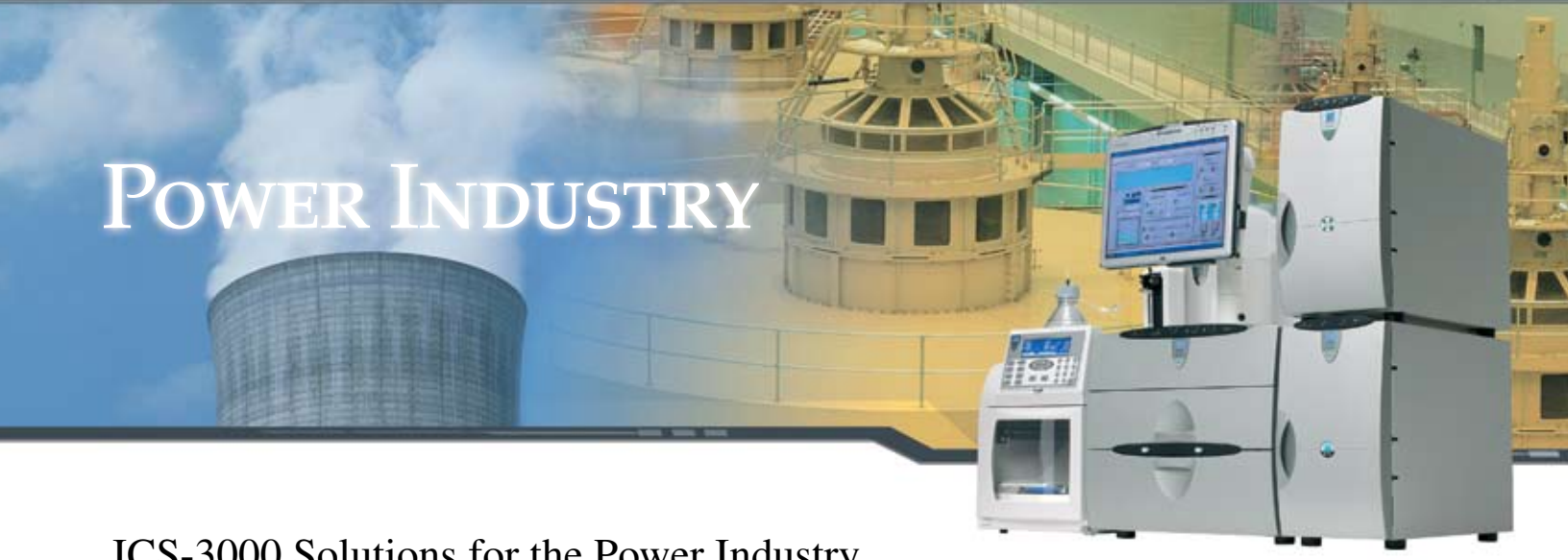

Power Industry

ICS-3000 Solutions for the Power Industry

Water and pure chemicals are the lifeblood of all nuclear, fossil fueled, combined cycle, and cogeneration power plants. U.S. thermoelectric power producers use more than 50 trillion gallons of water per year, according to current estimations. Analytical technology must ensure that the water, steam, and chemicals used in power plants are contaminant free. The power industry continues to face issues of corrosion fatigue caused by inorganic ions, environmental discharge regulations and hazardous materials that are unique to the industry. The ICS-3000 Ion Chromatography System delivers a dependable solution for analyzing plant waters and chemical additives.

Diagram showing common sources of ionic contamination that are detected by ion chromatography.

Ionic Contamination

The "water and steam" diagram (below, left) shows just a few of the common sources of ionic contamination for power plants. Many additional sources of contamination threaten the efficiency of plant operation. Vigilant analysis of the sources, using ion chromatography (IC), is the best way for power plants to determine and monitor the quality of their water and steam.

Additives and the Need for Analysis

Chemical additives enhance power plant water treatment. The treatment is typically customized to meet each individual site's needs, which vary with the source water quality, type of boiler, discharge requirements, and whether or not "used" water is recycled within the plant. Some common treatments include All Volatile Treatment, Equilibrium Phosphate Treatment, and Oxygenated Treatment. Several other water treatment regimens are also used such as polymeric dispersants, and chelating agents. In each case, care must be taken to assure that corrosive contaminants are not added along with the pure additives.

The Benefits of IC

During power plant operation, ion chromatographic analysis helps to: distinguish between corrosive and non-corrosive ionic intrusions; identify

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and eliminate sources of corrosive ingress; optimize and extend the lifetime of demineralizer resins; assure steam purity for protection of boilers, generators, and turbines; and maintain neutral anion-to-cation balances. The benefits of using IC systems are realized in a short period. Without IC to analyze waters and chemicals, power plants face down-time for forced outages due to water/steam side corrosion, boiler tube failures, replacing economizer tubes, cost of replacement power, and cost of chemical cleaning,

The advantages of IC are demonstrated by looking at typical applications in the nuclear, fossil fueled, combined cycle, and cogeneration industries. The new ICS-3000 system handles these applications better, faster, and more reliably.

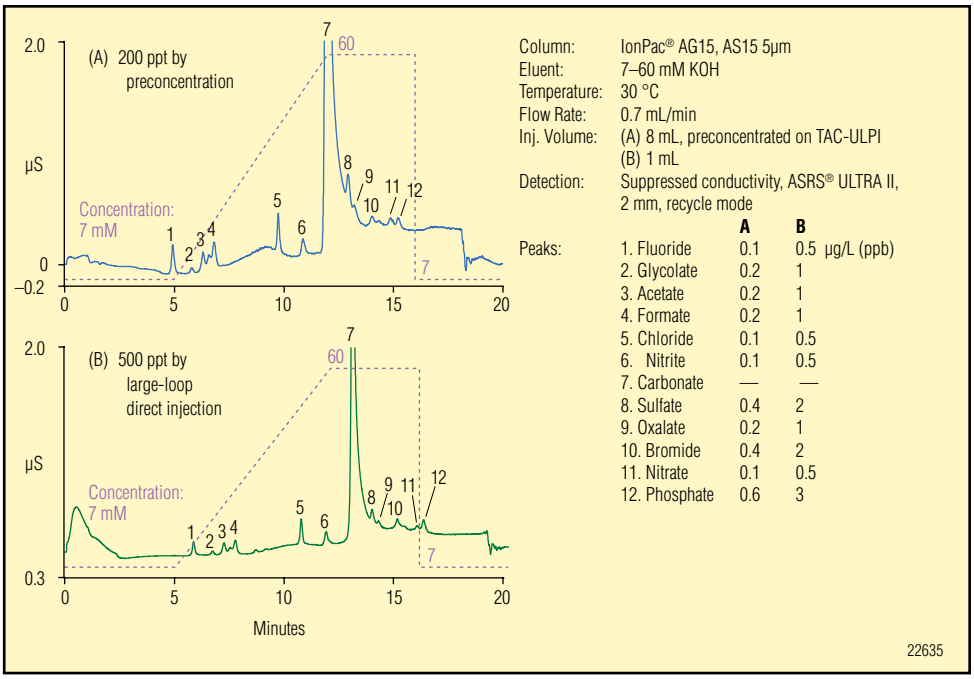

Figure 1. Determination of anions in high-purity water using the ICS-3000 with preconcentration and large-loop injection.

ICS-3000 and Ionic Contamination

Figures 1, 2, 3, and 4 show the advantages of using the ICS-3000 system. As demonstrated in Figure 1, the analysis of high-purity water yields impressive results with large-loop direct injection. The ICS-3000 provides superior sensitivity, robustness, serviceability, and reproducibility. Each module features advanced electronics that improve detection and enhance separations, translating into better analytical capability and reproducibility.

The ICS-3000 consists of a pump (single or dual), EG Eluent Generator, and DC Detector/Chromatography module. This instrumentation optimizes throughput and performance. Improved mechanical and electronic design have been coupled to generate precise fluidic flow control, accurate eluent generation with minimal noise, superior temperature isolation and stability, and outstanding signal to noise capability.

Whether the sample is raw water, pure water, irradiated water, boiler water containing amine additives, or condensed steam, the presence of low level anions and cations can be determined faster, more reliably and/or with better sensitivity using the ICS-3000. Figure 1 demonstrates the capability of the ICS-3000 for low-level anions using preconcentration (a) or large-loop injection (b) with the IonPac AS15 column. Figure 2 shows the advantage of using the Carbonate Removal Device (CRD) for anion analysis. Note the significantly decreased size of the carbonate peak. The CRD enhances reproducible integration of the sulfate peak for this analysis.

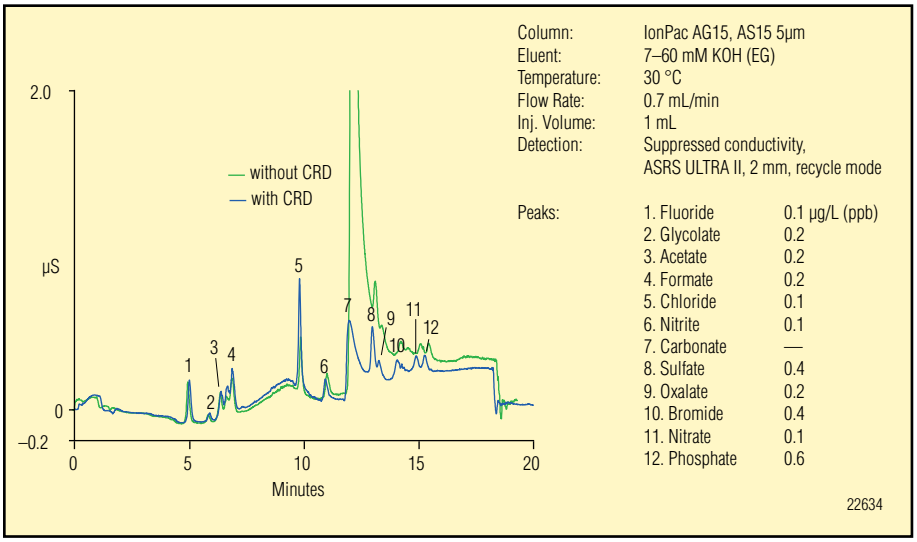

Figure 2. Chromatogram showing the advantages of using the Carbonate Removal Device. Note the decreased size of the carbonate peak.

Reliable Analyses

Instrument reliability is critical for all power plants. Around-the-clock operation requires immediate feedback on chemical parameters to ensure optimal performance of boilers, generators, and turbines. The ICS-3000 delivers reliable operation through improved pump design and use of eluent generation. Reliability is ensured by wellness tracking features whereby the system alerts the user of potential problems.

These features provide day-to-day reliability along with the ability to know when maintenance is required before it becomes a problem. The instrument is up and running when power plant engineers and managers need the information from water and steam quality analysis.

Flexible Configurations

The ICS-3000 provides flexiblity and multiple configurations to fit the application and multitasking demands of power plants. Here are just two of the possible configurations to improve throughput and productivity using the ICS-3000. To virtually double productivity using dual analysis, the system is configured with simultaneous injection capability. This configuration simultaneously fills two sample loops, injecting sample into two different eluent streams. Simultaneous injection is the basis of dual analysis. Instead of two dedicated systems, now you can use one system.

An alternate configuration, sequential injection, splits samples into separate applications. Sequential injection is ideal for applying two methods to the same sample and application requirements. This feature provides sample processing with one autosampler for two independent systems.

The flexibility of the ICS-3000 supports a multitude of configurations to handle diverse application needs. The system is configurable as a single, entry-level IC or a complete, high-throughput, dual system. In its simplest configuration, the ICS-3000 is dedicated for a single, routine application. Power plants facing new analytical challenges will appreciate the ability to upgrade from a single to dual system within the same footprint, saving bench space when combining multiple applications. Productivity is further enhanced with Chromeleon®, which integrates the entire workflow from injection to reporting results. The ICS-3000 building block configuration provides easy operation for a high-end instrument, with powerful application support and new method possibilities.

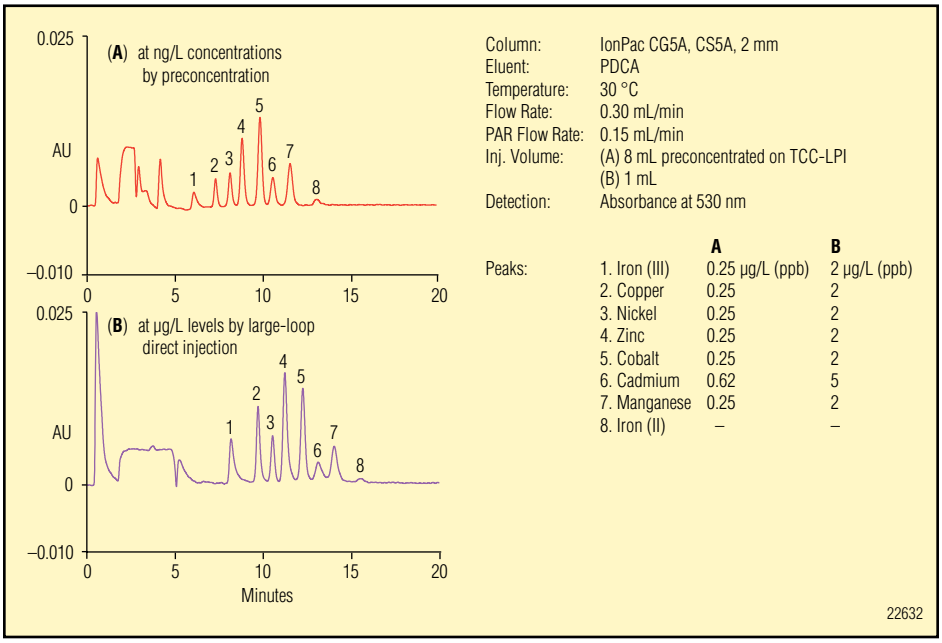

Figure 3. Determination of transition metals using the ICS-3000 with preconcentration and large-loop injection.

Run one sample and obtain results for both anion and cation analyses. It is easy to run two methods with one IC system. The flexibility of the ICS-3000 will not only help improve the productivity of data analysis, it also provides faster results for time-sensitive power production requirements.

The ICS-3000 pumps are stackable, dual-piston, and chemically inert. Access the pumps easily using sliding trays. Ion chromatography often requires a second independent pump for a variety of reasons:

- sample preconcentration of contaminants in ultrapure water
- matrix elimination
- postcolumn reagents
- suppression of external water delivery addition
- a spare pump if the primary fails
- clean consumables
- quick start procedures

For a minimal cost, you can take advantage of a second pump.

Trace Contaminants in Ultrapure Water

In the past, preconcentration, matrix elimination, and post column reagent techniques commonly used in power plants for trace analysis of pure water, chemicals and transition metal analysis respectively, required a maze of pumps, tubing and external devices. With the ICS-3000, one compact system will do the job. Figure 3 demonstrates a typical transition metal analysis using the ICS-3000 with both preconcentration (a) and large-loop injection (b).

Streamline Your Cation Methods

Cation-exchange IC methods are also made easier using the ICS-3000 with cation-exchange columns. The MSA eluent used with the IonPac CS16 column is easy to program into the application method and allows isocratic separation of Group I and Group II cations and amines which are important analytes for power plant operation. Figure 4 demonstrates the capability of the ICS-3000 for low level cations using preconcentration (a) or large loop injection (b) with the IonPac CS16 column.

Compare Analysis Methods

Ever wondered if a different column or eluent concentration might improve your analysis? Now you can directly compare columns or eluents, side by side on one system. With the ICS-3000 dual system, inject one sample at the same time, and directly compare which column or eluent works best for any given application. The possibilities are endless. Improvise and try new applications with ease.

Turn Trace Analysis into Routine Analysis

Eluent generation simplifies the analysis of trace-level anions and cations by automating eluent production. The ultrapure hydroxide (for anions) or MSA (for cations) produced by the EGC II cartridge results in a low, stable baseline that makes integration easier. Using the eluent generator with the CR-TC trap columns minimizes baseline shift during the step changes or gradients.

For most IC applications, eluent generation is a better solution. Consider these advantages:

- Significant savings in time and effort: Instead of manually preparing eluents, you simply supply your system with deionized water and proceed with your analyses. Each EluGen® cartridge lasts 6–12 months under typical usage conditions, and changing a cartridge takes only a few minutes.
- Greatly improved reproducibility: by eliminating variability associated with manual eluent preparation, and by eliminating the possibility of eluent contamination, eluent generation delivers reproducible results, day to day, week to week, lab to lab.

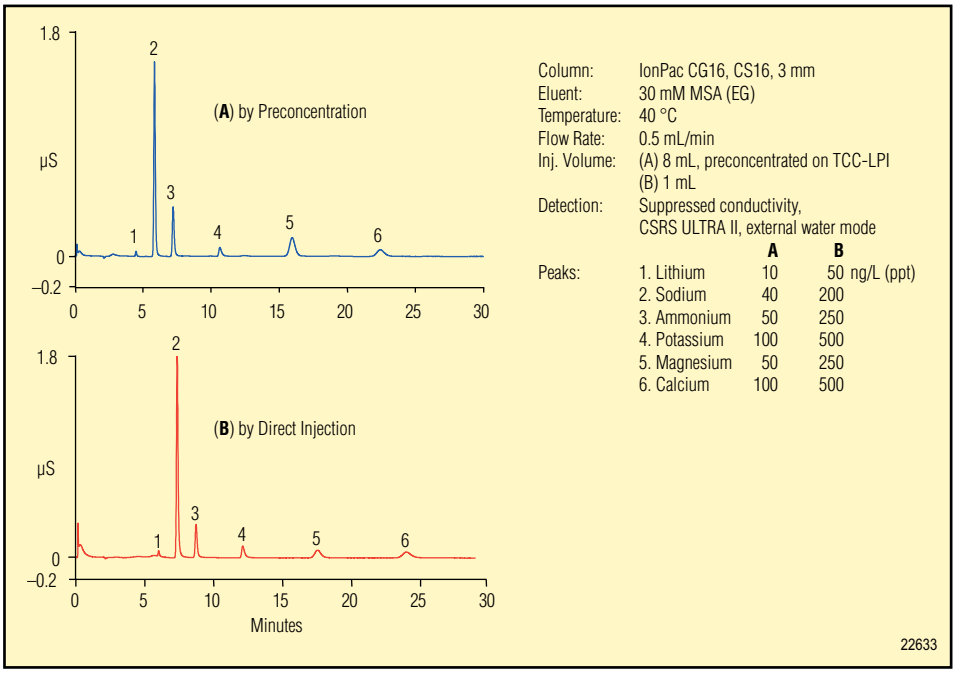

Figure 4. Determination of cations at ppt concentrations in high purity water using the ICS-3000 with both preconcentration and large-loop injection.

- Better gradient performance: electrolytically generated gradients are more precise than mechanically proportioned gradients, and have lower dispersion because dead volume is lower. Also, absorption of atmospheric carbon dioxide (for KOH eluents) or ammonia is virtually eliminated, so eluent contamination is no longer a concern. You get lower background signal, reduced noise, smaller baseline shifts, and better peak resolution.
- Greater pump reliability: because the only fluid in contact with the pump is deionized water, seals and pistons last much longer than they do when pumping premixed eluents.

Just Add Water

Eluent generation is the heart of Reagent-Free™ Ion Chromatography (RFIC™) systems. When IC automatically generates its own high-quality eluent on demand—in the exact amount and concentration needed for your application—you save time and effort while eliminating the variability that occurs with manually prepared eluents. No more measuring, mixing, and degassing. No more worrying about recipe errors or eluent contamination. You just add water and get great results.

Dionex eluent generators use electrolysis to convert pure water into potassium hydroxide eluent for anion separations or methanesulfonic acid eluent for cation separations. The result? A pure, contamination-free eluent is delivered on demand in the exact concentration needed for your application.

By adding automated eluent generation to your new ICS-3000 you can join the growing number of power plants that are benefiting from improved detection levels, easier use, and heightened productivity that comes with revolutionary RFIC systems.

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