Advancing ion chromatography for future research:

A look at the 2020 global IC virtual symposium

Executive summary

October 2020 saw the first ever virtual IC Symposium. Thermo Fisher Scientific's inaugural event was a celebration of the impact that ion chromatography (IC) has made, and attracted a host of distinguished guests from around the globe, all eager to share their experiences of working with IC. The symposium reflected on the 45-year evolution of one of the most important analytical tools and looked forward to the developments of the future.

Partner presentations by leading scientists highlighted exciting applications for IC, and Thermo Fisher Scientific's experts delivered invaluable insights based on their extensive knowledge. Additionally, there were a number of forums and Q&As, for the innovative exchange of ideas. Visitors to the symposium could ask experts questions on a wide range of topics and the presenters shared relevant and interesting ways to optimize methods and analyses.

Sign-up to access the on-demand presentations and register for the 2021 IC Virtual Symposium **here**.

Plenary Sessions

The Symposium included three plenary sessions led by experts from within the Thermo Fisher Scientific family. Taking a fascinating look back over the last 45 years of IC, the plenaries examined how this pioneering technology has evolved and what is likely to lie ahead.

ThermoFisher SCIENTIFIC

45 years of ion chromatography – milestones of the development

Opening
This first plenary session explored the history of IC, taking us from the pioneering work of Hamish Small and his colleagues through to the present day. PD Dr. Joachim Weiss, Technical Director Dionex Products, Thermo Fisher Scientific GmbH, outlined the developments that have proved pivotal in the evolution of IC technology.

Key learnings
The methods used for ion analysis looked rather different prior to the introduction of IC. Approaches such as Atomic Absorption Spectrometry (AAS) and polarography offered sensitive techniques for cations, but there was a lack of similarly sensitive techniques for anions. Furthermore, historical techniques were often laborious, time consuming and prone to interference.

Everything changed when Hamish Small sought to develop chromatography methods for use with ionic compounds, publishing his pivotal publication on the discovery of IC in 1975. This seminal text introduced the very first definition of IC, describing the process as the combination of separation by ion-exchange, eluent suppression, and electrical conductance detection.

In the beginning, IC was carried out on extremely large machines, and current practitioners may be surprised to learn that the first chromatographs were on cations. The first commercial use of IC took place in 1975, with the sale of the Thermo Scientific Dionex prototype system. These early experiments saw the use of glass columns and suppressors together with large injection volumes, which resulted in insensitive detection rates. Yet at the time IC represented a truly revolutionary technology.

Weiss explained that in the decades that followed, there were a number of key developments in IC and corresponding technologies. The 1980s saw the introduction of continuous suppression, which replaced packed-bed suppressors, as well as a breakthrough in cation-exchange chromatography, as the Thermo Scientific Dionex's research and development team created an organic polymer which enabled the separation of mono and divalent cations.

In the 1990s, the suppressor technology continued to evolve, with electrochemically regenerated suppressors replacing chemical regeneration. Indeed, suppressors have continued to be a focus for development, with improvements being made to pressure tolerance, robustness and the lifetime of the device. Further developments saw the introduction of capillary IC, or "IC on demand." Weiss also examined the set-up of instruments for combining IC with mass spectrometry (MS).

Closing
The scope of IC is now far greater than it was at its inception, with the range of anions and cations now able to be analyzed with IC far outstripping the simple level of analysis that was achievable at its introduction.

This rapid progress must be credited to the many contributors to IC technology over the years, from Hamish Small onwards. The definition of IC has evolved to reflect the advancement of the technology over the decades and is now considered an "umbrella term for all liquid chromatographic techniques that are capable of separating and detecting ionic or ionizable species."

Watch the full presentation on demand here.

45 years of ion chromatography and its impact on industries

Opening
PD Dr. Joachim Weiss, Technical Director Dionex products, Thermo Fisher Scientific GmbH, took another look at the history of IC in this session. He highlighted how IC techniques became commercialized and applied to a diverse range of industries.

Key learnings
Weiss commenced by outlining the approaches to ion analysis prior to the introduction of IC, and the pioneering work of Hamish Small, before discussing how IC has developed. He explained that IC is now widely used by many different industries, including the food and beverage, pharmaceutical and petrochemical industries, as well as use for environmental purposes, with applications such as arsenic speciation.

The 1970s saw the first commercial IC system, and Weiss highlighted the differences between the practices of the 1970s and today, such as use of large glass columns, and impossibility of gradient elution. There was discussion of the key developments of the 1980s, such as introduction of continuous suppression, and the first instance of Thermo Scientific Dionex products written into a method. Early applications covered were inorganic anion analysis in municipal drinking water, inorganic anion analysis in a flue gas scrubber solution, introduction of pulsed amperometric detection (PAD) for carbohydrate analysis, high-performance anion-exchange chromatography with pulsed amperometric detection

(HPAE-PAD) for carbohydrate analysis and gradient elution of petrochemically relevant amines.

Key developments such as electrochemically regenerated suppressors and hyperbranched anion-exchange polymers were also explored as well as the transition from analytic IC to capillary IC, which Weiss described as "IC on demand." These have led to improvements in particle diameter, capacity and pressure tolerances, with benefits including cost efficiency and better detection. Explaining that there is still more to come, he emphasized the latest topical developments, such as hyphenation techniques, and their application for areas of current interest such as polar pesticides.

Closing
The presentation clearly demonstrated how IC has greatly broadened its scope and is no longer just for inorganic ions – rather, it can be used to separate almost any anionic or cationic species, and the definition of IC has evolved to reflect this. It is now seen as an umbrella term for all liquid chromatographic techniques that are capable of separating and detecting ionic or ionizable species. Developments continue, meaning that IC still has more exciting innovations and applications to come.

View the full plenary presentation here.

What does the future hold for Ion Chromatography?

Opening
In this presentation, Jeffrey Rohrer, Ph.D. Director Applications Development, Thermo Fisher Scientific, explored expert predictions for the future of IC, based on current analytic chemistry trends. He offered valuable insights into how the trajectory of IC developments will likely continue, and the benefits it will bring.

Key learnings
Rohrer explained that speed from sample to results and increased automation were key trends in analytical chemistry, and that to operate more quickly, smaller particle columns, shorter columns and higher temperatures were required. He also outlined that advanced autosampler functions, inline sample preparation and better deployment of software are needed to increase automation.

When reviewing hyphenation techniques, Rohrer described how IC is ideal for MS, bringing with it a range of benefits including better detection limits, and increased confidence in results. Additionally, these faster processes mean less energy is used, and the environmental footprint is reduced.

Rohrer emphasized that "the future is now," showing how features already available in IC systems will be made better use of, including capillary IC. Similarly, the use of consumables monitoring and remote service access aid operational efficiency and laboratory management. He highlighted that applications and other software increase efficiency and reduce errors.

Closing
Rohrer summarized that the key trends currently seen in IC will continue, and reflected on what a laboratory of the future will look like, predicting smaller size columns, narrower column formats, and increased use of IC-MS. He remarked that efficiency will be improved through increased use of predictive features and simulation software, and future systems will likely be smaller with more advanced functions, perhaps even features including voice activation.

Watch the presentation here.

Partner Presentations

The 2020 virtual IC Symposium attracted leading scientists from around the world, who were all eager to share their experiences of working with IC. With expertise spanning a diverse range of fields, these partner presentations offered visitors an enthralling insight into a myriad of IC applications.

The advantage of using IC in treated sewage water analysis compared to photometric method

Opening
This session explored the work of Mr. Ang Eng Loo, Business Manager Analytical Division, CLMO Technology Sdn Bhd. Together with his team, Ang solved the challenge of analyzing nitrate and ammonium in samples of high matrix sewage water, using an IC system and autosampler.

Key learnings
There are certain requirements for an ammonium and nitrate analysis process, such as low running costs and eco-friendliness. Ang's team was the first to investigate the use of IC for this analysis, and approached the challenge from an angle never before attempted for nitrates and ammonias. They did so by using both conventional and reagent IC systems and autosamplers, with US EPA (United States Environmental Protection Agency) Method 300.0 for the determination of inorganic anions, and APHA (American Public Health Association)

Method 4110 for the determination of anions.

Ang made a comparison between colorimetry and IC techniques, including an assessment of preparation procedures, start-up and shut down times, disposal requirements, matrix interference and result accuracy. His findings showed that IC, as a separation technique, offered the advantage of excellent reproducibility, as well as yielding good separation of nitrate. IC also required only simple sodium carbonate bicarbonate, or water reagents, whereas colorimetry techniques necessitated complex reagents needing much more preparation. Furthermore, while colorimetry methods yielded results with a high level of matrix interference and poor accuracy, IC gave "consistently good accuracy and very low matrix interference."

The process was greatly enhanced by the use of Thermo Scientific Chromeleon 7.2 Chromatography Data System (CDS) as a data management solution, which enabled beneficial method validation, as well as "data acquisition, instrumentation control, customized reporting and Smart StartUp and Shutdown."

Closing
IC solved the problem of analyzing ammonium and nitrate, while offering significant benefits over other approaches. Ang found that using IC not only saved processing time and the associated costs, but also gave more accurate results with higher throughput of close to 200 samples per hour.

Watch the full presentation on demand here.

Improved understanding of the hydrogeochemistry of arsenic and selenium in ambient and industrial waters

Opening
Offering another fascinating insight into the varied applications of IC techniques, this session explored the use of IC on the speciation and hydrogeochemistry of trace elements found in ambient and industrial waters. Led by Professor Dirk Wallschläger, Environmental Chemistry, Trent University, Canada, the presentation highlighted that arsenic and selenium are two of the most environmentally important trace elements, and so their speciation is vital for the protection of both public health and aquatic ecosystems.

Key learnings
Arsenic speciation is essential due to the carcinogenic risk posed to humans exposed to it via drinking water, while selenium speciation is critical as reproductive defects develop in top predators as it bioaccumulates and biomagnifies in aquatic food chains. Previous ideas about arsenic and selenium speciation, based on old methods of analysis, were limited by the commercially available analytical standards. Scientists recognized that there were more forms of organic arsenic and selenium present in the water samples, however these were unable to be detected or analyzed.

Wallschläger started using anion-exchange chromatography combined with inductively coupled plasma mass spectrometry (AEC-ICP-MS) 20 years ago for his work, with alkaline eluent and hydroxide selective columns, along with high volume sample injections. This was key in advancing his research, as ICP-MS techniques allowed the analysis of highly polarizable anions, as well as offering advantages such as the high detection sensitivity and specificity, and the possibility of analyzing other species of arsenic and selenium.

As a result of this new approach, the team worked with samples taken from meromictic lakes and geothermal waters and by using IC-MS, was able to easily detect polarizable species. The team was also able to study methylated arsenic-sulfur compounds and hexofluoroarsenate using IC-MS techniques. Thanks to this groundbreaking work carried out by Wallschläger, the US EPA has developed an interest in these compounds.

By using IC techniques, Wallschläger and his team were also able to locate selenium-selenocyanate located in rivers, "proving for the first time that there is a biological means of production."

Closing
A vast amount about arsenic and selenium chemistry has been learned during the last 20 years, and as a consequence, our understanding has changed substantially. These advances in knowledge were made possible by the IC-MS techniques, which gave the progressive analysis needed. While there are still more challenges to overcome, the use of IC has certainly proved transformational in this field of research thus far.

View this presentation in full here.

What I see undersea with IC

Opening

Led by Nathan F. Dalleska, Ph.D, Director, Environmental Analysis Center Caltech USA, this presentation explored the IC protocol used in his research over the last decade. Dalleska outlined his project involving measuring rates and identifying biological mediators of nitrogen fixation in deep sea sediments.

Key learnings

Following the discovery of a bacterial mat growing on the seabed in deep sea off the coast of California, this research project sought to answer the question: "Where was the bacterial mat getting nitrogen at deep sea floor levels?". To find out, Dalleska needed means of obtaining better, more accurate evidence.

The sample collection process involved extracting sediment cores from the seabed, and then incubating the samples with ammonium or dinitrogen for 13 months. At this point, the samples would be split again, and be either fed with methane or starved with oxygen.

There were a number of challenges for the experiments, such as the need for sensitivity, and ability to handle high quantities of very small samples (<0.5 mL). Furthermore, the team needed a method which was simple to use, inexpensive and offered quick sample preparation.

The first IC protocol used by the team was DX-500 system models with Thermo Scientific Chromeleon 6.8 CDS, and this was followed by a move to a more compact system in 2012. This second IC protocol allowed continuous operation, and the results showed better resolution, stable quantitation, and improvements to the anion channel. It also had the ability to pick up additional interesting acids.

Closing

Dalleska and his team found that IC met the needs of the project, fulfilling all the desired criteria, and they will now be moving onto their third protocol, which will include two Thermo Scientific Dionex Integrion HPIC System units to be installed with variable wavelength detector and Dionex AS-DV autosampler. This new set-up promises exciting potential developments for their research.

See the presentation in full here.

IC coupled with (QQQ) mass spectrometry: A powerful solution for trace analysis and speciation in environmental and industrial Q&A session

Opening

Highlighting the potential that hyphenation techniques can offer, Professor Brett Paull, Associate Dean (Research), University of Science and Engineering, Tasmania, explored three projects that demonstrated the value of coupling IC with (QQQ) MS. Numerous advantages were realized, including considerable improvements in sensitivity and selectivity, as well as identification of unknowns in a sample, and the ability to handle samples with complex matrices.

Key learnings

Paull's research focused on environmental science. The first project he discussed was determining inorganic anions and oxyhalide disinfection by-products in freshwater, sea water and drinking water. There are limitations to traditional IC approaches for this work, such as the ability to achieve the sensitivity necessary for complex sample matrices, but IC-MS overcame these. With IC-MS, the typical responses show the high degree of sensitivity achieved, while the technique offered other advantages too. These benefits ranged from unique selectivity, enabling analysis of the isotopic abundance of various species, to the ability to monitor quantitation and confirmation peaks for each species. As a result, Paull described the system as "robust, with method development made easy."

Other applications of IC-MS were outlined, such as air samples and aerosol filters, which are of great importance to environmental scientists. Another advantage of using MS techniques is that sensitivity can be improved by adjusting ionization conditions and make-up solvents. Furthermore, there is valuable information that could be taken from samples as a result of this sensitivity, such as identifying rain events and ratios of burning wood matter in bush fire areas. Additional applications include identification of otherwise unidentifiable species in complex mixtures.

Paull described his lab set-up, which includes the Thermo Scientific Dionex CarboPac PA200, an electrolytic eluent suppressor and Thermo Scientific TSQ Quantiva triple-stage quadrupole mass spectrometer. Highlighting the need to use a high ionic strength eluent for the protocol, his typical sample analyses showed that it could provide limit of detections (LOD) in the ppb to ppt range for the target species.

Closing
Paull's experience demonstrates that IC-MS offers extremely sensitive results that cannot be achieved by other means, and offers a host of benefits to users such as a robust system, with incredibly easy method detection.

View the presentation in its entirety here.

IC in Forensics

Opening
In this riveting session, Dr. Elizabeth Gilchrist, School of Chemistry and Environmental Research Institute, University College Cork, Ireland, discussed the use of IC in forensic science. Forensic science typically involves detecting trace components, and being able to rapidly, sensitively and reliably identify these components is of critical importance. IC is already used for analysis of low-order explosives as it can speciate between metals, but there is potential for wider use.

Key learnings
Gilchrist advised that IC can be applied to a range of areas for analysis, such as explosives and bodily fluids with modern IC methods being able to detect which anions and cations are present in explosive residue, as well as the sugars that can be added as a fuel. She outlined major events which have involved explosions containing materials suitable for IC analysis, from the 1993 World Trade Center bombing to the 2020 attack in Beirut, Lebanon. IC also offers the potential to differentiate between ammunition types, therefore giving valuable insights into types of weapon used in a crime.

Advances in forensics that focus on alternative biological matrices, such as fingerprints, are also particularly well suited to IC analysis. Gilchrist stressed that "the importance of endogenous substances in fingermarks must not be underestimated," as they can provide vital insights into sex, diet and age. For example, factors such as smoking behaviors can be determined by IC methods when applied to secretions such as sweat, and it can also be used for establishing time of death.

IC-MS is a growing area in forensics, and offers advantages over other approaches, such as IC coupled with suppressed conductivity detection (IC-SCD) or high-resolution mass spectrometry (IC-HRMS). IC-MS offers vast improvements in sensitivity compared to other methods and provides reliable identification and quantification of compounds of interest, with a lack of interference.

Closing
IC's ability to offer accurate, rapid and sensitive results is extremely valuable to forensic investigation. Use of IC-MS has become more mainstream over the last 10 years, and has proven itself to be a highly beneficial technique, allowing increased confidence in compound identification.

Discover more about IC and its use in forensics here.

Q&A with Dr. Elizabeth Gilchrist

Opening
This Q&A expanded on the opinions of Dr. Elizabeth Gilchrist, School of Chemistry and Environmental Research Institute, University College Cork, Ireland, on using IC-MS, together with an insight into how her experience has changed over the past decade.

Key learnings
The questions ranged from technical queries relating to Gilchrist's own approaches, to the value that coupling IC with MS has given to her work. It was clear that MS has provided significant benefits to Gilchrist's research, such as higher sensitivity, and the ability to identify peaks which she had previously been unsure of.

Gilchrist also explained how she overcame challenges, such as dealing with high levels of chloride, by submerging samples in ionized water in order to subtract many of the compounds of interest. Other advice included how to establish a presence of ammonium nitrate post blast explosions, through analysis of degradation products using IC.

There were helpful practical tips on handling small samples of limited volumes, and methods for preventing contamination. Here, Gilchrist advised using careful preparation methods, using PPE, and running blanks and controls. She also recommended replicating samples.

Looking back at her 10 years of experience of using IC-MS, Gilchrist said that it has changed massively over the last decade and is now "easier to use, and offers better integration, than ever before."

Closing
Gilchrist's advice on best practices in using IC for forensics offered both interesting insights and practical help for visitors.

Watch the Q&A session in full here.

Exploring IC-MS for the analysis of metabolites in cells, tissues and bio-fluids

Opening

Delivered by Professor James McCullagh, Director of the Mass Spectrometry Research Facility, University of Oxford, UK, this presentation outlined the pioneering use of IC-MS for his work on metabolism. IC-MS techniques have helped his research significantly and have been used in collaborative areas of research such as cancer metabolism, and the effects of gene mutation.

Key learnings

McCullagh's work is focused on the understanding of the biomedical system from a small particle perspective. As such, it faces the fundamental challenges posed by analytic work on metabolics, such as reproducibility. The evolution of IC-MS technology has offered McCullagh considerable potential, such as the opportunity to focus effectively on the central carbon metabolism. As the previous chromatography platforms coupled with MS were not amenable to anion chromatography, this was an exciting development.

McCullough explained that IC-MS was a better platform than hydrophilic interaction chromatography-mass spectrometry (HILIC-MS), due to better stability and reproducibility. IC-MS was also able to resolve isobaric metabolites with the same molecular weight, such as sugar phosphates, which could not be resolved by MS alone. Since adopting IC-MS, his team has resolved over 400 anionic metabolites.

McCullough described several key research applications of IC-MS, such as research into the gene mutations that lead to cancer. As a result, he expressed IC-MS as "a valuable technique that can address some of the analytical challenges still involved in the analysis of biological samples."

Closing

As McCullough's groundbreaking research showed, IC-MS has proven itself to be a highly valuable technique, meeting a number of the challenges of analyzing biological samples. IC-MS has been able to resolve challenging metabolites while offering a range of desirable benefits such as reproducibility. Consequently, IC-MS is now being used in a number of research projects.

View the presentation in full here.

A HPAEC-PAD method for the analysis of FODMAPs in cereals and cereal-based products

Opening

Lilit Ispiryan, PhD Candidate, University College Cork, Ireland discussed a HPAEC-PAD method for the analysis of FODMAPs in cereals and cereal-based products. She began by explaining what the term "FODMAP" (fermentable, oligosaccharides, disaccharides, monosaccharides and polyols) meant and why these compounds are analyzed, as well as describing the importance a FODMAP diet has for alleviating the symptoms of gluten intolerance.

Key learnings

Ispiryan researched cereals and cereal-based products, which are often high in FODMAP, and is seeking to develop low FODMAP food products as a result. She explained that there are different FODMAP levels in cereals and cereal-based products, and so there is a need to identify carbohydrate levels, which should be under 0.3 g in standard food servings.

Ispiryan described the technical equipment used in her methods, which centered on the HPAEC-PAD Thermo Scientific Dionex ICS-5000+ Capillary HPIC System, and included the use of the Dionex CarboPac PA200 and Dionex CarboPac PA1 columns.

Challenges in sample presentation and analysis were discussed, such as the presence of yeast or native enzymes, and solutions given for sample preparation and IC analysis method, emphasizing that using "warm water was important to fully solubilize fructans and prevent undesired enzyme activities." There was also discussion of the issues that affect samples, including variables such as the defrosting process.

Closing

Ispiryan concluded that the method brings advantages, such as peak area reproducibility for carbohydrates and higher reproducibility for early eluting peaks. Using these techniques also promises the potential to discover more possibilities for optimization. As a result, using IC technology can be beneficial for creating foods that will transform the lives for many IBS sufferers.

Take a look at the presentation in full here.

Q&A with Prof James McCullagh & Lilit Ispiryan

Opening

This useful Q&A session was held by Professor James McCullagh, Director of the Mass Spectrometry Research Facility, University of Oxford, UK, and Lilit Ispiryan, PhD Candidate, University College Cork, Ireland, who are experts from biomedical and food and beverage industry research backgrounds, respectively. Questions ranged from practical maintenance and sample preparation, to technical queries about the comparative performance of HILIC for resolving metabolites.

Key learnings

During the Q&A, experts gave advice on the frequency of polishing detectors and the role that Thermo Scientific Chromeleon CDS can play in this, highlighting how such tools are beneficial. A software solution, built with the lab and IT in mind, Thermo Scientific Chromeleon CDS delivers excellent compliance tools, networking capabilities, automation and instrument control as well as data processing.

The experts were both keen to emphasize the positive value that Thermo Fisher Scientific has brought to their research. Indeed, McCullough revealed that he had discovered IC "by luck," after it was suggested to him by Thermo Fisher Scientific.

Interesting questions were raised, such as "Were any metabolites better resolved by HILIC?", with the experts' response reinforcing that while HILIC proved a useful complement, IC brought improved results. Other queries saw the discussion turn to how samples of cytokines from human skin cells might be effectively prepared for analysis. Ispiryan also gave useful information about her lab set-up, such as the successful use of IC without a helium or nitrogen supply.

Closing

The Q&A session offered practical insights into the best use of tools, such as Thermo Scientific Chromeleon CDS, and emphasized their benefits for instrument monitoring. Subsequently, the session provided useful tips, and was an ideal complement to the earlier partner presentations.

See the session in full here.

IC capabilities for analysis of plating bath

Opening

In this interesting presentation, Mr. P.S. Nandkumar, Vice President – Q.A., Grauer & Weil (India) Ltd., explored how the application of IC can be used in the electroplating process. Beginning with an explanation of the electroplating process, Nandkumar included details of plating bath parameters such as impurities in the raw material, bath temperature and bath composition. He went on to describe the techniques traditionally used for monitoring the plating process and their limitations, and the ones currently used today, including IC.

Key learnings

Using IC has greatly improved Nandkumar's monitoring of the plating process, bringing benefits such as enhanced plating quality through effective monitoring of the impurities in the raw material. As a result of using IC, Nandkumar has been able to stay ahead the competition, by enabling total analysis of products.

The expert outlined how the IC techniques are applied to different plating processes and how better monitoring with IC refines results. Using IC techniques for monitoring even allows control over the finished appearance of the product. He remarked "R&D in the development process becomes easy with IC technology."

Closing

IC has proven itself to be a valuable technique for monitoring the plating process, and by using IC Nandkumar has solved issues such as troubleshooting bath problems, resolving customer complaints, and assisting with R&D.

View the full presentation here.

The ultimate tips and tricks guide – from start up to software

Opening

Daniel Talbot, Applications Specialist, Thermo Fisher Scientific gave practical advice and tips for IC, and focused on the key areas of a typical IC set up.

Key learnings

Talbot began by reflecting on the important benefits of proper care and maintenance of equipment, for example contamination prevention. Taking a closer look at laboratory set-ups, he considered different components, such as tubing and fittings through to suppressors, before highlighting the problems that can arise from contaminated tubes, including ghost peaks and loss of sensitivity.

The benefits of the latest pre-cut Viper capillaries, a finger-tight fitting system for IC connections were discussed along with strategies for eluent preparation, including best water selection. There were also practical tips for restarting an IC system after a break, and a look at ways to protect columns from contamination, such as using guard and trap columns.

Talbot emphasized the benefit of using Thermo Scientific Chromeleon 7 CDS to help predict column change times, as well as other maintenance management practices, and said: “used with Queries, Chromeleon CDS makes predicting lifetimes easy.” He went on to explain the best approaches to caring for suppressors, including trouble shooting, as well as useful information about the ways that Chromeleon CDS can be used with suppressors, and directed attendees to the availability of useful resources online.

Closing

Talbot highlighted the availability of support and guides available on Chromeleon CDS for a range of topics, including best techniques for maintenance and installation. He also drew attendees’ attention to the value of the Virtual Column separation simulator. It was clear to see that proper care and management of all components brings a range of benefits, from extended lifetimes to consistent, sensitive results.

Take a look this presentation in full here.

Fundamentals of IC and virtual column

Opening

Dr. Charles Lucy, Professor Emeritus, University of Alberta, Canada, explored what goes on inside an IC column, and how that insight can be used to select the right column for the desired application. There are three key areas for consideration in an IC system: the analyte, the eluent, and their interaction.

Key learnings

Lucy began by reminding attendees that it is important to remember that ions are hydrated, and it is this hydrated radius which determines the ion exchange process. Hydroxide is the most commonly used eluent, but it brings a lot of water to the ion exchange site, with consequences for the ion exchanger and the ion.

Monovalent ions are very strongly retained on a med-high hydrophobicity column, but this retention declines as column hydrophobicity reduces. IC retention is based on electrostatics, showing that hydroxide is an effective eluent when it can get close to the ion exchange site. IC retention is therefore affected by hydrophobicity.

Continuing his explanation, Lucy discussed how retention and selectivity are affected by eluent concentration for ions with a similar and different charge, and that IC retention is predictable. This means that if the parameters are known, separation can be predicted.

He emphasized that this understanding is at the core of the Virtual Column application online. The program has in-built parameters and a database of 89 anions, with 15 different anion exchange columns, which means separation can be modeled on a variety of column diameters, in both isocratic and gradient modes. He stressed that this extensive base of data means that “selectivity, retention and column choice are predictable.”

Closing

It is evident, then, that selectivity and retention in IC depends on a number of factors but that selectivity, retention and column choice can produce predictable outcomes. By using Virtual Column, users can see benefits including better efficiency and time saved in the lab.

Watch the full presentation here.

Forums

The forums offered visitors to the symposium a valuable opportunity to gain tips and insights from a host of Thermo Fisher Scientific and Partner scientists, making these lively interactive sessions a perfect opportunity to learn more from these experienced experts.

Forum: Q&A with our panel of IC & Environmental experts

Opening

This forum included a panel of Thermo Fisher Scientific's very own IC and environmental experts: Jeffrey Rohrer, Ph.D. Director Applications Development, Kirk Chassinol, Manager Application Scientist, and Michael Hvidz, Senior Manager Application Scientist.

Key learnings

A range of topics were addressed, including practical tips on extending the life of suppressors, methods of achieving separation of co-eluding analytes, and discussion of whether gradient or UV detector methods are more reliable. Additionally, the role of a UV detector in achieving separation was highlighted, with Rohrer describing it as "a great tool used recently in the lab to determine nitrate in an over-the-counter pharmaceutical."

There was a look at the advantages of using different Thermo Fisher Scientific products such as 4-micron columns, and an exploration of the benefits of the Virtual Column Simulator, including its availability on the Appslab website. Of special interest was the availability of application notes, and how to find them with ease by using the search function.

The session addressed the topical environmental question relating to the sensitivity differences between carbonate- and hydroxide-based applications for certain methods, and gave practical advice on the best approach to bromate and chlorate analysis.

Closing

The panel of experts gave advice based on their own laboratory methods, and drew on their many years of experience, making it a rich source of valuable information.

See the full forum here.

Forum with PD Dr. Joachim Weiss, Professor Paul Haddad and Dr. Wai-Chi Man

Opening

A varied selection of topics were discussed during this session, with the experts offering key insights based on their vast wealth of experience. The international panel comprised PD Dr. Joachim Weiss, Technical Director, Thermo Fisher Scientific GmbH, Professor Paul Haddad, Emeritus Distinguished Professor, University of Tasmania, and Wai-Chi Man, IC Product Marketing Manager, Thermo Fisher Scientific.

Key learnings

The panel examined the role of IC in different industries such as pharmaceutical, agricultural and environmental sectors, illustrating the diverse applications for IC techniques. The experts outlined the benefits that IC can bring to specific areas of interest, such as metabolites and polar pesticides. The forum also addressed the ways that IC is being applied to cancer research in the UK.

There was a discussion of the relationship of IC to high performance liquid chromatography (HPLC) as a complementary technique, and an explanation as to why one method cannot replace the other. As the experts pointed out: "People used to say that HPLC was better than IC, but HPLC is a type of IC." The panel also considered ways that IC will likely improve in the future, and what needs to be achieved in order to exceed its current limitations.

Closing

This forum saw the specialists draw on their extensive personal experience to offer lively examples of practice. They predicted that the future of IC is likely to see improvements to aspects such as particle diameter and peak strength, and that developments are continuously in progress, including those on the software side of technology.

Watch the forum in its entirety here.

thermo scientific

Forum: Q&A with our panel of IC and Food & Beverage experts

Opening

Held with a panel of food and beverage experts: Timothy Lumb, ALS Laboratories; Lilit Ispiryan, University College Cork; Wai-Chi Man and Dr. Detlef Jenson, Thermo Fisher Scientific, this forum focused on the use of IC in the food and beverage industry. The experts answered a series of viewer questions, sharing practical advice based on their own experiences.

Key learnings

The panelists discussed how IC can be applied to the food industry, including the hot topic areas of organic acids and speciation analysis. They reflected on the current major challenges in the food safety market, including polar pesticides, leaching of packaging, food fraud and authenticity tracing.

Speaking of the advances they are most excited to see in the future, the panelists expect sharper peaks, more hyphenation, increased automation, AI and diagnostic capabilities. The experts also gave valuable practical information, including tips on how to best start up an IC after a period of shutdown. There was also discussion of other questions, such as recommendations on internal standards, maximizing suppressor lifetime, the ability to test dialkyl phosphates by IC, and how IC can be used in food analysis of colors. The experts also highlighted the "special close-knit community of customers" that they felt reflected their experience of working with the Thermo Fisher Scientific Dionex IC system.

Closing

This forum saw the panel of experts covering many current issues for the industry, with respect to how IC can help. They concluded by offering their one-word summary of IC, with descriptions such as "reliable," "robust" and "powerful."

View this forum in full here.

The future of IC

For anyone with an interest in ion chromatography, the 2020 Global IC Virtual Symposium was an event not to be missed. The scope of the available presentations ensured that there was plenty to learn, and the opportunity to hear the experience of such a selection of experts meant that all visitors came away with a new appreciation of this invaluable technology. This year's symposium promises to bring even more engrossing presentations and forums, making it the event that all scientists should plan to attend.

Make sure that you don't miss out on this year's stimulating event: **register for this year's event**.

Find out more at **thermofisher.com/icsymposium**

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