SUNDAY, MARCH 17th

Title: Introduction to Bioseparations
Name: Thomas Wheat
Date: Sunday 08:30 AM - 05:00 PM
Number: 102 Type: Short Course

This full day program is an introduction to the separation techniques used to characterize biological macromolecules, with an emphasis on practical applications. The most useful modes for protein separations will be emphasized, and substantial description of peptide mapping will be presented. Topics include theory and principles of the separations. Rationale for choosing a technique will be systematically considered. Strategies for methods development will be presented. Analytical techniques that are often used in the same laboratories, including amino acid analysis and glycan determination will be introduced. The role of mass spectrometry in the analytical biochemistry laboratory will be described.

MONDAY, MARCH 18th

Title: A New Accurate Mass Screening Solution Incorporating a Scientific Information System for the Analysis of Pesticide Residues at Regulatory Limits in Food
Name: Kenneth Rosnack Affiliation: Waters Corporation
Date / Time: Monday - 8:40 AM Session #: 420
Location: 115C Type: Oral

Pesticides control plant pests and improve crop production. Currently, more than 500 diverse pesticides are routinely used globally, with countries differing in regulations concerning licensing and maximum residue limits (MRLs). To protect consumer safety with increasing global trade, multi-analyte screening strategies capable of efficiently detecting residue violations are required. In recent years the use of accurate mass instruments has been at the forefront of food and environmental screening discussions: and this has also been reflected in the evolving CODEX guidelines that acknowledge this challenge and promote the use of accurate mass technology to address the challenges faced by industry.

In this pesticide screening study, the advantages of UPLC along with advances in TOF technology enabled full spectra acquisition and quantitation to be performed in complex matrices routinely at concentrations equivalent to 0.5 MRL. Over 100 pesticides were spiked into Mandarin matrix and targeted against a database of 512 pesticides held within a scientific information system. Correlation coefficients of 0.99 have been illustrated, residuals obtained of <5%, and mass accuracy of <2ppm obtained. Processing data through this new scientific information system enabled confirmation of pesticide residues with confidence through the use of a Peak 3D detection algorithm where data is componentized, spectra are time aligned and cleaned to provide the best quality data available. Using this Scientific Information System to perform data acquisition, data processing and data management requirements together with access to an extensive scientific library provides a comprehensive workflow to screen, quantify, and confirm residues in a single solution.
Title: Preparative Study on Overloaded Chiral Separations with Collection in SFC
Name: John Whelan Affiliation: Waters Corporation
Date / Time: Monday - 9:35 AM Session #: 480
Location: 120C Type: Oral

One of the advantages of using Supercritical Fluid Chromatography for large scale separations is the ability to quickly separate chiral compounds with low solvent use and faster dry down times. In the past many chiral presentations have been done, but typically with only a baseline separation being used as an example in the area of SFC. Contained in this study we have demonstrated overloaded separations yield two peaks or more peaks. The body of work will include Retention Time RSD% and effects of slight co-solvent/modifier changes with regards to retention time correlated to the degree of overloading with comparison to recovery yield.

Title: Working on AnIML - A View from a Vendor's Representative
Name: Maren Fiege Affiliation: Waters GmbH
Date / Time: Monday - 10:20 AM Session #: 350
Location: 202A Type: Workshops

The ASTM AnIML standard is being developed in response to a general need to deal with more and more complex analytical data being generated in increasing amounts in an often highly regulated environment. At the same time, the data is often created in a multitude of proprietary formats that do not easily facilitate interchange and long term readability. Complementing the industry, academic, and government perspectives on the AnIML effort, this workshop will present the motivation and viewpoint of an instrument and software vendor’s representative.

Title: Applicability of Rigid Hybrid-Based Packing Materials for Size-Based Separations of Synthetic Polymers
Name: Bonnie Alden Affiliation: Waters Corporation
Date / Time: Monday - Afternoon Session #: 890
Location: 204ABC Type: Poster

The technique of Gel Permeation Chromatography (GPC) was first described by J.C. Moore (J Polymer Sci A, 2, 835, 1964) for the fractionation of synthetic polymers by molecular weight using crosslinked polystyrene gels in non-aqueous mobile phases. The separation mechanism for GPC is based on the size of the polymer in solution relative to the pore size distribution present in the column’s packing material. This separation mode relies on the absence of all other separation mechanisms, such as hydrophobic interaction or ion-exchange.

Historically, packing materials for GPC have been exclusively organic polymers, such as hydrophobic crosslinked styrene-divinyl benzene gels or hydrophilic methacrylate gels. However, these gel columns do not provide the highest efficiency due to their lack of rigidity and susceptibility for compressing under pressure. The goal of this paper is to investigate the use of low dispersion chromatographic systems in combination with high efficiency essentially non-compressible hybrid packing materials. These hybrid materials have been synthesized to have pore sizes ranging from 50Å to 450Å, and were evaluated with regard to their ability to perform size-based separations. Initial evaluations were performed to determine the usable molecular weight range for each of the pore size materials and the
The pharmaceutical industry is required by the FDA to demonstrate drug product integrity when in contact with containers and closures. Subsequently, packaging material manufacturers for pharmaceutical industry are motivated to control their product to ensure that no harmful additives are used or formed during their manufacturing processes. The initial investigation, called a controlled extraction study, qualitatively and quantitatively investigates the nature of extractable profiles from critical container closure system components. The testing involves solvent extraction techniques varying a range of polarity, solvent compatibility studies, and multiple analytical techniques. To analyze non-polar extractables by LC, the nonpolar extract is dried down and reconstituted in a solvent compatible with reversed phase chromatography, which results in time consuming and labor intensive sample preparation.

In the current study, we explore sub-2µm packed column supercritical chromatography (pSFC) to better streamline the workflow of extractable and leachable profiling of pharmaceutical drug product container closure systems. The chromatographic analysis was employed using Ultraperformance Convergence Chromatography (UPC2), a supercritical CO2 fluid based technology. The UPC2 allowed for the analysis of the various extraction techniques regardless of the solvent extraction solution. Different container closure systems were extracted using extraction techniques such as reflux, microwave, Soxlet, and supercritical fluid extraction (SFE). The extracts were rapidly screened for 14 common polymer additives. The UPC2 analysis was compared to the profiles observed by using GC and LC techniques.

TUESDAY, MARCH 19

Title: QuEChERS Sample Preparation for Food and Forensic Applications in Animal Tissues and Biological Fluids
Name: Michael Young Affiliation: Waters Corporation
Date / Time: Tuesday - 10:15 AM Session #: 1040
Location: 121C Type: Organized Contributed Sessions

QuEChERS methodology was developed for sample preparation of fruits and vegetables prior to GC/MS or LC/MS for determination of pesticide residues. Because it is Quicker, Easier, Cheaper, as Rugged and Safer than prior methods of sample preparation QuEChERS is now commonly used worldwide. The requirements for the sample matrix are that it can be readily homogenized, that it is suitable for extraction with acetonitrile, and that it contains sufficient water for the liquid
partition cleanup following addition of the QuEChERS salts. For a successful analysis using QuEChERS methodology the compound(s) of interest must have a suitable partition coefficient when partitioned between acetonitrile and salt/saturated water. With these parameters in mind, the purpose of this study is to demonstrate the application of QuEChERS methodology to other types of analytes and other types of sample matrices as an alternative to more cumbersome methods of sample preparation. Among the tissue matrices studied are muscle, kidney and shellfish. Among the biological fluids studied are milk and blood. The food safety applications include pesticides, steroids and estrogenic compounds in animal tissues and milk. Other applications include drugs of abuse in biological fluids.

Title: Systematic Screening of pH and Ionic Strength as Method Development Tools for Reversed-Phase Separations  
Name: Aparna Chavali  
Affiliation: Waters Corporation  
Date / Time: Tuesday - Morning Session #: 1220  
Location: Exposition Floor, Aisles 1600-2100 Type: Poster

Developing a chromatographic method for reversed-phase separations that is reproducible and robust for routine use can be a very lengthy and cumbersome process. The chromatographic parameters that typically influence peak retention, selectivity and resolution are gradient slope, flow rate, temperature, column length and organic solvent and modifier concentration. However, use of method development screening tools such as pH and ionic strength can prove to significantly alter selectivity and resolution of a separation. This effect can be seen at high as well as low pH with very small increments in pH or ionic strength.

We have developed, and herein describe, a novel software tool that accurately and precisely allows a quaternary LC system to automatically blend and create mobile phases of different pH and ionic strength online. The system can be programmed directly in the familiar units of pH and salt concentration as well as aqueous and organic mobile phase compositions. As a result, the screening of mobile phase pH in increments of 0.1pH units or less can be performed to identify the pH that maximizes selectivity for a particular sample or to investigate method robustness. The entire pH spectrum can be screened to test the effect on selectivity and resolution. The automated blending and generation of various mobile phase mixtures by this tool significantly reduces the substantial effort and time required in preparing pre-mixed mobile phases. It also reduces the possible range of errors that can be introduced during manual pH measurements and solvent handling and the allowable range of error for pH measurements during mobile phase preparation. The use of this technology is illustrated with typical reversed-phase separations. The effect of varying the organic solvent with pH can alter peak selectivity differently. These adjustments to pH, ionic strength and organic solvent can enhance method development strategies for reversed-phase separations.

Title: Analysis of Carbohydrates Using Ultra Performance Convergence Chromatography  
Name: Christopher Hudalla  
Affiliation: Waters Corporation  
Date / Time: Tuesday - Afternoon Session #: 1510  
Location: 204ABC Type: Poster
Carbohydrates are routinely characterized by chromatographic methods including LC, utilizing either a HILIC or anion exchange mechanism, and GC, requiring additional sample derivitization. These analyses are often difficult due to the small differences in stereochemistry for many saccharides, the varying degrees of polymerization (DP), and the limited thermal stability of saccharide derivatives. Here we present the application of a new separation technique to this often challenging application. For this application, UltraPerformance Convergence Chromatography exploits the benefits of a sub-2µm particle size stationary phase, with carbon dioxide as the primary mobile phase component. The convergence chromatographic system has been designed and optimized for low dispersion and high sensitivity, and utilizes an evaporative light scattering detector (ELSD) for detection of the carbohydrates due to their lack of UV chromophores. One of the most important parameters for method development is the selection of an appropriate stationary phase. In addition, to enhance the solubility of the carbohydrates, polar modifiers are used and can be varied in nature and composition to affect the separation. Temperature and pressure may also be used to further optimize the separation. In this study we will explore combinations of these parameters to demonstrate the applicability of convergence chromatography to the separation of carbohydrates.

Title: Quantification of Fat Soluble Vitamins in Infant Formula and Standard Reference Material 1849a
Name: Kenneth Rosnack Affiliation: Waters Corporation
Date / Time: Tuesday - Afternoon Session #: 1510
Location: 204ABC Type: Poster

Infant formula is a highly regulated food product in the market and with the implementation of the Infant Formula Act of 1980, manufacturers are required to test their products to meet the specified limits. Thus, the National Institute of Standards and Technology provided Standard Reference Materials to insure the quality of nutrient evaluation. Infant formulas are known to contain all the necessary micro and macronutrients required by infants. Fat soluble vitamins (FSVs) are among the micronutrients essential for the growth and development. Therefore, it is mandatory to accurately determine the level of fortification to meet the regulatory requirements. This requires a selective, reliable and sensitive method for successful determination of FSVs in a complex infant formula. Sample preparation is the most challenging step due to the complexity of infant formula. For this reason, solid phase extraction (SPE) interest has increased due to their short and simple procedure. This application describes an SPE method for the simultaneous extraction of fat-soluble vitamins from infant formula and Standard Reference Material (SRM) 1849a using a standard addition quantitation method. SRM 1849a has been used to validate the developed method. The extracted FSVs were analyzed using UPLC/MS under Atmospheric Pressure Chemical Ionization in positive mode. The method is capable of detecting FSVs present in trace amounts, particularly Vitamin D3 in complex infant formula. This application can potentially replace time consuming conventional assays for FSVs determination (in a single method) and increase sample analysis throughput while avoiding the use of toxic solvents.
The measurement of petroleum biomarkers for assessment of source, age, maturation and biodegradation state of oil reservoirs is a well established analytical technique. Early work in this field involved the use of GC/MS with electron ionization (EI). However, the great complexity of these samples and relatively low abundance of the biomarkers is generally accepted to lead to the requirement for GC/MS/MS for accurate measurement of the ratios between and among various biomarker types (hopanes and steranes) used to establish the condition and origin of the sample. The greater selectivity of MS/MS over single stage MS reduces or eliminates interference from coeluting species and chemical background contributed by the complex matrix of crude oils or source rock extracts which are most often the subject of these studies. These biomarkers may also need to be determined in environmental forensic applications which also involve complex sample matrices.

Just as MS/MS has been shown to improve the determination of these compounds for mass analysis, atmospheric pressure (AP) ionization is demonstrating specific advantages that improve upon EI. APGC generates molecular ions of the same form as EI, M.+, but of much higher relative abundance. This improves the selectivity of the first stage of MS and delivers a high abundance molecular ion to the fragmentation cell for a controllable extent of fragmentation in the MS/MS process. This is in contrast to the fixed fragmentation and poor molecular ion abundance in EI. Since the same form of the molecular ion is used in both EI and APGC under the charge exchange conditions used for these experiments, the MRM transitions used for APGC MS/MS and EI MS/MS are exactly the same, facilitating correlation of historical data to this new approach.

Crude oil and source rock extracts will also be used to demonstrate the utility of concurrently acquired full scan data using the RADAR acquisition method.

Quantitation of amyloid peptides in cerebrospinal fluid and their relationship to Alzheimer's disease is of critical interest to many researchers. Measurement of these peptides routinely employs immunoassays, such as ELISA, for their selectivity and sensitivity. These assays are subject to matrix interferences, cross reactivity, non-specific binding and can be expensive and time-consuming to develop. Although measurement of these peptides relies on immunoassays, their use is not always practical in a discovery setting.

This work focuses on the development of an LC/MS/MS method, coupled to selective SPE sample preparation for the 1-38, 1-40, and 1-42 fragments of amyloid precursor protein (APP). In particular, emphasis was placed on overcoming the analytical
challenges associated with handling and quantifying amyloid beta peptides. These include non-specific binding, poor solubility, aggregation, and low MS sensitivity, amongst others. Human and monkey CSF samples were extracted using a polymeric mixed-mode ion exchange SPE sorbent. Detection was performed on a triple quadrupole MS system in positive ion mode. The SPE method, which relies on the mixed-mode reversed-phase and ion-exchange nature of the base sorbent, was successfully used to quantitate endogenous levels of the 1-38, 1-40 and 1-42 amyloid beta peptides from 50µL human or monkey CSF, with CV’s < 7%. Levels measured were consistent with previously published literature values based on LBAs. Standard curves were linear. Accuracy and precision of QC samples (prepared at concentrations from 40 pg/mL to 6 ng/mL) met regulatory criteria with average CV’s <6%. 96-well plates were processed in <30 minutes, making this an attractive option for high-throughput assays. While ELISA assays for amyloid peptides require specific assays for each peptide, multiple amyloid peptides are quantitated simultaneously, and with a high degree of accuracy and precision, with the single LC/MS/MS assay developed here.

WEDNESDAY, MARCH 20th

Title: Supercritical Fluid Chromatography in the Pharmaceutical Industry
Name: Larry Taylor & John VanAntwerp
Date: Wednesday 08:30 AM - 05:00 PM
Number: 174 Type: Short Course

This course will focus on the fundamentals and advances in analytical and preparative supercritical fluid chromatography (SFC) employing carbon dioxide-based mobile phases and packed column stationary phases. The day-long course will cover:
• Analytical and preparative scale separations • Advantages of carbon dioxide-based mobile phases relative to conventional liquid mobile phase solvents: (1) column efficiency per unit time, (2) sample throughput, (3) cost of analysis, (4) detector compatibility and interface design, (5) multiple stacked columns for enhanced resolution, (6) screening of columns & modifiers, and (7) hyphenation with sample preparation • Guidelines for stationary phase selection • Comparisons of SFC with normal phase HPLC • Detection with emphasis on mass spectrometry • Instrumentation for preparative scale separations in conjunction with high throughput requirements • Fundamental physico-chemical properties of compressible fluid phases within the context of chromatographic science • Role of both mobile phases modifiers and additives in the separation of polar analytes • Applications that incorporate a wide variety of functional groups relevant to pharmaceutical science such as quaternary amine salts, phospholipids, polyphenols, and surfactants

Title: Quantitative Analysis of Egg Allergens Using Ion Mobility Data Independent Mass Spectrometry
Name: Kenneth Rosnack Affiliation: Waters Corporation
Date / Time: Wednesday - Morning Session #: 1840
Location: 204ABC Type: Poster

Food allergies arise from an abnormal immunological response to certain foods. Proteins are the main candidates for triggering allergic reactions. Egg-based proteins are one of the most frequent causes of adverse reactions in food. Since many processed foods contain egg as a raw ingredient, the ability to assess
changes in protein structure and detection through the manufacturing cycle is important. In this study, we focus on identifying and quantifying known allergenic proteins from raw and cooked egg samples. Proteins extracted from raw and cooked egg samples were digested using trypsin and label-free protein expression data were acquired with a Time-of-Flight MS using an ion mobility data independent approach, whereby the collision energy was switched between low and elevated energy state during alternate scans and associate precursor and product ions by means of retention and drift time alignment. The acquired data was processed using PLGS and searched against a Gallus Gallus database. The results generated allowed for relative quantification to be established. Proteins which were identified as being regulated were further processed to provide viable MRM transitions, which were then transferred to a tandem MS in order to provide absolute quantification for the allergenic peptides detected. The results of this study showed that a significant proportion of the proteins identified were expressed when comparing the cooked and raw egg sample sets, which included the known allergenic proteins (e.g. apovitellenin I). Peptides identified in both sample sets allowed for MRM transitions to be generated and a quantifiable value assigned.

Title: An Automated Approach to Increase Sensitivity in LC/MS Multidimensional Methods
Name: Dan Root
Affiliation: Waters Corporation
Date / Time: Wednesday - Afternoon Session #: 2190
Location: Exposition Floor, Aisles 1600-2100 Type: Poster

Trap and elution and peak transfer (heart cutting) methodologies can increase sensitivity and resolution for analytes in complex samples. Unfortunately, there are occasions where the physical and chemical nature of the analytes and solvents used can seemingly preclude the effective application of these techniques. For example, in trap and elution the sample is loaded into a stream of low solvent strength mobile phase. Analytes are retained on the trap, and then eluted to an analytical column for subsequent analysis. Samples in high solvent strength diluents, either because of solubility concerns or as a result of an extraction procedure, are not sufficiently diluted during sample loading to be effectively retained, yielding poor sensitivity. Similarly, during a peak transfer or ‘heart cut’, a certain volume of mobile phase is diverted to a second column. The analyte is then retained on this second column in preparation for elution to the next step. A relatively hydrophobic analyte, when diverted, will be in a high solvent strength mobile phase which may compromise retention or broaden the final chromatographic peak, reducing the sensitivity of the analysis. An approach that involves the introduction of an additional aqueous flow at a predetermined point in these methodologies would dilute the high solvent strengths, consequently increasing retention and the final sensitivity of the methods. A software and hardware platform that can control multiple pumps and multiple valves can automate this approach, yielding reliable and robust performance. A methodology for the determination of the parameters of this dilution flow approach is presented. Samples of pharmaceutical interest will be employed to determine performance.
Title: Information Rich Detection and Automated Mobile Phase Adjustment for Chromatographic Method Development  
Name: Thomas Wheat  
Affiliation: Waters Corporation  
Date / Time: Wednesday - 2:00 PM Session #: 2090  
Location: 120A Type: Oral

Liquid chromatography is used as analytical technique to provide qualitative and quantitative sample composition. A method is evaluated by peak identification and by assurance that a single component contributes to the detector response. Development of a chromatographic method that meets these criteria can be a complex process that exploits many physical and chemical parameters. As the separation space is explored, the sample components usually change their relative elution position. This interferes with systematic method development in that comparisons of different conditions may not accurately track each sample component and coelutions may go unrecognized. New software tools can aid peak tracking and the assessment of peak homogeneity. This application combines data from two information-rich detectors, photodiode array detection and mass spectra. Algorithms for matching spectra and for judging peak purity have been used for LC-PDA experiments and for LC-MS data. Here, the combination of the two detectors is considered. For method development, the data analysis must consider changes in the spectrum as a function of mobile phase, including nature and concentration of organic solvent and pH. The interpretation of mass spectra must include background, isotopes, multiple charging, and fragmentation. Tools for considering these effects permit assessment of peak homogeneity and tracking. Developing chromatographic methods includes mobile phase modification. Selectivity changes have been hard to define because it is cumbersome and time-consuming to prepare the combinations of solvents and pH/ionic strength modifiers. Instrumental functions have been combined with solvent management algorithms to permit continuous adjustment of pH while using different organic solvents. The combination of mobile phase manipulation with information-rich component identification and tracking makes chromatographic method development more complete and efficient.

Title: Open Mind and Follow the Trend  
Name: Chuping Luo  
Affiliation: Waters Corporation  
Date / Time: Wednesday - 3:50 PM Session #: 2000  
Location: 202A Type: Workshops

As a chemist, most of us have been "labeled" as an analytical chemist, a polymer chemist, or a organic chemist, etc. However, in many cases, multidisciplinary knowledge is required to solve the technical challenges. In case like this, an open-minded individual will be more successful.  

More and more technologies have been developed and, in the meantime, some technologies have been faded out. A scientist can only be successful when s/he can follow the trend of technology.
Title: Rapid Detection of Pesticides in Fruit Juice Without Sample Preparation Using High Resolution Chromatography and Highly Sensitive Tandem MS
Name: Kenneth Rosnack Affiliation: Waters Corporation
Date / Time: Thursday - 8:40 AM Session #: 2340
Location: 115A Type: Oral

Many published methods are capable of analyzing pesticides in fruit juice. However, sample preparation is required to remove matrix interferences. With the large volumes of testing required following the detection of carbendazim, fast methods to screen products were required. An LC-MS/MS method using a simple ‘dilute-and-shoot’ approach was employed. A standard mix of 80 pesticides was prepared and spiked into orange juice at 5 different levels (5 ppb to 200 ppb) then diluted 100 times with water. Samples were filtered and 10µL injected for analysis. Each of the 80 pesticides that were spiked were detected and quantified in orange juice. Quantification of the spiked pesticides showed that the majority of the pesticides could be detected at 5 ppb in orange juice without any further sample preparation. The impact of the matrix was examined by comparison with standards prepared in water. Both orange juice from concentrate and pure orange juice were tested and results from both will be presented. In order to assess the robustness of injecting orange juice without sample preparation a study was undertaken to assess the effects of continuous injections of diluted juices over a number of days. The repeatability over this study will also be presented.

Title: Chromatographic Method Development Strategies with Carbon Dioxide Mobile Phases
Name: Paula Hong Affiliation: Waters Corporation
Date / Time: Thursday - 9:55 AM Session #: 2470
Location: 121C Type: Oral

Convergence chromatography utilizes carbon dioxide as the primary mobile phase component to achieve unique selectivity, low solvent usage and high efficiencies. While method development strategies in LC and GC chromatography are well defined, standard approaches in achiral convergence chromatography are not as well established. It is clear that numerous factors impact these separations, including column chemistries, organic modifiers and physical factors. The wide array of available column chemistries allows for numerous retention mechanisms including hydrogen bonding, hydrophobic interactions, dipolar and polarizability interactions and solute partitioning. Organic modifiers can affect the charge of the analyte and/or column chemistry thereby influencing peak shape and retention. Lastly, physical factors, including temperature and pressure, impact the density of the supercritical carbon dioxide thereby affecting column efficiency. Combining and optimizing the impact of these factors can be a complex and time-consuming method development process.

In order to streamline this process, we are developing a systematic approach to achiral convergence chromatography method development. Initial steps will evaluate the properties of the analyte of interest, including hydrophobicity and functional groups. Based on these chemical properties, column and organic modifiers will be screened for their impact on peak shape and resolution. In addition, physical factors such as pressure and temperature will also be examined for maximizing efficiencies and/or throughput. This process, when combined with sub-2 µm column chemistries, and a wide range of detectors including PDA, ELSD and MS, will
allow for a streamlined approach to convergence chromatography method development for a wide range of compounds, including both pharmaceutical and natural products.

Title: 50 Years of Size Exclusion Chromatography (SEC)
Name: Michael OLeary Affiliation: Waters Corporation
Date / Time: Thursday - Afternoon Session #: 2780
Location: 204ABC Type: Poster

This year, 2013, marks the 50th anniversary of the first commercial SEC system or as it is commonly referred to as Gel Permeation Chromatography (GPC). Since James Logan Waters introduced the Waters GPC 100 system significant advances have been made in polymer science and the analysis of polymer molecular weight characterization based on that system. Over the first decades many refinements have been introduced on the original concept. With the introduction of tighter column pore size, more stable solvent delivery systems, automated sample introduction and more robust detector technology the use of the analytical technology has advanced to become a stable analytical work horse for the polymer research, process control and quality control laboratory. However, the past two decades little improvement has been made. Recent focus on reduced solvent consumption and rapid throughput testing has proven useful but with a tradeoff between analytical performance (resolution and sensitivity) versus speed of analysis. Limited by pore size limits and column particle size there has been no driving force to leverage the chromatographic advances seen in the last several years with Ultra Performance Liquid Chromatography (UPLC). Further, the dispersion limitation and dead volume limitation of conventional refractive index detectors has not allowed the technological development required to break the speed vs. performance tradeoff.

This poster reveals the limit of the current SEC technology and the obstacles that must be understood and addressed to produce the next breakthrough in polymer molecular weight characterization.