

NEWS

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APPLICATION SPOTLIGHT

The Elegra Argon Humidifier: Uninterrupted and Maintenance-Free ICP Operation

It is standard operation to use dry argon as your ICP nebulizer gas in order to generate an aerosol and transport the sample to the plasma. However, when dealing with samples containing high amounts of total dissolved solids (TDS) you have an increased likelihood of salt deposits forming at the tip of the nebulizer and injector; this can result in a failed analysis due to a drift in signal or an extinguished plasma. In order to handle a challenging sample matrix, such as high TDS, it is important that you optimize your ICP sample introduction system. This includes choosing a nebulizer with the ability to handle high TDS, a baffled cyclonic spray chamber to minimize droplet size, and a large bore injector to allow for longer run times. For optimum performance you can also humidify the nebulizer gas before it comes in contact with the sample, decreasing the likelihood of salt deposits forming at the nebulizer and injector tip. Adding an argon humidifier will reduce maintenance and the chance of an extinguished plasma due to a blocked nebulizer or injector.

Glass Expansion designed the new Elegra™ argon humidifier to provide an efficient, but simple to use humidifier for ICP-OES and ICP-MS applications. In this article we will focus on the advantages of the Elegra design and the benefits of adding a humidifier for high TDS applications.

Design

The elegant design of the Elegra results in a very compact accessory (Figure 1). The small footprint of the Elegra makes it easier to fit into each ICP model without overcrowding the sample compartment. The Elegra utilizes highly efficient membrane technology to add moisture to the gas as it flows through the inert metal-free construction. The membrane technology eliminates the need for the Elegra vessel to be pressurized or heated (no electrical power), as required by some other humidifier designs. Following Glass Expansion's previous design, the Capricorn™, the Elegra is also configured with a bypass switch so that the operator can turn humidification on and off without connecting or disconnecting any tubing.

For easy installation on any ICP instrument and with any nebulizer, each Elegra Kit is packaged with customized gas connectors. In Figure 2 we show an example of the Elegra installation on an Agilent 5100 ICP-OES with Glass Expansion's SeaSpray™ and DuraMist™ nebulizers. The layout of the gas connections to and from the Elegra are shown in Figure 2a. P/N 70-803-0911 is used to make the connection from the Agilent 5100 nebulizer gas port directly to the Elegra gas inlet (Figure 2b). A second gas line is used to make the connection from the Elegra outlet directly to the nebulizer. This is P/N 70-803-1278 for the DuraMist nebulizer or P/N 70-803-0911 for the SeaSpray (Figure 2c). Each Elegra Kit is also supplied with an adapter kit for non-GE nebulizers. To find the Elegra kit suitable for your ICP please refer to Table 1 or www.geicp.com/intro/elegra.

Glass Expansion News

PITTCON 2016

A wide selection of Glass Expansion products will be on display at Pittcon 2016, Georgia World Congress Center, Atlanta, GA, USA, March 6-10, 2016. The display will include nebulizers, spray chambers, torches, RF coils, ICP-MS cones and accessories. You will also be able to see a demonstration of the Assist CM enhanced productivity system. Glass Expansion specialists will be on hand to answer your questions and assist you to choose the optimum components for your ICP. Please visit us at Booth # 1457.

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Figure1. Elegra Argon Humidifier



Figure 2. Elegra Argon Humidifier Installation (Agilent 5100 ICP-OES)
Figure 2a



Figure 2b (Agilent 5100)

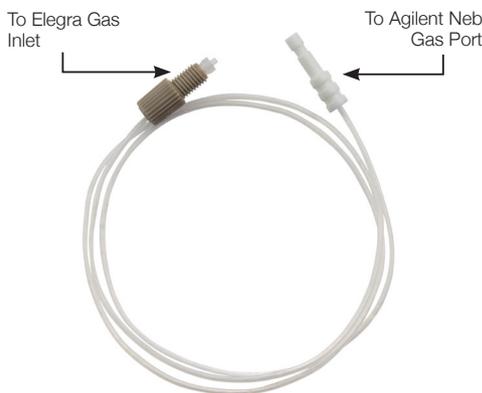
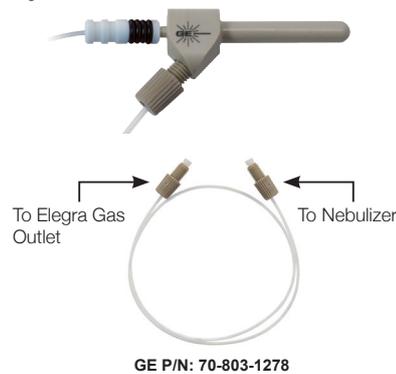


Figure 2c



ICP-MS is being used more often, in place of ICP-OES and AA techniques, for trace metals analysis of high matrix samples like seawater and geological samples. For this reason, a dilution gas setup is now a standard option on most ICP-MS instruments¹⁻³. Inline “aerosol dilution” of the sample prior to introduction into the plasma greatly improves the robustness of the plasma, which allows for improved analysis of high matrix samples by ICP-MS. High matrix samples also need to be diluted for ICP-MS analysis in order to prevent the rapid build-up of salt deposits on the interface cones, which would otherwise result in signal drift and frequent cleaning. Relying on aerosol dilution rather than offline dilution of the samples⁴ prevents errors associated with manual sample preparation. The Elegra Dual two-channel configuration allows for humidification of both the nebulizer gas and the dilution gas for this type of ICP-MS setup.

An example of a dilution gas setup with the Elegra Dual is shown in Figure 3. With the dual channel Elegra (Figure 3a) the nebulizer gas is humidified, preventing nebulizer and injector blockages due to the high salts, and the moisture added to the dilution gas (Figure 3b) helps to further improve plasma robustness.³ A cyclonic spray chamber with dilution port for the PerkinElmer NexION ICP-MS is shown. However Glass Expansion offers several cyclonic spray chamber designs that allow for a dilution gas to be added at the exit tube of the spray chamber, see www.geicp.com to find an option suitable for your ICP-MS instrument.

Experimental

As mentioned previously, when dealing with high TDS it is important to select the proper nebulizer. Glass Expansion currently offers two concentric nebulizers capable of handling high dissolved solids, the SeaSpray and DuraMist. Unique to the SeaSpray nebulizer is a self-washing tip that tolerates up to 20% for the most common salts. The DuraMist is a PEEK nebulizer capable of handling up to 30% TDS, in addition to being HF-resistant.⁵

Table 1. Elegra Argon Humidifier Kits

Part Number	Elegra to Suit
70-803-1265	Agilent/Varian Vista/700-ES/MP-OES or Leeman
70-803-1266	Agilent 5100
70-803-1267	Agilent 4500/7500
70-803-1268	Agilent 7700/7800/7900
70-803-1269	PerkinElmer Optima or Spectro
70-803-1270	PerkinElmer ELAN/NexION
70-803-1312	Shimadzu 9000/9800
70-803-1303	Thermo iCAP 6000/7000/Q, X Series
70-803-1271	Other models
70-803-1272	Elegra Dual for Agilent 4500/7500
70-803-1273	Elegra Dual for Agilent 7700/7800/7900
70-803-1274	Elegra Dual for PerkinElmer ELAN/NexION
70-803-1275	Elegra Dual for other models

To evaluate the performance of the Elegra, a nebulizer stress test was completed by aspirating a 25% NaCl solution, while monitoring the nebulizer gas flow with and without the Elegra (Figure 4). The 25% NaCl solution was aspirated continuously with no rinsing. Typically the Conikal™ nebulizer would not be recommended for use with a high TDS matrix, as it has a tolerance of only 5% TDS. However it was used here to highlight the advantage of the Elegra. As expected, the nebulizer was completely clogged after only 5 minutes of aspirating the salt solution without the Elegra. In contrast the nebulizer held a relatively constant gas flow with

Figure 3. Elegra Dual on Perkin Elmer NexION with gas dilution sample introduction system.³

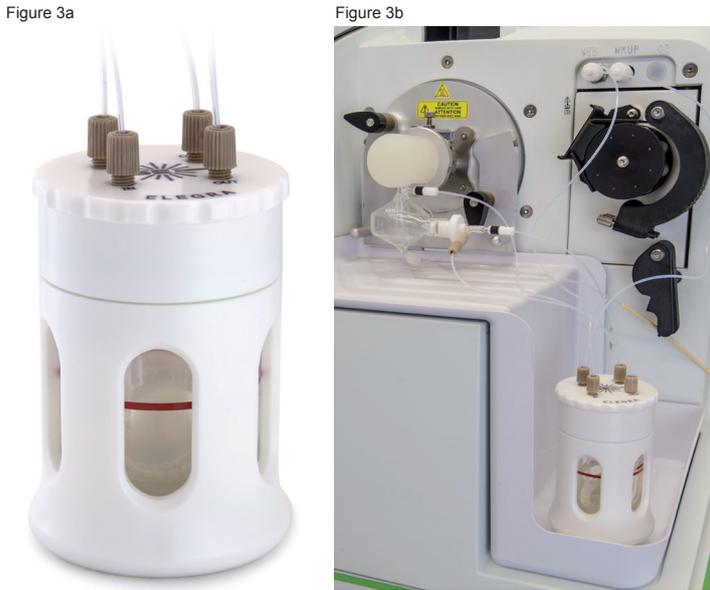
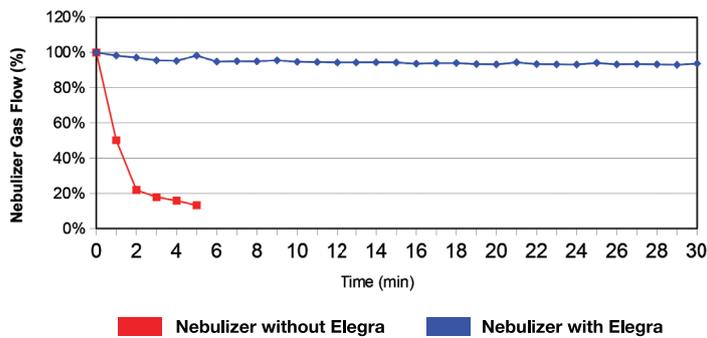


Figure 4. Elegra Nebulizer High TDS Stress Test (25% NaCl)

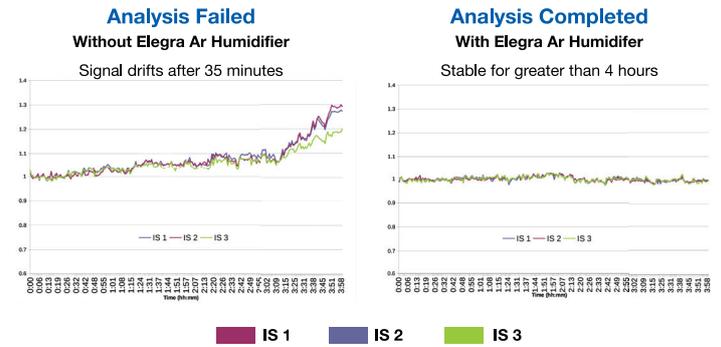


the Elegra throughout the entire test (over 30 minutes). The added moisture from the Elegra prevented the nebulizer from clogging. Whereas without the Elegra present the analysis would have been interrupted due to the clogged nebulizer.

Even when a proper high TDS nebulizer is chosen, some matrices like lithium metaborate fusions can still pose a challenge. The high amount of dissolved solids in such matrices often requires frequent nebulizer maintenance. Extended analyses are also often re-run due to a drift in signal from the slow build-up of salts. An easy way to eliminate the drift and frequent maintenance is to add the Elegra. A high throughput contract laboratory evaluated the Elegra with their lithium metaborate method on their ICP optical spectrometer. The stability of 3 internal standard (IS) lines were compared with and without the Elegra (Figure 5). Without the Elegra the IS signal begins to drift after 35mins, eventually resulting in a failed analysis (> 10% drift). With the Elegra there is virtually no variation in IS signal over a period of 4 hours. Additionally this particular Elegra customer reported a significant reduction in the required nebulizer maintenance, going over two months without a cleaning as opposed to weekly cleaning without the Elegra.

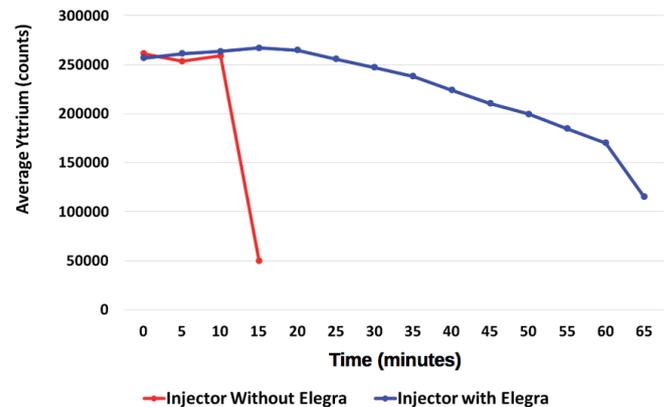
With respect to the ICP torch injector tube, it is recommended that you use a larger bore (> 2.0 mm i.d.) for high TDS applications. Since the torch outer tube often suffers rapid devitrification, we also suggest a demountable torch design, like the Glass Expansion D-Torch™, which allows you to reduce torch consumable costs.⁶

Figure 5. Internal Standard Stability in 0.5% Lithium Metaborate



Increasing the auxiliary argon flow will lift the plasma higher off the injector, this helps to slow the build-up of salts at the injector tip. Utilizing extended rinses in between each sample is also recommended. However, adding the Elegra will provide the greatest decrease in the rate of salt build-up at the injector tip and lengthy rinses can be avoided. To show the advantage of the Elegra, an injector stress test was completed, aspirating a solution of 5ppm yttrium in 20% NaCl while monitoring the yttrium IS signal with and without the Elegra (Figure 6). The 20% NaCl solution was aspirated continuously with no rinsing and a 2.5mm i.d. injector was used. Without the Elegra, the yttrium signal dropped sharply after only 10 minutes and the injector was completely blocked in less than 15 minutes. In contrast, with the Elegra, the yttrium signal remained stable for twice as long, and slowly began to decrease after 35 minutes.

Figure 6. Elegra Injector High TDS Stress Test (20% NaCl and 2.5mm i.d. Injector)



Conclusion

The new Elegra is a compact argon humidifier that helps to alleviate salt deposits in the nebulizer and torch injector, allowing uninterrupted and maintenance-free ICP operation. The highly efficient membrane technology does not require a pressurized water reservoir, heating or electric power. An inert metal-free construction eliminates any possibility of contamination, providing a reliable humidifier for high purity ICP-MS applications. And with an easy-to-use bypass switch, you can take the Elegra off-line without disconnecting any argon lines. Lastly the unique Elegra dual channel model provides the ability to humidify both the nebulizer gas and a dilution gas simultaneously.

References

1. Agilent Technologies Application Note# 5989-7737EN, "Performance Characteristics of the Agilent HMI Accessory for the 7500 Series ICP-MS," <https://www.agilent.com/cs/library/technicaloverviews/public/5989-7737EN.pdf>
2. Agilent Technologies Application Note # 5991-4257EN, "Performance of Agilent 7900 ICP-MS with UHMI for high salt matrix analysis," https://www.agilent.com/cs/library/applications/5991-4257EN_AppNote7900_ICP-MS_salt.pdf
3. Perkin Elmer Product Note # 012394-01, "All Matrix Solution System for the NexION ICP-MS," http://www.perkinelmer.com/CMSResources/Images/44-175832PRD_NexION-AMS-Systems-Product-Note-012394_01.pdf
4. Agilent Technologies Application Note # 5989-8573EN, "Eliminate the Dilution Step from ICP-MS Sample Prep with the Agilent High Matrix Introduction System," http://www.agilent.com/cs/library/technicaloverviews/public/5989_8573EN.pdf
5. Glass Expansion Newsletter, June 2013 Issue, "A Nebulizer Update."
6. Glass Expansion Newsletter, October 2013 Issue, "How to Achieve High Accuracy with Difficult Samples."

NEW PRODUCTS

DC NEBULIZER

The DC (Direct Connection) nebulizer is our latest design. It has a UniFit sample connector which slides easily over the sample arm and an argon connector configured to connect directly to your ICP.

The benefits of the DC nebulizer are:

- Inert metal-free argon connector.
- Instrument-specific Direct Connect flexible argon line.
- Reliable ratchet fitting ensures leak-free gas connection

In addition to these unique benefits, the DC nebulizer shares the following benefits with the U-Series nebulizer:

- Resists blockage: The sample channel is uniform from the entry point to the tip, so there is nowhere for particulates to be trapped.
- Fast washout: Since there is nowhere for sample to be trapped, the fastest possible washout and highest sample throughput is achieved.
- Simple to use: Our proprietary UniFit connector slides easily over the sample arm and creates an excellent seal.
- Full length VitriCone construction: With the VitriCone design, the sample channel is constructed from heavy glass capillary which is machined to very high tolerances.

SeaSpray DC Nebulizer for Agilent 5100
GE P/N A14-07-USS2



NEW PRODUCTS

DC NEBULIZER

DC versions of the SeaSpray, MicroMist, Conikal, Slurry, DuraMist, OpalMist and VeeSpray nebulizers are available to suit the most common models of ICP-OES and ICP-MS. The glass DC nebulizers use the inert PEEK gas connector, part number 70-803-1096.

The DC nebulizer part number has a prefix specific to each type of gas connector. For example, the prefix “A31-” denotes a connector for the Thermo models, so part number A31-07-USS2 is a SeaSpray nebulizer configured for direct connection to the Thermo models. See table below for a complete list of prefixes for the DC nebulizers line.

Manufacturer	Model	P/N Prefix	Gas Line Included	
Agilent	Vista/700-ES Series	A11-	70-803-0969	
Agilent	MP-AES	A11-	70-803-0969	
Agilent	4500/7500	A12-	70-803-1086	
Agilent	7700/7800/7900/8800	A13-	70-803-1105	
Agilent	5100	A14-	70-803-0911	
Leeman	All Models	A11-	70-803-0969	
PerkinElmer	Optima	A21-	70-803-1070	
PerkinElmer	Elan/NexION	A22-	70-803-1049	
Shimadzu	9000/9800	A41-	70-803-1311	
Spectro	All Models	A21-	70-803-1070	
Thermo	iCAP 6000/7000/Q & X-Series	A31-	70-803-1292	

For more information on GE Nebulizers visit: www.geicp.com/intro/nebulizers

INSTRUMENT NEWS

From Agilent Technologies - New application note: Analysis of milk powders based on Chinese standard method using the Agilent 5100 SVDV ICP-OES

Milk consumption is a significant source of essential nutrients for humans but it also can be a pathway for toxic metal intake. Standard methods are being developed to monitor the elemental content of milk. For example, China's National Food Safety Standard GB 5413.21-2010 covers the determination of Ca, Fe, Zn, Na, K, Mg, Cu, Mn in foods, raw milk and dairy products.

The 5100 Synchronous Vertical Dual View (SVDV) ICP-OES has a range of features that simplify the elemental analysis and sample preparation procedures required for this GB method.

Eliminate Dilutions: The instrument's SVDV mode measures the axial and radial views of the plasma to be measured at the same time. This allows elevated levels of nutrient elements like Na and K to be measured synchronously with trace elements, eliminating the need for different dilutions.

Cost Effective Sample analysis: SVDV mode allows faster sample-sample analysis which reduces argon consumption per sample.

Easy to use: The plug and play torch creates reproducible performance, even with multiple operators.

Download the application note [here](#) to learn more about how you could save money in your lab, using Agilent's 5100 SVDV ICP-OES.

From Analytik Jena - High efficiency ReflexION ion optics for the Analytik Jena ICP-MS

The superior performance of the PlasmaQuant® MS is achieved through the synergy of innovative technologies. From the next generation plasma system and dual-cone interface, to the ReflexION's highly efficient, 3-dimensional focusing of ions into the high-definition quadrupole. They all work together to provide the world's most sensitive ICP-MS. The simultaneous removal of photons and neutral particles reduces the background to < 1 count, allowing the lowest possible detection limits to be reached.

The ion optics assembly combines the ReflexION ion mirror and a set of extraction lenses that direct the ion beam towards the ion mirror. The parabolic electrostatic field produced by the ion mirror reflects the analyte ions 90° towards the entrance lens of the pre-quadrupole. Photons and neutral particles are not affected by the electrostatic field and harmlessly pass through the hollow structure to be removed by the vacuum system. By reflecting the ion beam, complete 3D control of the ion focal point is possible. The benefit is tunable sensitivity that can be optimized to your specific application needs. The intuitive ASpect MS software provides fast, automatic optimization of all ion lens settings.

- Efficient transmission of analyte ions through the interface
- Reflection of ion beam with 3D control of the focal point
- Effective removal of photons and neutral particles
- Optimal signal-to-background noise through 90° reflection
- Automatic, user-defined optimization protocols for all parameters
- Easy-to-use and maintenance-free design

From Spectro - New Application Brief: Analysis of Oils Using ICP-OES With Radial Plasma Observation

A new application brief explains how the use of ICP-OES with radial plasma observation provides a simple, fast, accurate and precise method for the analysis of trace elements, wear metals, additives, chlorine, and sulfur in oil matrices.

The [elemental analysis of oils](#) is important for many petroleum laboratories and refining processes. Samples can be crude oils, new and used lubricating oils, gas or fuel oils, and the elements to be analyzed vary with the product.

In crude oils, sulfur, alkali elements, vanadium, copper, nickel, iron, arsenic and phosphorus are of importance to characterize the oil and to avoid deactivation of catalysts in the refining process. For wear metals in lubricating oils, aluminum, copper, nickel or iron can be indicative of wear in oil-wetted components. Other elements like silicon, magnesium or potassium can be indicative of contamination of the oil. Also, the correct addition of elements, such as molybdenum, calcium, barium, phosphorus, and zinc should be monitored.

ICP-OES instruments, due to their multi element capability, high dynamic linear range, stability, and low detection limits, are suggested in several standard procedures for [oil and fuel analysis](#).

The paper details how ICP-OES, using the new SPECTRO ARCOS ICP-OES instrument with radial plasma observation, can provide a fast, simultaneous determination of trace elements, wear metals, additives, chlorine, and sulfur in oil. The easy sample preparation and low detection limits, combined with the high sample throughput of the method ensures low costs of analysis and enables its use for various applications in the petrochemical field.

To download the application brief, "Analysis of Oils Using ICP-OES with Radial Plasma Observation," visit <http://goo.gl/eEqVNm>.