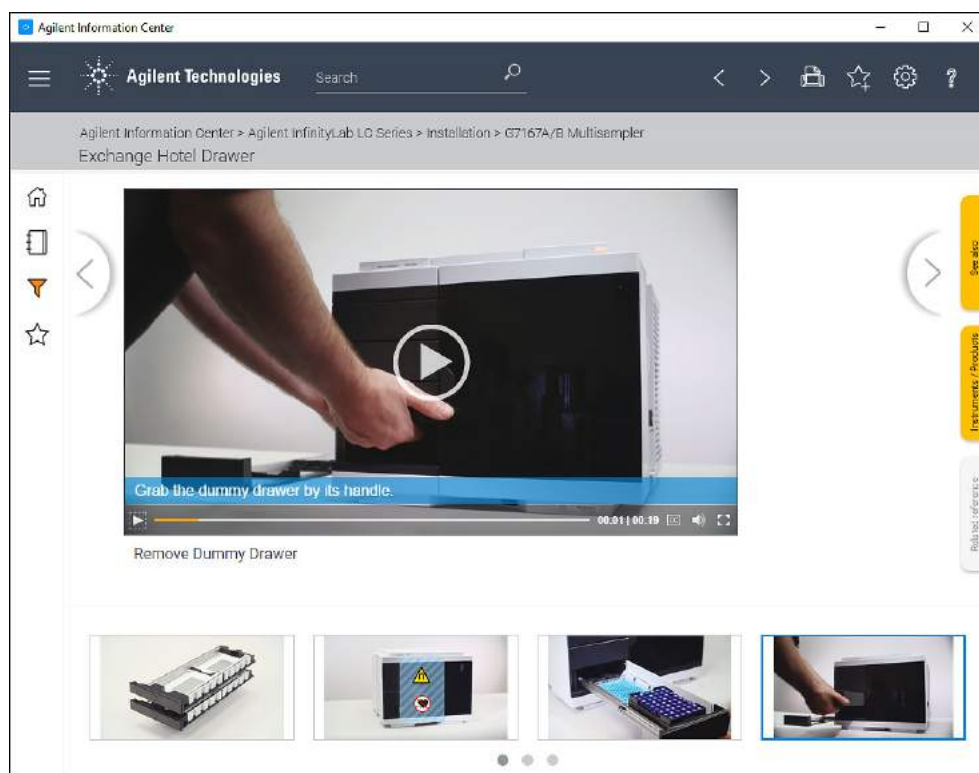
### Mind behind the Science

*"When it came to testing, the challenge was with the reliability testing; you can find yourself in a delicate position if the robustness tests come back and show we need to make a change after the design is frozen. The trick is not to be at the very edge; you need room to have the freedom to make important improvements as you learn more."*

**– Matthias Wetzel, PhD,**  
Senior Engineering Director, Agilent Technologies, Inc.

## Information on Demand

Career development activities for laboratory staff are recommended by the United Nations Food and Agriculture Organization as a way to ensure a positive working environment.<sup>4</sup> This brings us to the final pillar of employee retention—good training opportunities. The demographics of today’s modern analyst mean that LC training information must be current, searchable, and readily-available. To respond to this expectation, Agilent provides a searchable Information Center with every instrument purchase where users can self-educate on topics when needed, giving analysts the on-demand experience that they are accustomed to.



**Figure 8.** The Agilent Information Center has instruction videos such as this one demonstrating drawer removal in the 1260 Infinity II Multisampler.

## Chapter 2

One Instrument, Many Methods

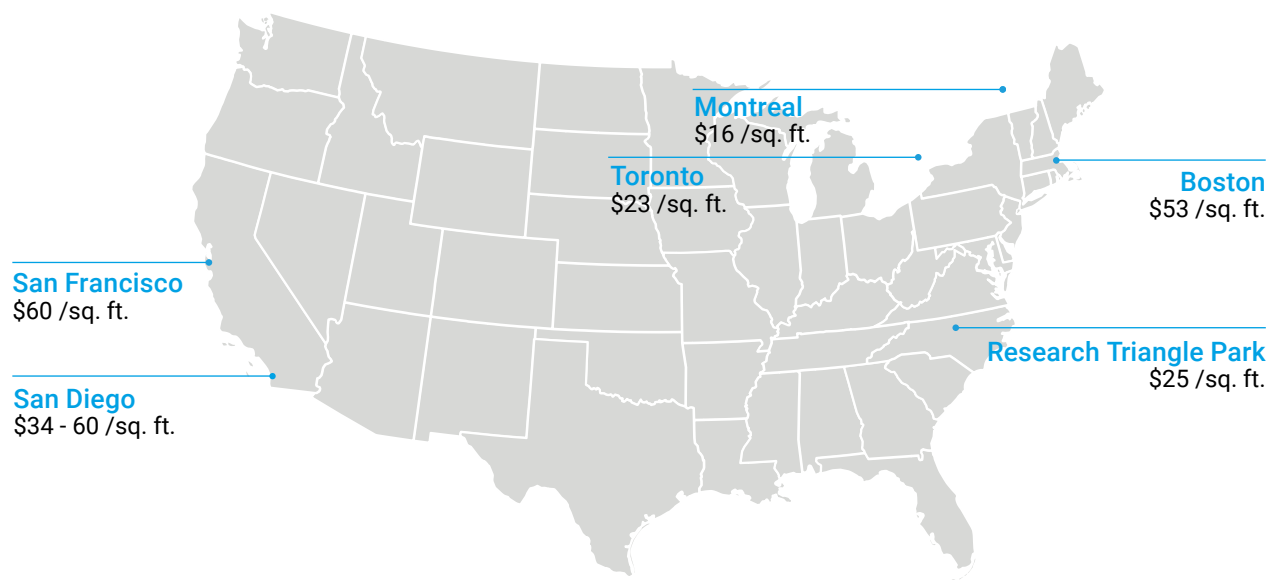
The days of dedicating instruments to methods are over





## Skyrocketing Costs

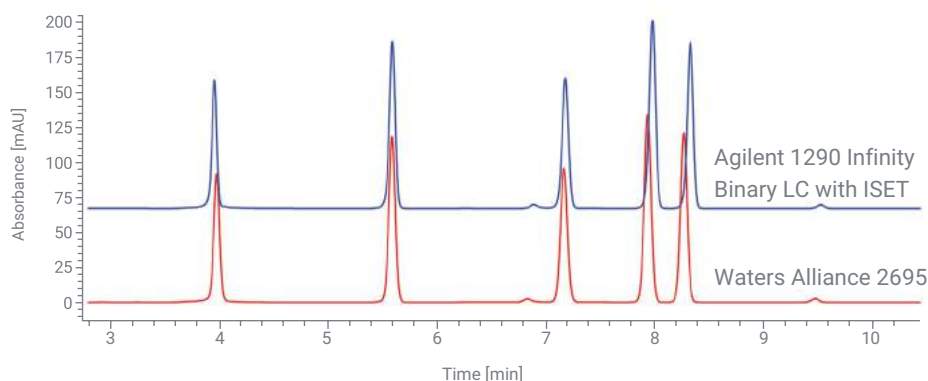
A 2004 publication exploring best practices for solid waste testing describes a long foregone situation: contract laboratories were able to achieve economies of scale by dedicating LC instruments to a particular analyte, independent of the customer or sample type.<sup>5</sup> As sample throughput demands increase, a common solution is to purchase and install more LC instrumentation; however, given the current costs of laboratory space (Figure 9), this approach is viable for only so long.<sup>6</sup>



**Figure 9.** Merely installing more LC instrumentation is a short-term fix given the high cost to rent lab space.<sup>6</sup>

## Expect More from Your UHPLC

A key strategy for many savvy lab managers is to invest in multipurpose LC systems—those that can either run both HPLC or UHPLC methodologies in a single flow path or systems that can run multiple methods overnight (or, more commonly, over the weekend) without human intervention. In the first case, traditional approaches require a compromise in reducing system volume in order to run sub-2  $\mu\text{m}$  column chemistries, but those design decisions have prevented the low-dispersion instruments from continuing to run HPLC-style experiments.<sup>7</sup> Agilent Intelligent System Emulation Technology (ISET), which enables UHPLCs to emulate legacy HPLCs by providing similar retention times and chromatographic resolution, is the solution for this fundamental problem.<sup>8</sup>



**Figure 10.** Overlay of an Agilent 1290 Infinity II LC system emulating a Waters Alliance 2695 HPLC using ISET (in blue), delivering similar retention times and chromatographic resolution as the original method (in red).

Learn more



**Download application notes** from the Agilent Application Finder.



#### **Mind behind the Science**

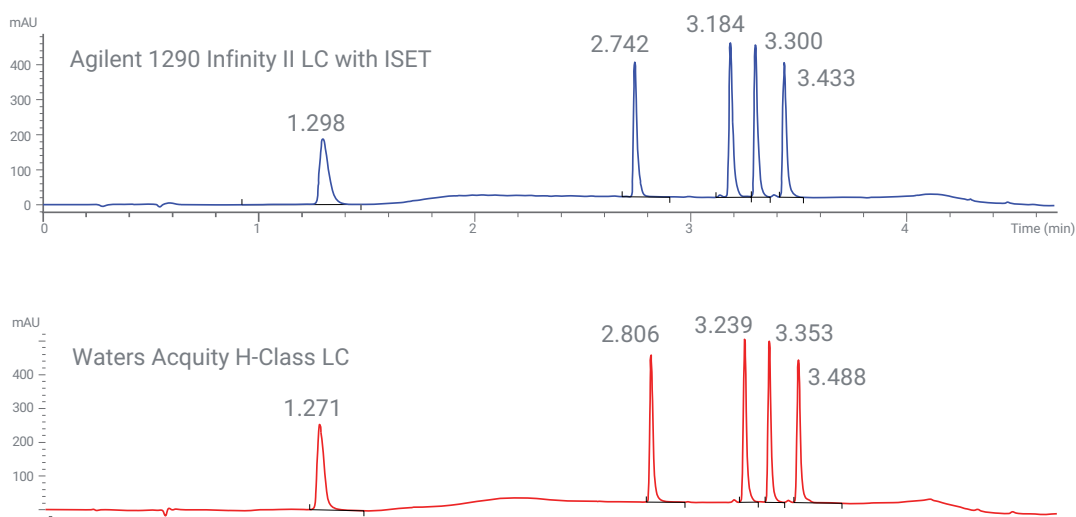
*"The 1290 Infinity system was optimized for very low dwell volumes and high pump accuracy. Some customers wanted to run their legacy methods on the new system but got deviating results due to the differences in system characteristics... an issue that needed to be addressed right away. We decided to go for a software-based system emulation (ISET) as we needed to address a large number of different system configurations (including systems from other vendors), which would have been impossible to achieve with hardware-based approaches."*

**– Monika Dittman, PhD,**

Principal Scientist, Liquid Phase R&D, Agilent Technologies, Inc.

## Replace UHPLCs from Other Vendors

The ability of a single instrument to run a wide range of applications, including HPLC and UHPLC in a single flow path, is a significant improvement over the prior practice of needing to dedicate specific instruments to UHPLC.



**Figure 11.** The Agilent 1290 Infinity II LC with ISET (in blue) delivers similar retention times and chromatographic resolution as the Waters Acquity H-Class when enabling ISET (in red).

*“By using ISET, the retention time and separation pattern obtained under the analysis conditions developed by other companies’ LC will be assured. It can be reproduced, enabling technology transfer without changing complex impurity profiles. It is a very important function for us.”*

**– Kazuaki Kanai, PhD,**  
President & CEO of JITSUBO



### Mind behind the Science

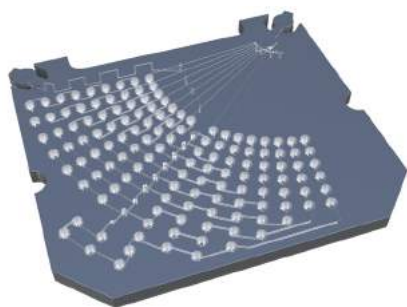
*"ISET is flexible—you don't need to do plumbing and get parts and pieces out of a drawer to modify your instrument. If you have an overnight run—possibly with different problems, different methods, even different columns—there is a lot of additional work that you have to consider. It isn't simply a matter of automating the process, because automation doesn't account for someone swapping components, verifying that the pumping is correct, checking for leaks, and so on. You could do automated valve switching but still, you are limited to what is installed in the instrument. If you use ISET, and use what is in the software implementation, then you don't worry about what is installed in the equipment. You can adapt to whatever has been the historic method development platform and then you can execute the method on the more modern instrument. You need to have lower volumes on the smart instrument than you have been using on the historical equipment... that is the only limitation."*

**– Klaus Witt, PhD,**

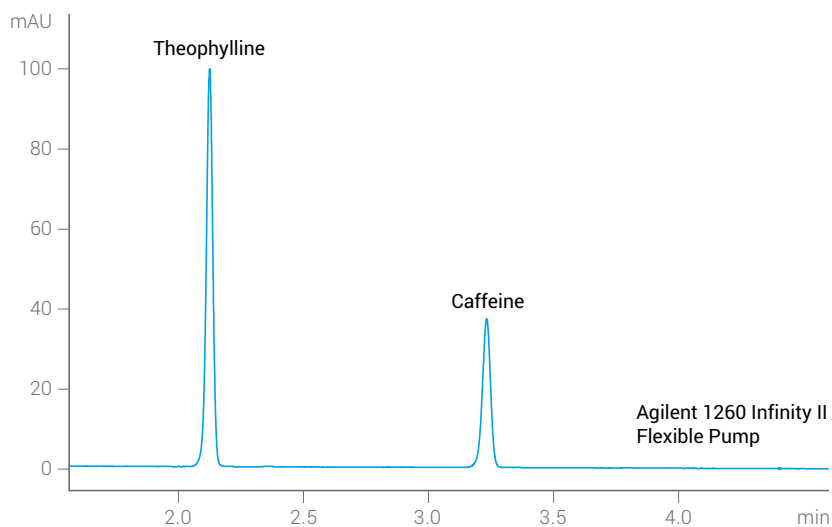
Senior Technology Lead, Liquid Phase R&D, Agilent Technologies, Inc.

## Space-worthy technology

The technical demands of emulating different types of systems, including UHPLCs from other vendors, include a very precise delivery of flow precision and also flow and compositional accuracy. A core hardware component in Agilent high-end pumps that delivers this excellent accuracy and precision is the Agilent Jet Weaver, which ensures thorough mixing of the mobile phase components without having a detrimental effect on the system's dispersion characteristics.

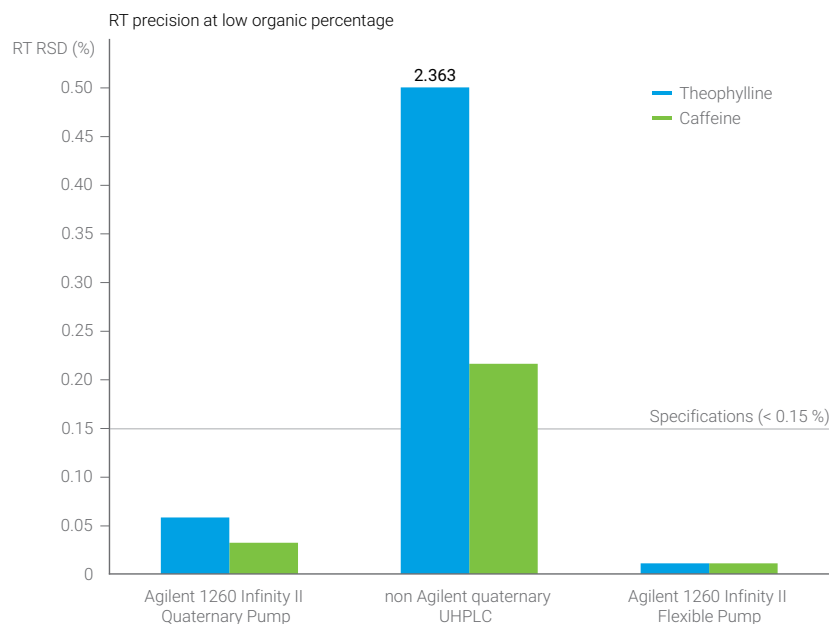


**Figure 12.** The design of the Agilent Jet Weaver provides excellent mixing efficiency within a very small volume.



**Figure 13.** A challenge experiment for demonstrating pump performance using a shallow gradient (change of 2% B per minute).





**Figure 14.** Unlike traditional quaternary mixing performance, the Agilent Jet Weaver enables a very high accuracy of mobile phase delivery, as represented by a very low (<0.06%) %RSD for retention time precision.



#### Mind behind the Science

*“The Jet Weaver is similar to a multilayer circuit board, but we manipulate liquids instead of electrons. The underlying technology has its origins in space travel and, for me, as an engineer, the goal should always be to use high tech to make the life of our customer or user as easy as possible, without confronting them with the fact that we use a very advanced technology.”*

– **Christian Ruf, PhD,**  
R&D Manager, Agilent Technologies, Inc.

## Any Sample Format

One of the largest challenges with running multiple methods within a single LC stack is variations in the sample format. If samples come from a variety of sources, there is no guarantee that they will arrive in the same type of container. The Agilent InfinityLab multisamplers have an elegant solution to this conundrum, employing a “hotel” concept to allow multiple types of containers to be used within a single autosampler device. Similar to hotels with VIP suites on the top floor and economically priced, smaller rooms on the lower floors, every multisampler allows for a diverse mixture of configurations. For example, 384 shallow well plates can coexist with 4 mL or custom containers in taller drawers within a single device.



**Figure 15.** Agilent 1290 Infinity II Multisampler with 2 mL vials and a 96 well plate installed in a single drawer. Taller and shorter drawers are also available to accommodate either larger sample containers or more samples.

Learn more



**Watch a video** to learn more about the 1290 Infinity II Multisampler.



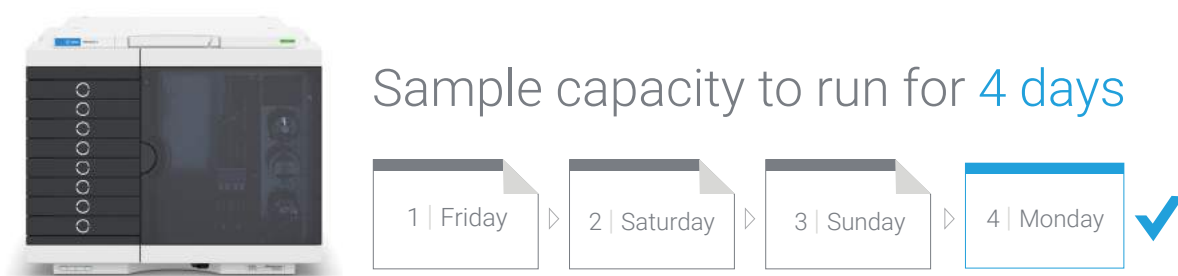
**Mind behind the Science**

*"I am definitely most proud of the flexibility of the multisampler... there is by far no other module in our LC portfolio which can compete with it in terms of flexibility for our users, for example the choice to do dual needle or the multiwash, it is up to the customer and they can change between when needed."*

**– Thomas Ortmann,**  
R&D Engineer, Agilent Technologies, Inc.

## 4+ Days of Uninterrupted Running

If 384 shallow-well plates are your most common format, 6,144 samples can be loaded into 16 shallow drawers for unattended analysis, meaning for a one-minute cycle time, more than four days of uninterrupted data collection can be achieved. The **Agilent 1290 Infinity II Multisampler** is a core component of the **Agilent 1290 Infinity II High-Throughput System**.



**Figure 16.** Four days of uninterrupted data acquisition is possible using the maximum capacity of the Agilent InfinityLab multisamplers (assuming a 1 minute cycle time).

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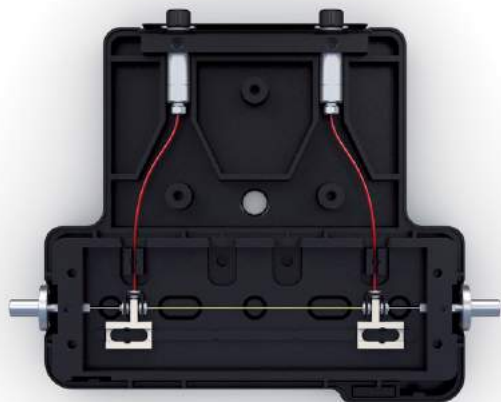
#### **Mind behind the Science**

*“Thinking about the multisampler, what I am most proud of is that 6,144 samples can be run unattended within the same spatial geometry as what previously could only handle two well plates of 384 samples each. It is purely very astonishing and is very unique in the marketplace.”*

**– Matthias Wetzel, PhD,**  
Senior Engineering Director, Agilent Technologies, Inc.

## Wide Range of Capabilities Is a Must

Hardware options (mixers, heat exchangers, detector flow cells, tubing) must be carefully considered and software features must allow for automated switch-over as the loaded instrument parameters change in a multi-method environment. Agilent has developed a specific instrument for this business objective, demonstrating robust and reliable analysis of antioxidants, sweeteners, and preservatives as application examples from a food control laboratory.<sup>9</sup> The **Agilent 1260 Infinity II Multi-Method System** has been specifically designed to give multiple users access to HPLC and entry-level UHPLC capabilities.



**Figure 17.** The Max-Light cartridge flow cell is a core component in the Agilent InfinityLab diode array detector.

*"It's a little bit of a game to get everything on your calibration curve if you don't have a wide dynamic range and the Agilent DAD system has shown us that, which allows us to do a lot of different types of samples without doing multiple dilutions."*

**– Julie Kowalski, PhD,**  
Chief Scientific Officer, Trace Analytics

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#### **Mind behind the Science**

*“At the time, UHPLC refraction variation in UV cells were very high and showed very bad apparent absorption effects. I did a huge number of so-called ray-tracing simulations and after a certain time I came to the conclusion that I cannot achieve the goals with classical approaches, so I knew we needed a technology leap... the light guiding technology was the technology leap we needed. It took me a long time to get this working... in the end, we tried fused silica and with this we made it and we were the first supplier to offer this in a robust and stable configuration.”*

**– Beno Müller, PhD,**  
R&D Manager, Agilent Technologies, Inc

## Dreams Come True in Method Screening

Another startling bottleneck in the modern laboratory is the definition of highly sensitive, specific, and precise LC methods for newly emerging contaminants, new polymers or new chemical/biological entities. As the fundamentals of chromatography theory dictate that column and mobile phase composition have the largest effect on chromatographic resolution, quickly and effectively evaluating the many possible combinations of columns and mobile phases is of paramount importance. This is the ultimate implementation of an instrument that is capable of running different methods; the **Agilent 1290 Infinity II Method Development System** can switch seamlessly between up to 5,400 separation conditions and the **Agilent Method Scouting Wizard** manages the creation of screening campaigns by automatically including necessary steps for equilibration, flushing and transition.

Learn more

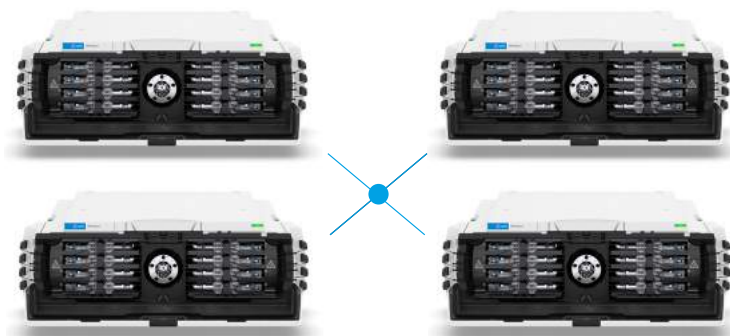


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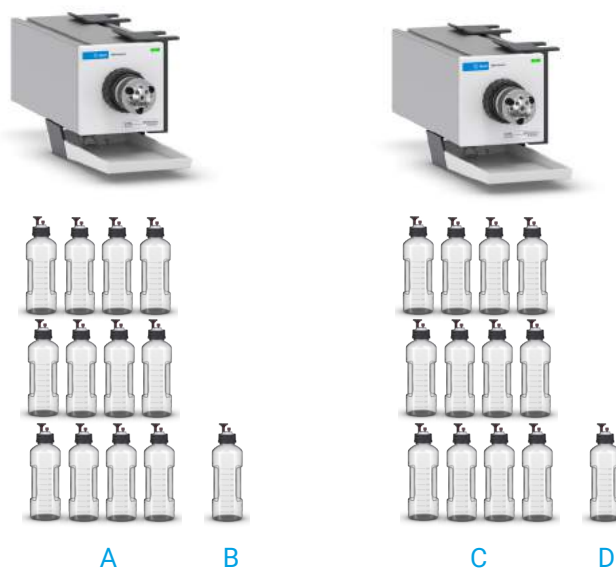
## 1290 Infinity II Advanced Setup

Column Capacity



Eight columns per MCT, clustering of up to four MCT

External Solvent Selection Valves



Two solvent selection valves (26 mobile phases)  
> 5400 chromatographic conditions  
+

Temperature Zones



Up to eight temperature zones in four MCT

**Figure 18.** Up to 5,400 screening options are possible with the Agilent 1290 Infinity II Method Development System.

## Chapter 3

Reaping the Business Benefits of Modern LCs  
**Can your LCs contribute to your company's strategic goals?**



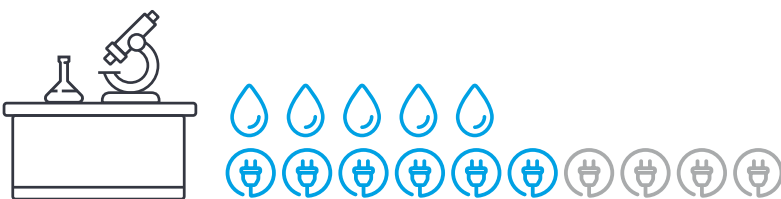
## Corporate Responsibility

As shareholder and public scrutiny intensifies about firms' profitability and sustainability achievements, lab managers will increasingly need to consider the business and environmental impact of their purchasing decisions. Quick wins in reducing laboratory costs include focusing on a reduction of energy consumption<sup>10</sup> and buying in bulk.<sup>11</sup> However, the costs associated with LC experiments are not trivial; in addition to the capital expenditure of serialized equipment, you have consumables costs related to LC columns, sample containers and mobile phase. Eliminating waste from these consumables can also assist with achieving sustainability goals that lab managers are expected to meet.<sup>11</sup>

Office consumption



Lab consumption



**Figure 19.** Labs consume 6-10x the electricity<sup>12</sup> and 5x the water per square foot of a normal office space.<sup>13</sup>

## UHPLC Pros and Cons

UHPLC experiments are less expensive to conduct than traditional HPLC experiments because they require less time, less mobile phase and less sample to achieve often superior results; in fact, many reports seeing improved sensitivity and resolution in run times that are 2-20 times faster.<sup>14</sup> The cost savings of translating one or two HPLC methods was often offset by the need to purchase dedicated UHPLCs and, in the (bio-)pharmaceutical space, the implications of post-approval method changes make the revision of current methodologies unattractive. While the new ICH Q14 guidelines should assist with the latter, the introduction of the Agilent 1290 Infinity LC system in 2009 (a combined HPLC/UHPLC instrument) changed the return on investment ROI calculation for adopting UHPLC approaches for new methods.<sup>15</sup> You can now also run HPLC and UHPLC methods in a single flow path with the **Agilent 1260 Infinity II Prime LC system**.

*"With the Agilent 1290 Infinity II LC system,  
we save a lot of time, we can do a lot of work with it."*

**– Li Lin, PhD,**  
Director of Analysis, Bellen Chemistry Co., Ltd.

Learn more



**Download** the 1260 Infinity II Prime LC Investment Guide.



#### **Mind behind the Science**

*“During the development of the 1290 Infinity LC system, I was involved in the investigation of fundamental aspects of UHPLC such as kinetic column performance and impact of frictional heating and dispersion. The thorough understanding of these aspects had an impact on the design and configuration of the final instrument. It also led to a clear understanding about the application-specific requirements for a high-performance system. During the development of the 1290 Infinity II LC system we incorporated the learnings from the first version to further improve the system.”*

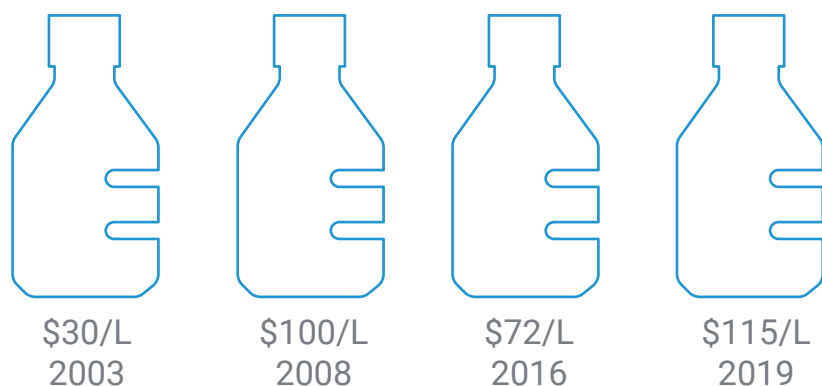
**– Monika Dittman, PhD,**  
Principal Scientist, Liquid Phase R&D, Agilent Technologies, Inc.

## Going Green

Acetonitrile, a common eluent component in reverse phase (RP) and hydrophilic interaction (HILIC) modes of chromatography, is expensive and toxic.<sup>16</sup> As a complement to UHPLC approaches, one way to reduce acetonitrile and similar solvent consumption and disposal costs is to adopt supercritical fluid chromatography (SFC). In addition to requiring very little organic solvent in the mobile phases, SFC is inexpensive to deploy because food-grade carbon dioxide can be used as the primary eluent.

The scientific benefits are also clear: SFC provides a truly orthogonal separation and is often considered superior to normal phase separations for chiral analyses.<sup>17</sup>

### Cost of ACN over time



**Figure 20.** The cost to purchase high-purity acetonitrile for LC experiments has varied over the years and experienced a supply shortage in 2008.

## Safely Sharing Instruments

Avoiding the purchase of redundant LCs is also an area where equipment budgets can be better utilized. Vendor-provided tools for allowing the safe transport of LCs can help organizations share these capital assets, where LCs can be moved from one lab to another, or perhaps to different detector technologies, for example, moving from one type of mass spectrometer to another. The **Agilent InfinityLab Flex Bench** is specifically designed to facilitate this type of flexible relocation and the superior usability with built-in storage ensures the correct tools for each instrument travel alongside.

Learn more

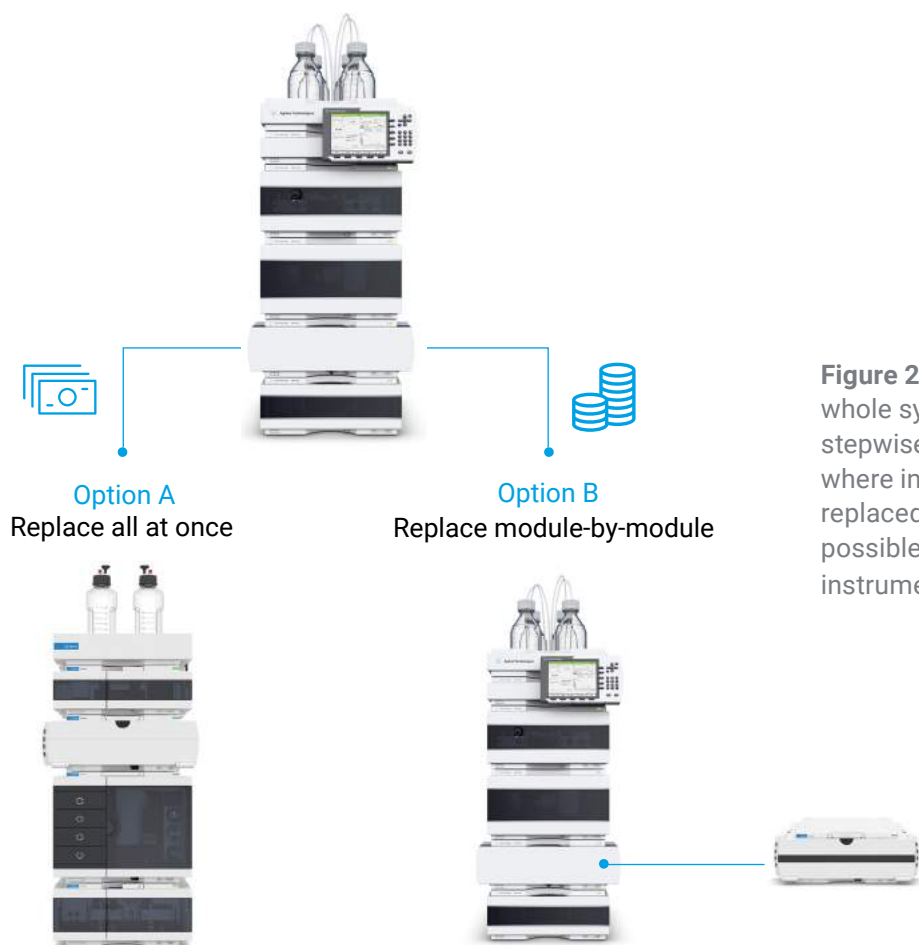


**Watch a video** to learn more about how to gain flexibility with the InfinityLab Flex Bench family.



## Stepwise Investment

When investing in new instrumentation, many suppliers require that the entire LC stack be purchased at once. Alternatively, an individual module (for example, an autosampler or pump) can be purchased and installed at different times. The latter approach allows purchasing funds to be spread across multiple troublesome or aging systems. It also allows for budget to be spent flexibly should a last-minute surplus become available. Vendors like Agilent providing this model also offer modified installation and, when needed, instrument qualification products, to assist with this type of deployment.



**Figure 21.** In addition to replacing whole systems (option A), stepwise upgrades (option B), where individual modules are replaced one-at-a-time, are possible so that you can use your instrument capital budget flexibly.





### **Mind behind the Science**

*“One thing that was very important during the development of the multisampler was method-backwards compatibility. We had several very excellent ideas for the flow path, but we chose the one we knew our users would appreciate, one where they could easily run the methods that they have been historically, without disruption.”*

**– Matthias Wetzel, PhD,**  
Senior Engineering Director, Agilent Technologies, Inc.

## Total Cost of Ownership

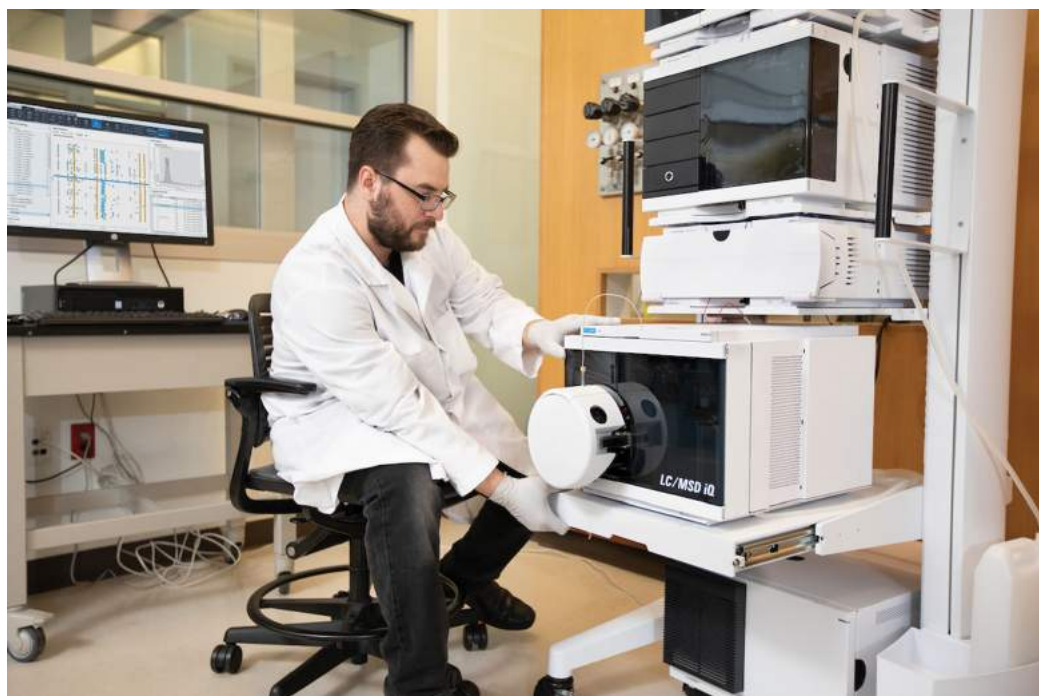
One area where there can be ugly surprises in unexpected costs is that of unplanned maintenance. Making sure that instrument reliability is a core aspect of new purchases ensures that money is spent in the correct year/budget cycle and that emergency reallocation of funds is not required. Another area where uncertainty around future costs can be eliminated is ensuring a usable lifetime for newly acquired LCs. Agilent provides a unique Value Promise: seven years of guaranteed support and a three-year best effort service. This guarantees a residual value credit toward a replacement model upgrade if needed within the time frame.

*"At the end of the day, you're going to spend the same amount of money. In five years, it's your choice to spend the money either upfront and we get three to five years of use without any major issues or we only get two years before there are major issues, and then you have downtime, my time and service costs."*

**– Julie Kowalski, PhD,**  
Chief Scientific Officer, Trace Analytics

## The Importance of Stackability

"Stackability" isn't just about increasing sample throughput demands. Greater sample complexity can require more instrumentation and even new technology adoption. Given the costs of building out new laboratory space (\$120 and \$160 per square foot to build), adding detectors that have been historically quite large could lead to a significant expense.<sup>18</sup> The "stackability" of the **Agilent InfinityLab LC/MSD iQ**, **Agilent InfinityLab LC/MSD**, and **Agilent InfinityLab LC/MSD XT** allow the possibility to expand laboratory technical capabilities without requiring additional lab space.



**Figure 20.** The Agilent 1260 Infinity II Prime LC system with Agilent InfinityLab LC/MSD iQ stacked in an Agilent InfinityLab Flex Bench keeps the overall instrument's footprint small.

Learn more



**Download brochure** on the Agilent Value Promise.



#### **Mind behind the Science**

*“You can't just be a technical expert—in customer support, you need to understand their core issue and then merge that with your technical expertise. You must first bring empathy and take the customer from the point where they are, understand that they are in a very unpleasant situation, and only then bring in the technical side of the discussion. You must work together to solve the issue and I really enjoy this.”*

– **Daniel Kühner**,  
Global Scheduling Service Systems Architect, Agilent Technologies, Inc.

# References

- 1 Workmann, Jr., J., Salary Survey: Some Slight Gains and the Gender Gap Narrows. <http://www.chromatographyonline.com/2019-salary-survey-some-slight-gains-and-gender-gap-narrows-0?pageID=2> (accessed September 19, 2019).
- 2 Goldsmith, M., Empowering Your Employees to Empower Themselves. [https://hbr.org/2010/04/empowering-your-employees-to-e?referral=03759&cm\\_vc=rr\\_item\\_page.bottom](https://hbr.org/2010/04/empowering-your-employees-to-e?referral=03759&cm_vc=rr_item_page.bottom) (accessed September 19, 2019).
- 3 Issaq, H. J., *A Century of Separation Science*, CRC Press, **2001**.
- 4 de Jonge, L.H. & Jackson, F.S., The feed analysis laboratory: Establishment and quality control. Setting up a feed analysis laboratory, and implementing a quality assurance system compliant with ISO/IEC 17025:2005. H.P.S. Makkar, ed. *Animal Production and Health Guidelines No. 15*. Rome, FAO, **2005**.
- 5 Twardowska, I., Allen, H., Kettrup, A., & Lacy, W., *Solid Waste: Assessment, Monitoring and Remediation*, Pergamon, **2004**.
- 6 Cushman & Wakefield, *Life Science: Great Promise and Rapid Growth*. <https://cushwake.cld.bz/Life-Science-Great-Promise-Rapid-Growth/16/> (accessed September 23, 2019).
- 7 Cappiello, A., & Palma, P., *Advances in the Use of Liquid Chromatography Mass Spectrometry (LC-MS): Instrumentation Developments and Applications*, Volume 79, Elsevier, **2018**.
- 8 Byrd, J., Intelligent System Emulation Technology, eurolab magazine, 2018, pp. 24-25. <https://content.yudu.com/web/15ex3/0A2nih/EurolabJune2018/html/index.html?page=24&origin=reade> (accessed September 23, 2019).
- 9 Schneider, S., Different Food Applications on a Single LC System Using Automated Column and Solvent Selection, Agilent Technologies application note, publication number 5991-7622EN, **2014**.
- 10 Steward, K., Sustainability Through Innovation. <https://www.technologynetworks.com/analysis/blog/sustainability-through-innovation-310028> (accessed September 23, 2019).
- 11 InterFocus Ltd., How to Cut Costs in a Laboratory. <https://www.mynewlab.com/blog/how-to-cut-costs-in-a-laboratory/> (accessed September 23, 2019).
- 12 McKinney, C., Monitoring Lab Energy Usage. <https://www.rdmag.com/article/2015/06/monitoring-lab-energy-usage> (accessed September 23, 2019).
- 13 Watch, D., Trends in Lab Design. <https://www.wbdg.org/resources/trends-lab-design> (accessed September 23, 2019).
- 14 Donglu Zhang, D.; Surapaneni, S., *ADME-Enabling Technologies in Drug Design and Development*, Wiley, **2012**.
- 15 Kreiss, W., Exploring the Economics of Innovation. <https://theanalyticalscientist.com/techniques-tools/exploring-the-economics-of-innovation> (accessed September 23, 2019)
- 16 Yabré, M.; Ferey, L.; Touridomon Somé, I.; Gaudin, K., Greening Reversed-Phase Liquid Chromatography Methods Using Alternative Solvents for Pharmaceutical Analysis. <https://www.mdpi.com/1420-3049/23/5/1065/htm> (accessed September 18, 2019)
- 17 Harps, L. C.; Joseph, J. F., Parr, M. K., SFC for chiral separations in bioanalysis. <https://www.sciencedirect.com/science/article/pii/S0731708518310896> (accessed September 18, 2019)
- 18 Scheer Partners, The Need for Lab Space: No More Room in the County? <https://scheerpartners.com/the-need-for-lab-space-no-more-room-in-the-county/> (accessed September 18, 2019)

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© Agilent Technologies, Inc. 2019  
Published in the USA, December 20, 2019  
5994-1326EN

