



GLASS EXPANSION NEWSLETTER

Quality By Design

February 2006

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manufacturers have standardized on different operating conditions for the nebulizer. This is partly due to the implementation of a wide variety of sample introduction components during the development and maturation of the technology. Each specific choice was optimized with a unique combination of gas and liquid flows and pressures. These conditions were then generally passed on to newer models of spectrometer and sample introduction components were designed to accommodate the preset conditions. Today, many of the instrument manufacturers have standardized on concentric glass nebulizers used in conjunction with a cyclonic spray chamber. Companies such as Glass Expansion, who provide nebulizers customized for each manufacturer's make and model, have responded by designing specific nebulizers designed to run optimally under widely different conditions. For example, our nebulizers are manufactured to operate under any combination of the conditions shown in Table 1.

APPLICATION SPOTLIGHT

Improving the Performance of ICP Spectrometers

INTRODUCTION

This application note is based on a poster paper that was presented at the 2006 Winter Conference on Plasma Spectrochemistry. The paper was authored by Jerry Dulude of our US office along with Vesna Dolic and Dr. Peter Liddell of our Australian office and was entitled, **Approaching a Universal Pneumatic Nebulizer**.

As instrumentation for ICP-AES and ICP-MS spectrometry has evolved over the past 30 years, different

Our investigation hinges on the theory that there is one optimal argon pressure that can be used to design a universal nebulizer that will perform optimally on all spectrometer systems when used with a cyclonic spray chamber. Based on this hypothesis, we developed a batch of nebulizers based on our successful SeaSpray design, and which were designed to run at 60psi pressure, 0.7L/min Ar flow and 2mL/min natural sample uptake. These nebulizers were tested at uptake rates of 0.4 and 2.0mL/min. This report compares the performance of these new nebulizers with the standard 30psi nebulizers for two separate ICP-AES systems.

Table 1. Range of Nebulizer Conditions Available from Glass Expansion

Argon pressure (psi)	Argon flow (L/min)	Sample uptake (mL/min)
27	0.4	0.05
30	0.7	0.1
35	0.75	0.2
40	1.0	0.4
45		0.6
50		1.0
		2.0
		3.0

NEW 2006 CATALOG



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EXPERIMENTAL

The test nebulizers were operated with a Tracey cyclonic spray chamber. This system was evaluated with a Varian MPX Axial and a Perkin-Elmer Optima 2100 Dual-View ICP-AES Spectrometer. Instrumental parameters were as shown in Table 2.

VARIAN RESULTS

Inter-nebulizer Reproducibility

To determine the effects of subtle changes in parameters, it is necessary to first establish the inter-nebulizer variability within a given design. Figure 1 demonstrates the inter-nebulizer variability for a group of 5 different 60 psi nebulizers of the same configuration at two different sample uptake rates. (Results reflect the average of the same group of element lines used throughout the study and listed in Figure 3.) The consistent performance across the five nebulizers is due to the unique construction of the VitriCone sample channel in which a heavy glass capillary is machined to very tight tolerances.

Note that even though the uptake rate has been decreased by a factor of 5, emission intensity counts are decreased by only about 20 to 25%. This is due to the much higher efficiency produced at lower uptake rates.

Performance Results

Figures 2 through 4 compare the performance of the 60psi nebulizers with the standard 30psi nebulizers on the Varian instrument for a range of element lines.

The data in Figure 2 demonstrates that the 60psi nebulizer increased the sensitivity by 8% on average. It is believed that the increased gas pressure resulted in a smaller mean droplet size in the primary aerosol which in turn caused a significant enhancement in transport efficiency (tertiary aerosol). Figure 3 indicates that the stability of the sample introduction system was improved through the use of the high pressure nebulizer as well. Combining enhanced signal with lower noise should result in a significant improvement in detection limits which is borne out in Figure 4 for most elements; an improvement of 23% on average.

The next step was to determine if the enhanced performance found with the 60psi nebulizer in the Varian system could be duplicated on the Perkin Elmer instrument.

PERKIN ELMER RESULTS

The tests above were repeated on the PE system (Figures 5 through 7).

Table 2. Instrumental Parameters

Parameter	Varian MPX	Perkin Elmer Optima 2100
Power (watts)	1300	1450
Coolant flow (LPM)	15	15
Aux. flow (LPM)	1.5	0.2
Nebulizer gas flow (LPM)	0.7	0.7
Viewing	Axial	Axial
Read time (sec)	10	10

Figure 1. Inter-nebulizer Reproducibility: 3.9% RSD at 2ml/min and 6.8% at 0.4ml/min

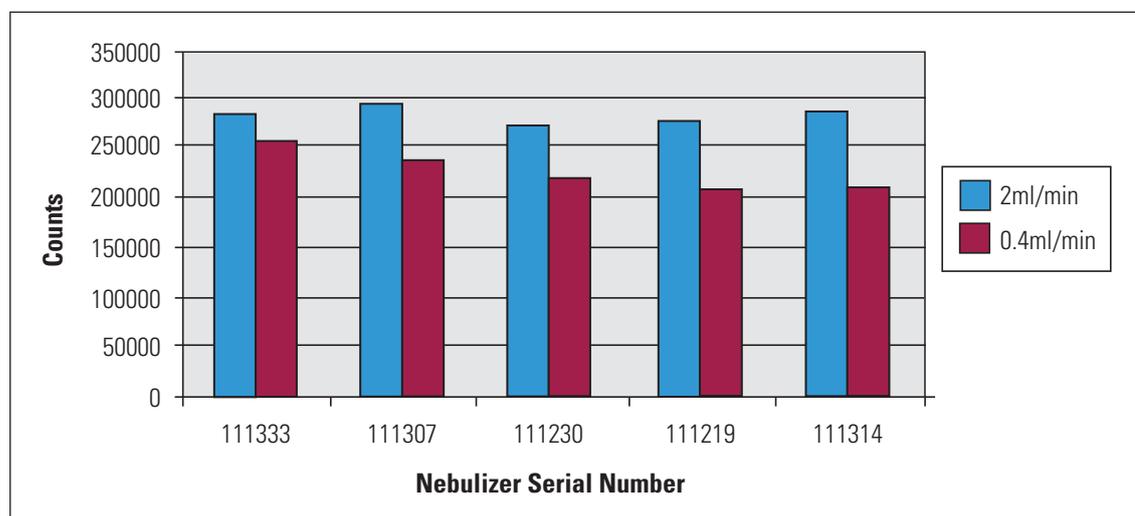


Figure 2. Effect of Pressure on Performance - Signal Intensity (2ml/min uptake), Varian Results

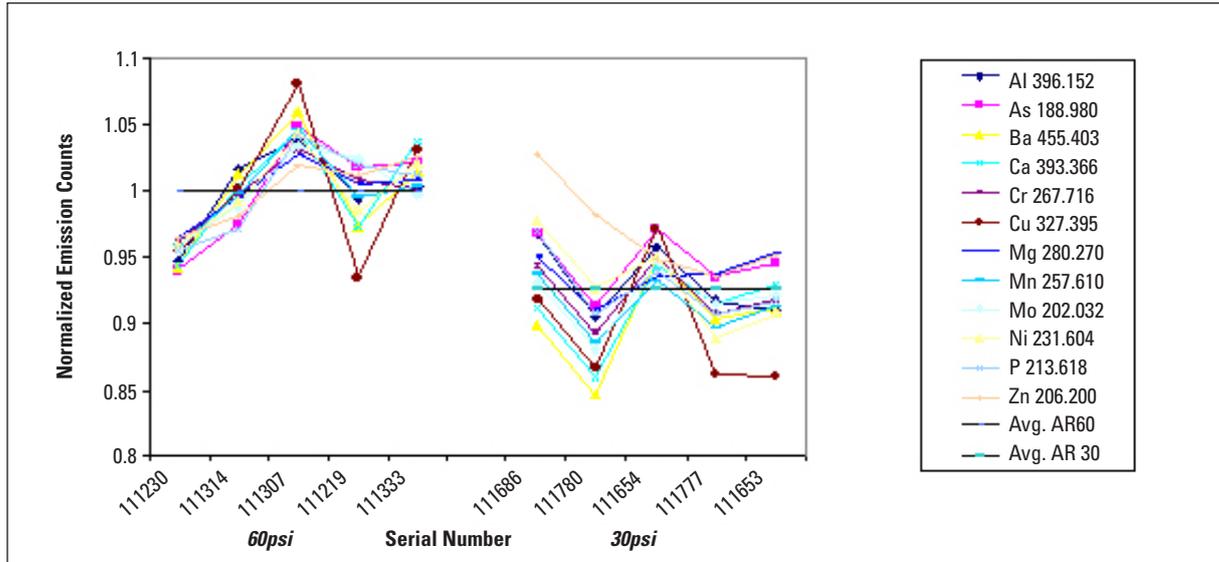


Figure 3. Effect of Pressure on Performance - Long-term (2 hours) Stability (2ml/min uptake), Varian Results

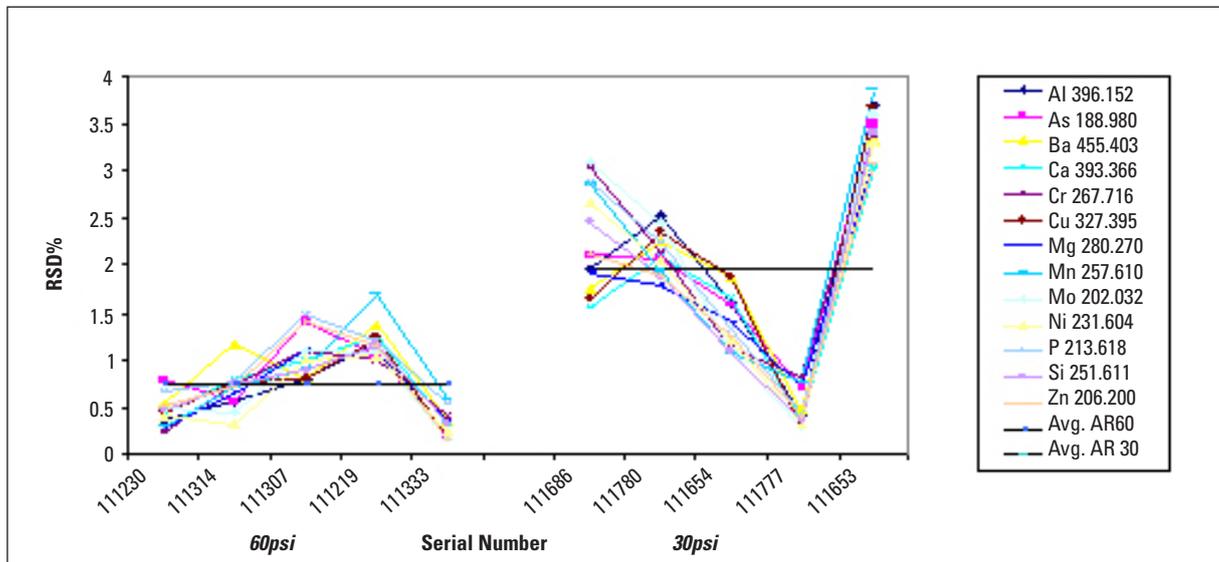


Figure 4. Effect of Pressure on Performance - Detection Limit (0.4ml/min), Varian Results

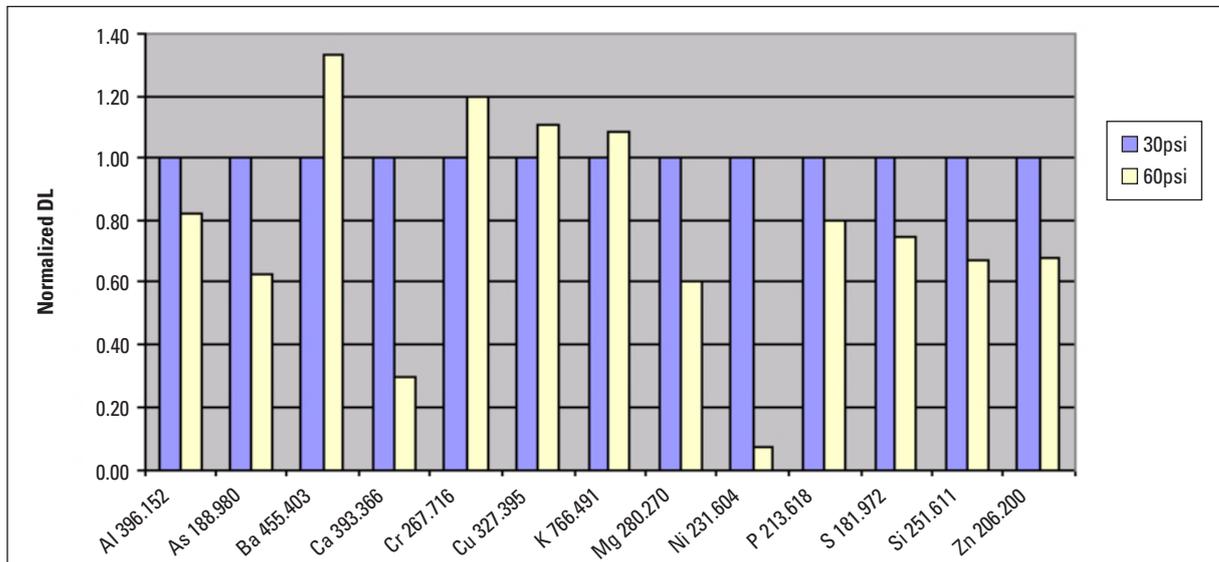


Figure 5. Effect of Pressure on Performance - Signal Intensity (2ml/min uptake), Perkin Elmer Results

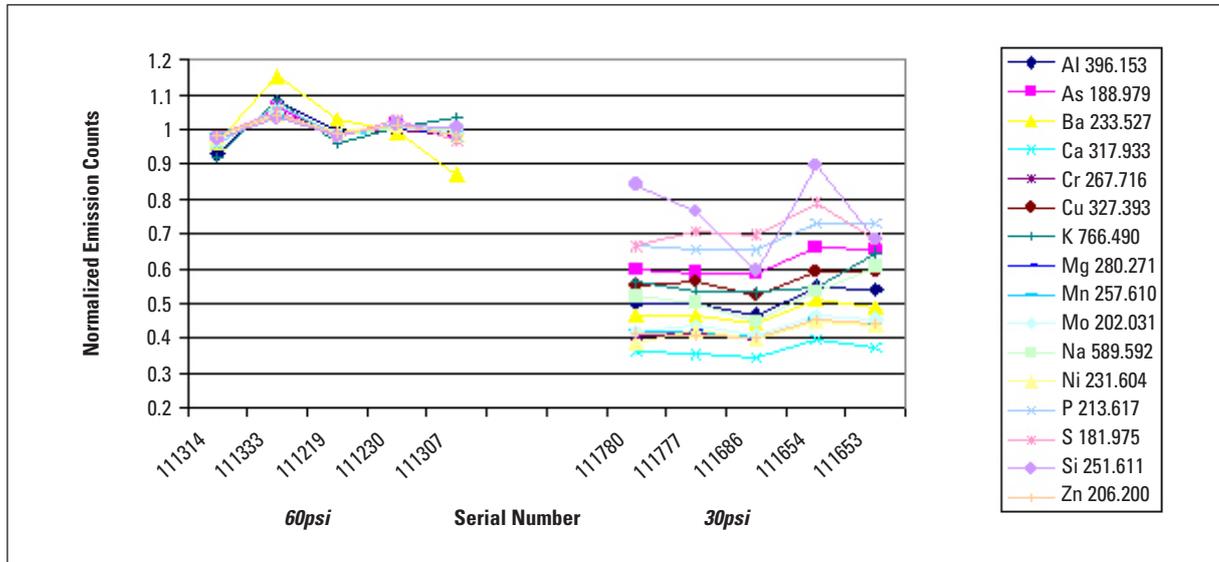


Figure 6. Effect of Pressure on Performance - Long-term (2 hours) Stability (2ml/min uptake), Perkin Elmer Results

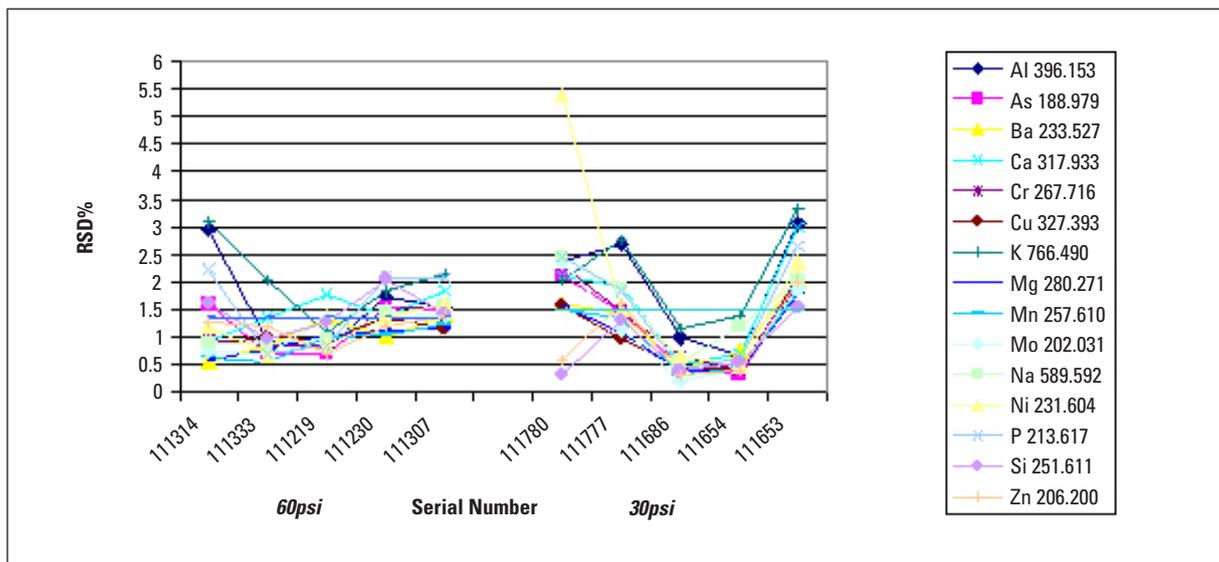
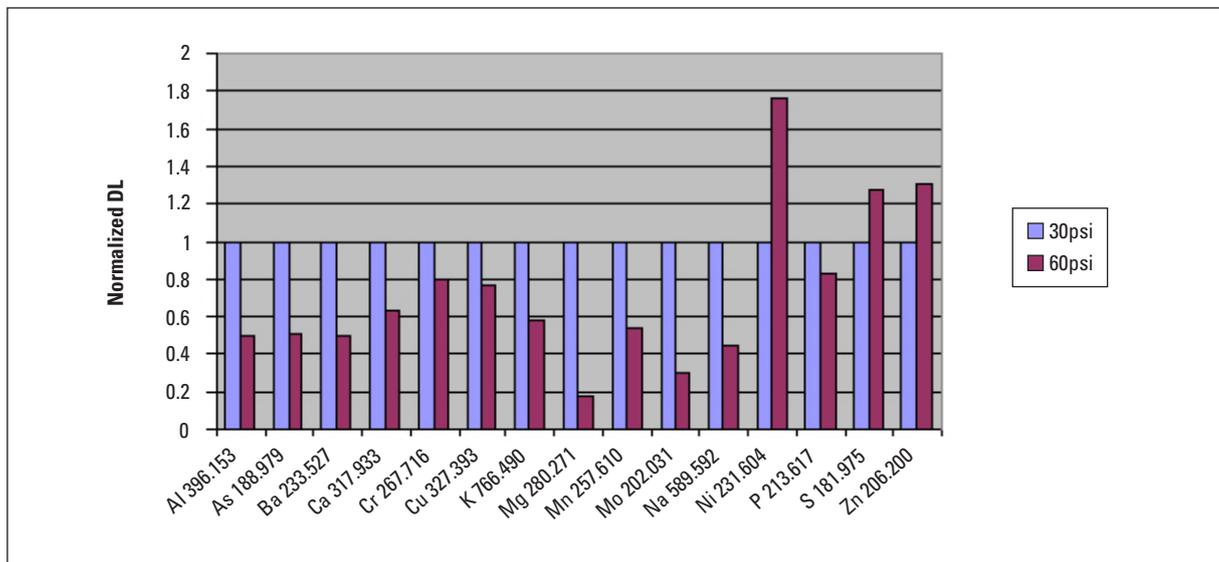


Figure 7. Effect of Pressure on Performance - Detection Limit (2ml/min), Perkin Elmer Results



Similar enhancements in performance were observed with respect to sensitivity and stability. Figure 7 demonstrates the resultant improvement in detection limits; on average a 27% improvement with the 60psi nebulizer. This compares well with the 23% enhancement observed using the 60psi nebulizer on the Varian system.

CONCLUSIONS

A concentric glass nebulizer designed to operate at 60psi was manufactured and tested with respect to a number of performance criteria on two separate makes of ICP-AES spectrometer. This new design was found to be superior to the standard nebulizer for both systems. Future work will focus on the ability of this nebulizer to handle dissolved solids and its performance on ICP-MS instrumentation.

NEW PRODUCTS

PFA SPRAY CHAMBER FOR ICP-MS

The extreme sensitivity of the ICP-MS technique demands exceptional purity in all sample introduction components. This is why we have developed a new range of PFA spray chambers for ICP-MS. The design is based on the established Tracey glass cyclonic spray chamber which is known for its excellent sensitivity and precision. Fast washout is also a feature of this design and enables the highest possible sample throughput. The PFA material is ultra-pure, making the new Tracey PFA44 spray chamber ideal for ultra-trace ICP-MS analyses. It is also totally inert, enabling the new spray chamber to be used with all common ICP-MS samples, including those containing HF. The Tracey PFA44 spray chamber incorporates the inert Helix nebulizer interface, which has minimal dead volume in order to minimise carry-over between samples. It can be teamed with the OpalMist PFA nebulizer to form the highest purity, most inert sample introduction system available. There is a system available to suit most ICP-MS models. Contact enquiries@geicp.com for more information.



Tracey PFA44 Spray Chamber - P/N 20-809-2515

PTFE SPRAY CHAMBER FOR ICP-OES

While the PFA material used for the Tracey PFA44 spray chambers has exceptional purity, it is relatively expensive.

For ICP-OES analyses, PTFE (Teflon) represents a more cost-effective alternative. It is almost as pure as PFA and it offers the same inertness to all of the common samples, including those containing HF. We have now released a new range of PTFE spray chambers for ICP-OES. These are also based on the established Tracey cyclonic design with its renowned sensitivity, stability and fast washout. The Tracey TFE range also incorporates the inert Helix nebulizer interface to minimize carryover between samples. The Tracey TFE spray chambers are specially treated to ensure efficient drainage and they offer better sensitivity and precision than the old polypropylene spray chambers. They can be teamed with the PolyCon HF-resistant nebulizers to form the ideal chemically inert sample introduction system for ICP-OES. There is a system available to suit most ICP-OES models. Contact enquiries@geicp.com for more information.



Tracey TFE Spray Chamber - P/N 20-809-9188

NIAGARA RAPID RINSE ACCESSORY WITH SERIAL COMMUNICATION

The Niagara Rapid Rinse Accessory has been increasing ICP sample throughput and saving money for its users for about a year. A new model is now available which communicates with the autosampler through a serial cable rather than a trigger switch. This significantly simplifies the installation. The serial communications kit is available for most ICP/autosampler combinations and we are offering a free upgrade for existing users. Contact enquiries@geicp.com for details.



Niagara Rapid Rinse Accessory

INSTRUMENT NEWS

FROM AGILENT TECHNOLOGIES

Two new ICP-MS Educational Aids

Free ICP-MS Primer

This 86 page comprehensive guide to ICP-MS is designed to provide the reader with a clear understanding of the technique and its capabilities. The Primer describes the basic concepts of ICP-MS, moving to a closer look at the hardware design and finishing with an overview of all major applications. You can download a pdf of the ICP-MS Primer or request your own copy in paperback format via the Agilent ICP-MS website at www.agilent.com/chem/icpms.

Agilent 7500ce ORS Video

Shows a sample's journey through the 7500ce. This video describes the principles of ICP-MS, including an animated sequence of an "ion's eye view" as it travels through the 7500ce. More information is found on the Agilent website.

FROM TELEDYNE LEEMAN

Measure Nitrogen by ICP-OES

Teledyne Leeman Labs has developed an accessory for ICP-OES instruments which permits highly accurate determinations of elemental nitrogen in a variety of sample matrices.

Nitrogen is an analyte of interest in materials ranging from phosphate-based fertilizers to organic compounds. In fertilizers, nitrogen (as ammonium) is a relatively expensive component and must be accurately measured to ensure both product quality and to contain production costs. While a variety of elements in fertilizers are routinely measured by ICP-OES, inorganic nitrogen has typically required alternate analytical techniques, such as the use of a dedicated nitrogen analyzer.

Historically, there have been numerous limitations to the determination of inorganic nitrogen by ICP-OES. The primary limitations included high nitrogen blank levels from diffusion of laboratory air into the plasma and dissolution of air in the samples and standards.

Leeman's new Nitrogen Accessory includes an air free optical path, a custom torch designed to prevent migration of nitrogen (from air) into the plasma and an innovative sample degassing device that is designed to work with conventional solution autosamplers. Together, these innovations allow the modern ICP to achieve levels of accuracy that used to require a dedicated nitrogen analyzer.

To receive additional information, email LeemanLabsinfo@teledyne.com or visit their website at www.leemanlabs.com.

FROM SPECTRO

A Sidelong Glance Into The Plasma

SPECTRO Analytical Instruments will introduce the new SPECTRO GENESIS SOP (Side-On-Plasma) with radial plasma observation at the Pittcon 2006 Conference on March 13th.

The ICP-OES records the entire spectrum between 175 and 777 nm, enabling the simultaneous determination of more than 70 elements. Based on similar technology to the SPECTRO GENESIS EOP introduced in 2005, the SPECTRO GENESIS SOP utilizes an alternative transfer optic with radial observation of the plasma.

"The observation volume is smaller for radial observation of the plasma," explains Olaf Schulz, Product Manager for ICP at SPECTRO. "The detection limits are not quite as low as for the EOP model of the instrument, but it makes up for this with a larger matrix tolerance: The instrument is much more precise for medium to high contents – from the lower ppm to the percent range."

The SPECTRO GENESIS SOP is designed to meet the requirements of industrial users. Typical applications include the examination of industrial waste water, the analysis of wear metals and additives in oils, and examination of soils and sludge in the agricultural industry. The instrument also can be used within the chemical industry to examine saline solutions or organic samples, for which axial plasma observation would not deliver satisfying results. Also currently available are the first packet of methods for use with the SPECTRO GENESIS SOP.

FROM THERMO

The World's Smallest ICP

Thermo Electron Corporation announces the launch of its new iCAP 6000 Series, featuring the most compact ICP emission spectrometers available on the market, the iCAP 6300 and the iCAP 6500. Thermo's expertise within the ICP market has resulted in advanced, high efficiency optical design for these new instruments. The iCAP provides excellent resolution, stability and sensitivity and excellent detection limits which enable enhanced productivity, greater ease of operation and reduced cost of ownership.

Thermo's new iCAP 6000 Series is equipped with a high power, solid state RF generator capable of handling all sample types. A distributed purge system offers reduced gas consumption and improved performance for elements

such as As, Sb, Se and Te. Fully automated wavelength calibration and offset correction ensure excellent long-term stability. The ergonomic design of a large 270° door allows unrestricted access to a large sample compartment and peristaltic pump.

A core part of any ICP spectrometer is the detector, and the iCAP 6000 series' unique RACID86 fourth generation Charge Injection Device (CID) detector offers several unique benefits. Able to perform non-destructive readout, this detector allows high intensity signals to be read very rapidly while lower intensity signals are accumulated over a longer time, ensuring optimum signal to noise and resistance to saturation. The RACID86 detector allows selective Region Of Interest (ROI) and true random access pixel address, which greatly shortens analysis times and improves sample throughput.

The iCAP 6300 offers fast, reliable and simplified performance for routine analysis and is available with either a dedicated Radial or Duo plasma source. The Radial view achieves optimum performance and minimum interference for difficult samples such as metals or used oils. Alternatively, the Duo offers the flexibility of axial view for lowest detection limits and Radial view for reduced interference, ideal for environmental samples.

The iCAP 6500 provides ultimate flexibility and productivity, and is operated via powerful software with automated set-up and automatic optimization. This system includes an intelligent operation mode which groups functions together, minimizing overhead time and ensuring a typical time saving of 15% for an analysis where both axial and radial measurements are being made.

For more information about Thermo's new iCAP 6000 Series, please e-mail analyze@thermo.com or visit www.thermo.com/elemental.

GLASS EXPANSION NEWS

THE 2006 CATALOG NOW AVAILABLE

The new Glass Expansion catalog Issue 5 is now available. This 132-page full color catalog lists nebulizers, spray chambers, torches, RF coils, ICP-MS cones, accessories and consumables for over 70 ICP-AES and ICP-MS models. If you would like your personal copy, please send your mailing address to enquiries@geicp.com and we will rush a copy to you.

WEBSITE IN ITALIAN

Most of the Glass Expansion website is now available in Italian. This is in addition to the previously available languages - English, French, German, Spanish, Chinese,

Japanese and Russian. Navigation is simple and you can switch languages at any time using the language buttons at the top of each page.

PITTCON

A wide selection of Glass Expansion products will be on display at Pittcon 2006, Orlando, Florida, USA, March 13 - 16, 2006. The display will include nebulizers, spray chambers, torches, RF coils and accessories (including the new Niagara Rapid Rinse Accessory). 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 4259.