

# Agilent InfinityLab Solutions for Environment, Health, and Safety Aspects in an HPLC Workflow

## Introduction

In today's laboratory environment, themes surrounding environment, health, and safety (EHS) are more relevant than ever. A recent independent survey of 387 lab managers, EHS managers, and scientists revealed that 70% of all respondents are regularly involved in EHS-related topics, and that these issues influence their buying behavior. More specifically, 84% indicated that chemical safety is their main EHS-related concern, and 94% would consider purchasing an ergonomic system when investing in new instruments. Among several competitors, Agilent ranked highest as a supplier of safe, ergonomic products.

This white page covers findings from this survey and how Agilent has developed solutions to address the lab safety, ergonomics, and sustainability concerns it highlights.

## Chemical safety

### Solvent handling

According to the survey, 54% of lab and EHS managers consider solvent handling a central concern in the area of chemical safety. To address this issue, Agilent offers several solutions. As a first example, easy-to-carry Agilent InfinityLab solvent bottles are qualified against tipping, and their slender profile and gripping zones on both sides make their handling comfortable and safe (Figure 1).



Figure 1. Agilent InfinityLab solvent bottle.

The Agilent InfinityLab LC Series has been designed for safe leak and waste handling. To protect against solvent leakage, leak sensors and optimized leak-to-waste funnels are located in every InfinityLab LC Series module (Figure 2). The leak sensor in the leak plane stops the running system as soon as the leak detection level is reached. Loose connections, which could lead to leaks, can be minimized or eliminated

by using Agilent InfinityLab fittings. Also, the Agilent InfinityLab LC Series Solvent Cabinet consists of qualified material, with 8 L of volume to safely capture solvents in the event of a leak.

As a further measure to improve solvent handling safety, the height of LC systems can be adjusted with the Agilent InfinityLab Flex Bench system, making it easier to reach bottles when changing solvents.

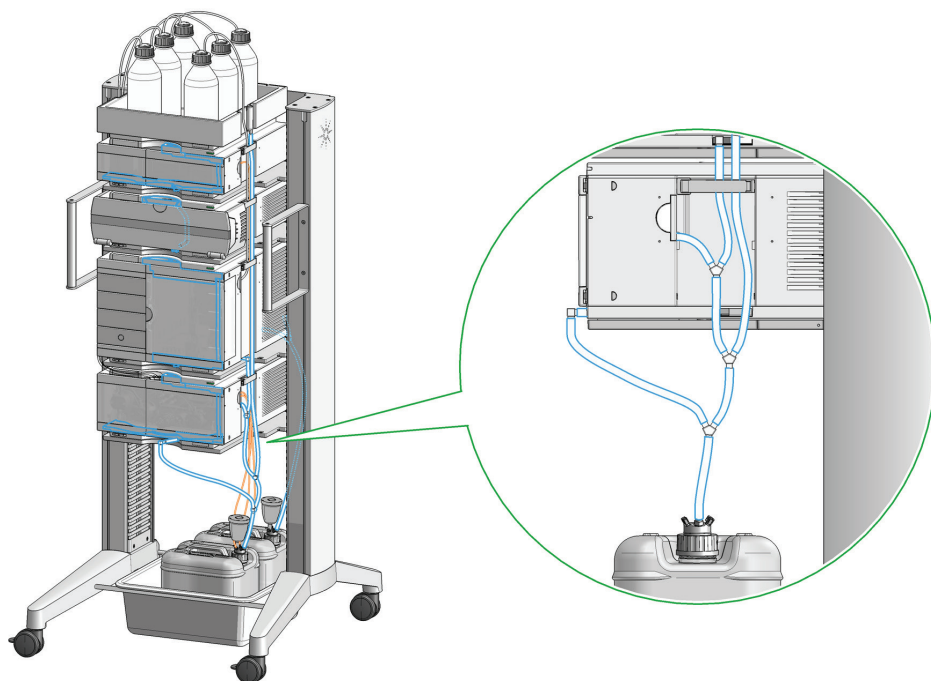


Figure 2. Agilent Infinity II leak waste concept (InfinityLab Flex Bench installation).

### Chemical vapor reduction

Altogether, 84% of lab and EHS managers rank chemical vapor reduction as a key chemical safety concern. Dealing with hazardous organic solvents is especially unavoidable in an HPLC setting; for the sake of users' health, limiting solvent evaporation into the lab is a priority. Evaporation of solvent can also alter the make-up of mobile phases, and so have a negative effect on chromatographic performance.

This issue can be counteracted with Agilent InfinityLab Stay Safe caps, which are designed to contain solvent vapor in the bottle. Experiments showed that Stay Safe caps could reduce solvent vapor evaporation by 98% compared to an open bottle, and by 85% compared to a standard solvent cap (Figure 3).

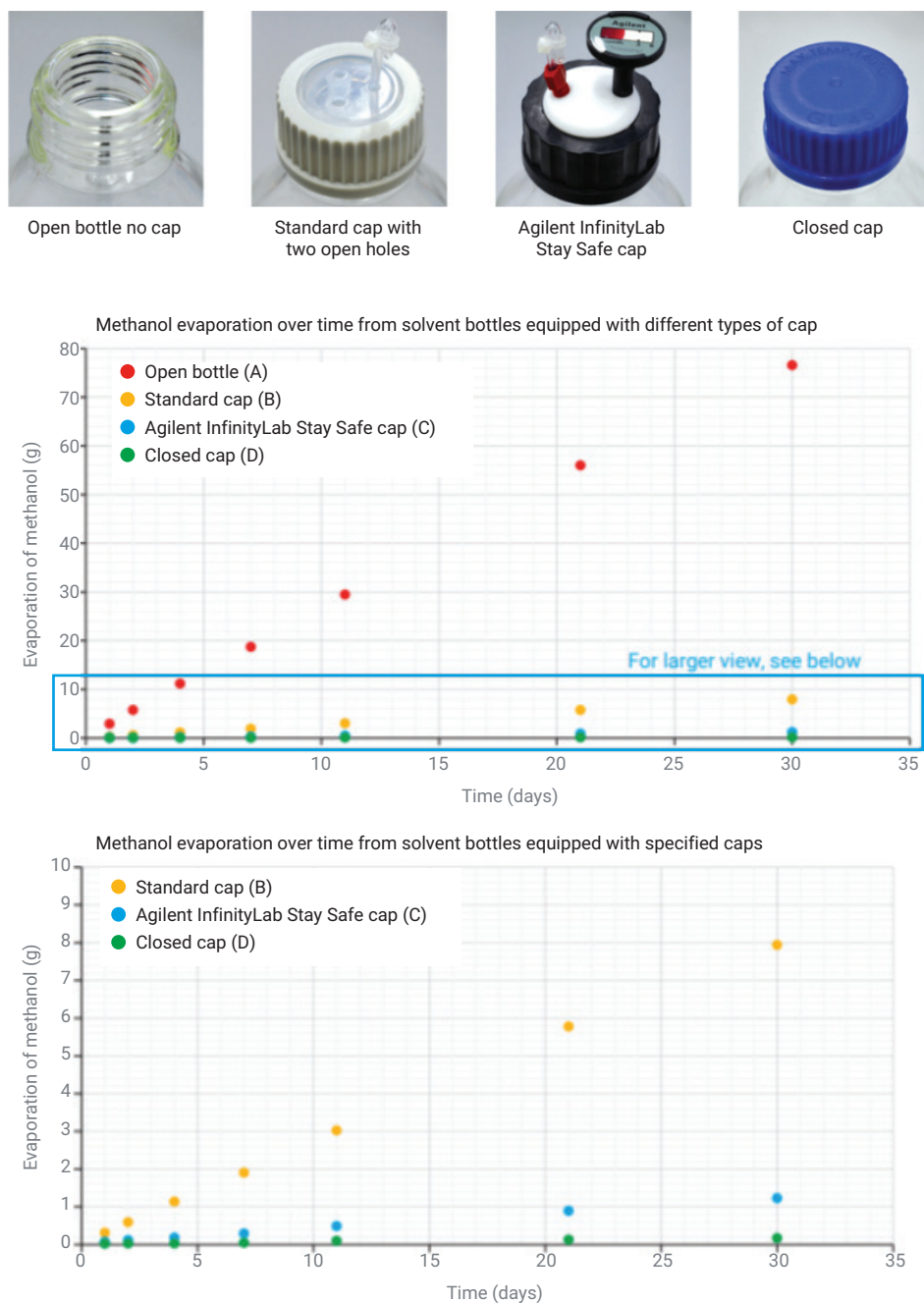


Figure 3. Reduction of solvent evaporation by Agilent InfinityLab Stay Safe caps.<sup>1</sup>

The vent valve features a time strip function that indicates when the filter membrane is blocked, and the valve should be changed (Figure 4). Charcoal filters with time strips are also available for Stay Safe caps used on waste bottles, to effectively absorb hazardous solvent vapors and to maintain equal pressure inside and outside the waste container (Figure 5). Additionally, to handle leaks and to limit resulting solvent evaporation, Stay Safe caps have optimized leak and waste funnels.

Stay Safe caps are readily compatible with InfinityLab solvent bottles, and are available for bottles with GL45 and GL38 threads and for waste cans with GL45, S60, and GL38 threads. The 1–4 ports have optimized fittings for minimal leakage. Stay Safe caps can be used with either analytical or preparative systems.

### System purging

In many laboratories, the HPLC purging process remains a significant source of solvent vapors. These vapors can escape into the laboratory air because the solvent bottle is either left open or covered with parafilm or aluminum foil. However, the InfinityLab Stay Safe purging bottle (Figure 6) offers an innovative solution to this problem. This purging bottle can receive and secure up to four solvent lines, enabling HPLC users to purge multiple solvent channels with the same solvent. Using this purging bottle, laboratory users can significantly reduce the amount of solvent vapor released into the air.



**Figure 4.** Agilent InfinityLab Stay Safe cap for solvent bottles, featuring a time strip.



**Figure 5.** Agilent InfinityLab Stay Safe cap for waste canisters.



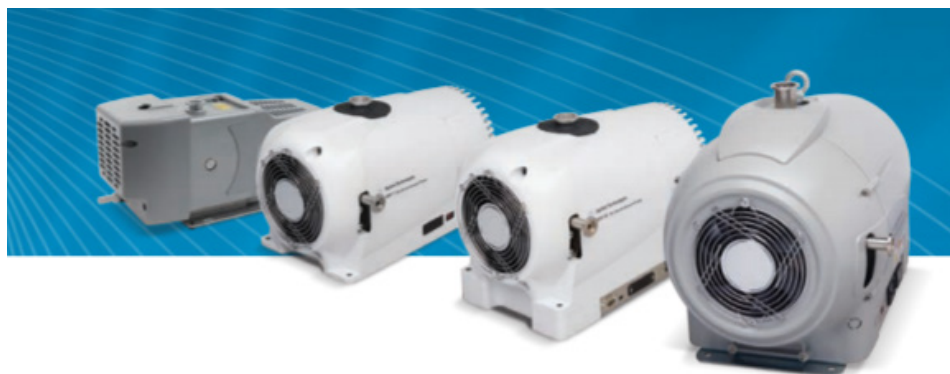
**Figure 6.** Agilent InfinityLab Stay Safe purging bottles in use.

Aside from these, features that help to reduce chemical vapor release include the closed system architecture of InfinityLab LC Series modules and pre-slitted, evaporation-reducing sealing mats for Agilent InfinityLab well plates (Figure 7). These microplates are qualified for use with the InfinityLab Multisampler.



**Figure 7.** Agilent InfinityLab well plates with pre-slitted sealing mat.

Alongside organic solvent evaporation, another factor to consider is that harmful oil vapor from LC/MS-related vacuum pumps can diffuse into the lab environment. By being oil-free, Agilent IDP dry scroll pumps effectively eliminate this concern (Figure 8).



**Figure 8.** Agilent IDP dry scroll pumps.<sup>2</sup>

### Waste handling

A total of 80% of lab and EHS managers believe that waste handling is an important chemical safety issue to deal with. To address this safety aspect, Agilent instruments have their waste funnels located at the side, reducing the risk of contact with users and other instrument parts. To handle varying waste volumes, qualified waste canisters are available in 5, 6, and 10 L sizes and with various form factors (Figure 9). With the InfinityLab Flex Bench in particular, waste bins can be safely positioned below or next to the system, and their rugged material and bin volume comfortably accommodate excess waste.

As well as reducing oil vapor generation, Agilent IDP scroll pumps can also be used to minimize waste, given their oil-free operation.



**Figure 9.** Agilent waste canister with Stay Safe cap.



## Solvent usage reduction

### UHPLC columns

A rarely discussed aspect of UHPLC methods is their positive effect on a lab's environmental footprint. The reduced solvent consumption per sample measured lowers costs for proper waste management and decreases consumption and handling of potentially hazardous solvents such as methanol, acetonitrile, or even nonpolar solvents such as heptane. In addition, the portions of solvents stored in the lab are smaller, reducing the risk and impact of an accidental exposure (i.e., by breaking solvent bottles).

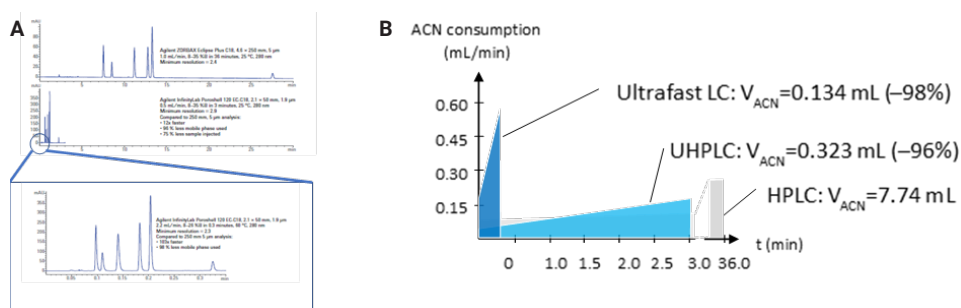
The key to modern, efficient UHPLC separations is the LC column. With the introduction of superficially porous particle (SPP) technology, Agilent has paved the way for reproducible, robust LC methods with a low number of unexpected issues (column clogging or column failure), while still enabling increased efficiency and sample throughput. Users can take advantage of SPP particle technology in existing methods today. The transfer of methods from traditional, totally porous particle columns (TPP) to modern SPP columns is a method modernization that does not require redevelopment of the entire LC method.

An example method transfer from Agilent ZORBAX (TPP) to InfinityLab Poroshell 120 (SPP), and vice versa, can be found in the Agilent technical overview Transfer of Methods between Poroshell 120 EC-C18 and ZORBAX Eclipse Plus C18 Columns (publication number 5990-6588EN).

An analysis of 10 of the most popular Agilent application notes dealing with modernizing LC methods showed that solvent consumption can be reduced by 80 to 98%, depending on the application that was modernized.

Figure 10A, based on Agilent application note Improved Aromatic Acids Analysis,<sup>3</sup> shows an example of a method modernization. Figure 10B highlights the overall acetonitrile consumption when being performed as an HPLC, a UHPLC, and an ultrafast LC separation.

While it is thought that ultrafast LC separations consume more solvent than UHPLC separations, mainly due to the significantly higher flow rate, ultrafast LC can save 40% of the solvents when compared to UHPLC separations.



**Figure 10.** (A) Organic solvent consumption of the analysis; (B) Using ultrafast liquid chromatography (UHPLC), the amount of consumed acetonitrile can be reduced by 98% compared to conventional HPLC separations.

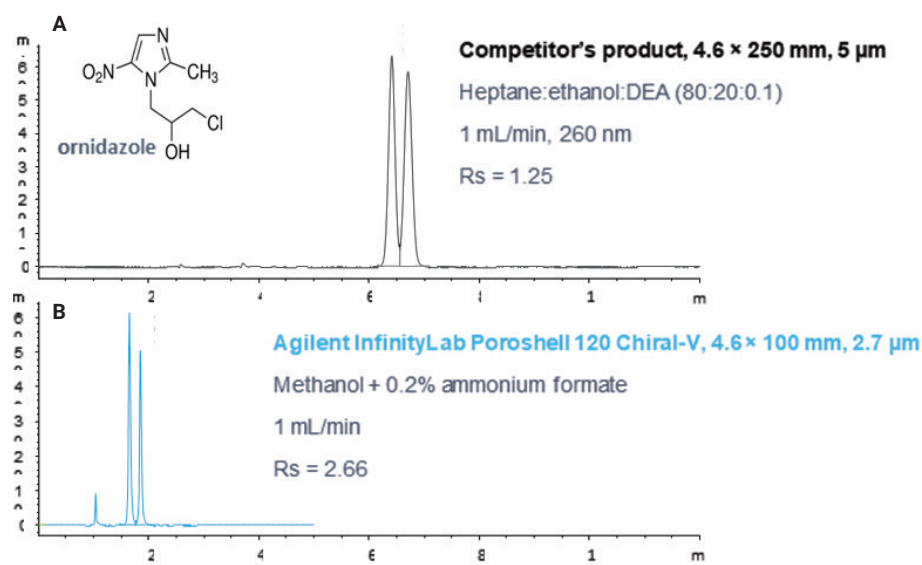
## Hazardous solvent reduction

Even today, many chromatographers still rely on traditional separations that require normal-phase solvents, such as the separation of polar molecules or chiral separations.

Modern stationary phases, like InfinityLab Poroshell 120 Chiral and HILIC columns, offer opportunities to modernize traditional methods to achieve higher throughput but also to substitute normal-phase methods with reversed-phase or polar-organic and polar-ionic methods. Such methods mostly use different alkyl alcohols or acetonitrile and water instead of heptane or dichloromethane.

An example of a chiral method modernization is given in Figure 11. Ornidazole, an antibiotic, was traditionally separated on a 5  $\mu\text{m}$ , totally porous chiral column using a mixture of heptane and ethanol as a mobile phase. The migration to a modern InfinityLab Poroshell 120 column resulted in these improvements:

- Run time was 3.5 times faster than the previous normal-phase method, reducing the solvent consumption by 69%
- Methanol (~\$90/L) was used as a mobile phase solvent as an acceptable substitute for the heptane/ethanol (~\$160/L) mixture used in the original methods
- Analysis did not require a dedicated instrument reserved for normal-phase analysis
- Resolution was doubled and sensitivity increased tenfold



**Figure 11.** Chromatographic comparison of ornidazole separation using a normal-phase competitor's column (A) with the same separation using a reversed-phase, Agilent InfinityLab Poroshell 120 Chiral-V column (B).

## Ergonomics

### Improving repetitive working positions

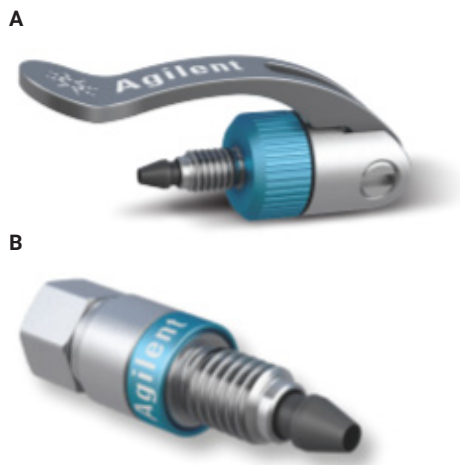
A further survey finding was that as much as 93% of lab and EHS managers would consider investing in ergonomic instrument benches when buying new instruments. With InfinityLab Flex Benches, modules are individually stacked to minimize repetitive heavy lifting and wrench work when reconfiguring or servicing an

instrument (Figure 12). The single-stack height allows for a comfortable working position, and individual modules can be positioned to suit the user. Accessing the back of the stack is straightforward, as is reaching MS pumps for oil changes when using the Flex Bench MS and Agilent Quiet Covers. The Flex Bench MS also has an extendable shelf for the MSD or Ultivo TQ, making it easy to access the top and side of the MS detector for maintenance and repair.



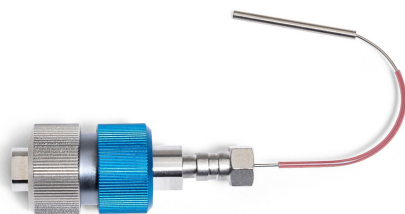
**Figure 12.** Agilent InfinityLab Flex Bench family.<sup>4</sup>

InfinityLab fittings enable tool-free connection of capillaries within LC systems, reducing the need for repetitive wrench work in tight spaces (Figure 13). As a further contribution to lab ergonomics, the previously mentioned, easy-to-grip design of InfinityLab solvent bottles makes them not just safe, but comfortable to hold.



**Figure 13.** Agilent InfinityLab Quick Connect (A) and Quick Turn (B) fittings.<sup>5</sup>

Similar to InfinityLab fittings, the InfinityLab Quick Change inline filter allows for simple and quick replacement of filter discs without the need for any tools. It also has an innovative click and seal design that makes a clicking sound when the filter is tightened up to 1,300 bar, with no risk of over or under tightening (Figure 14).



**Figure 14.** Agilent InfinityLab Quick Change inline filter.

## Noise reduction

Noise can be scaled down by using Quiet Covers for MS vacuum pumps, lowering noise levels while maintaining pump performance and lifetime. The noise-reducing covers of InfinityLab LC Series modules also limit noise transfer to the lab environment.

## Electrical safety

To lower electrical risks, certain safety measures have been applied to Agilent instruments. For instance, leak sensors and waste funnels run along the side of Agilent systems, reducing the risk of these coming into contact with electronics. The Flex Bench MS with power strip organizes all module cables into qualified power strip, avoiding multiple cable connections from instrument to socket. And, as concerns Agilent LC/MS ion sources, their high source voltage and the accessible ion source are grounded.

## Low natural resource use

### My Green Lab

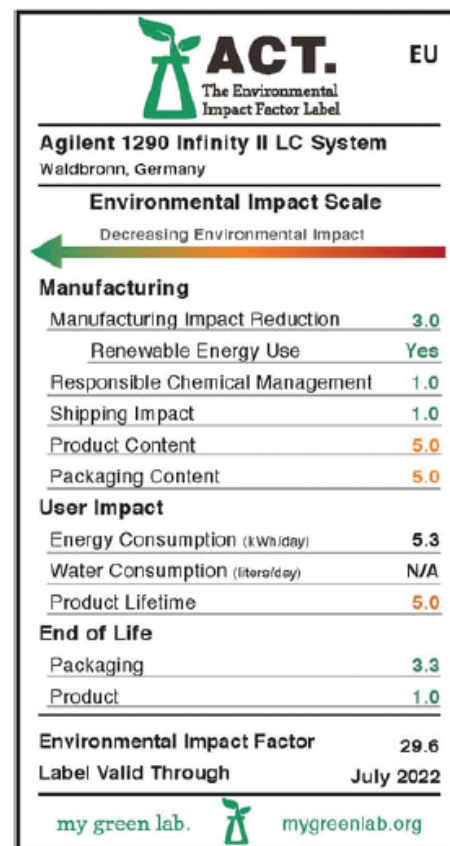
To support sustainable innovation in laboratories, Agilent has recently become a top-level sponsor of My Green Lab, a nonprofit organization dedicated to improving sustainability of scientific research. Agilent is now working with My Green Lab to have their instruments independently audited for the organization's Accountability, Consistency, and Transparency (ACT) label. The ACT label (Figure 15) provides information about the environmental impact of manufacturing, using, and disposing of a product and its packaging, enabling purchasers to make better informed, sustainable choices.

## Manufacturing impact reduction

This category evaluates the steps that have been taken to reduce energy, water, and waste at their manufacturing facility. Agilent has implemented various initiatives at the facility where the 1290 Infinity II LC System is manufactured to reduce the facility's energy and water consumption. These initiatives, which include rain-water harvesting, equipment replacement, and an upgraded, onsite combined heat and power plant, have resulted in energy and water reductions relative to a 2015 baseline.

### Renewable energy use

Agilent has a large photovoltaic system to support and offset electricity from the grid to help produce its products. The average capacity of the system is approximately 250 kWh per year.



**Figure 15.** ACT label for an Agilent 1290 Infinity II LC System, valid in the European Union.<sup>6</sup> Smaller values indicate lower environmental impact.



## Responsible chemical management

Agilent has implemented policies and procedures internally and within its supply chain, following the General Specification for the Environment (GSE), to understand and communicate hazardous chemistries. Further, the Agilent manufacturing facility is ISO 14001 certified and the 1290 Infinity II LC System is EU RoHS compliant.

## Packaging end-of-life

The 1290 Infinity II LC System packaging materials include cardboard, polyethylene, and polypropylene. In the UK, and select EU countries, Agilent participates in Extended Producer Responsibility (EPR) schemes to support the responsible management of packaging at its end-of-life. In the remaining EU countries, the cardboard is readily recyclable, while the plastic materials are recycled, land-filled, or incinerated via a waste-to-energy recovery process.

## Product end-of-life

Agilent offers an active take-back/refurbishment program for the 1290 Infinity II LC System in EU and US.

## Conclusion

As this white paper demonstrates, Agilent has thoroughly considered how best to operate, develop, and produce solutions to help customers apply and improve their EHS measures. In the survey highlighted in this paper, Agilent was by far the highest-rated instrument provider in terms of ergonomics and safety. With 8% of the revenue invested in R&D, Agilent continues to develop solutions to facilitate all aspects of EHS.

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