



OIL GAS & PETROCHEM INDUSTRIES CONVERGE ON ROTTERDAM

With 46 seminars, 4 conferences, 33 poster sessions and 114 exhibition stands representing over 250 companies, PEFTEC 2019 was the focal point for everything relating to testing and monitoring in the oil, gas and petrochemical sectors. Addressing the key issues relating to regulations, standards, methods and technologies in testing and monitoring, PEFTEC 2019 took place on 22nd and 23rd May at the Rotterdam Ahoy Exhibition Centre - a vibrant facility, located at the heart of one of the world's major petrochemical hubs.

Process Monitoring Conference

The first speaker, Alison Norden from the University of Strathclyde, delivered a presentation on new developments in NMR low-field for at-line analysis and ultrasound imaging. She said that ultrasound imaging is promising, because it may enable the measurement of bubble size distribution in process pipes non-invasively, which could, in the future, be used to optimise mass-transfer in gas-liquid reactions on-line.

Etienne SMITH from AP2E gave a presentation on the combination of OFCEAS Spectroscopy and low pressure sampling, for ppb measurement of trace gases in hydrocarbons. He described the novel use of cavity ring down spectroscopy combined with regular background measurement and low-pressure sampling to achieve ppt-sensitivities in emissions gas analysis. These analysers offer great stability and sensitivity, and 600 of them have been sold to-date.

Carlo Bruno from Pollution Analytical Equipment described a micro Gas Chromatograph for real time environmental monitoring of BTEX and VOCs. The device employs lab-on-a-chip technology, with no additional gas canisters required, which lower costs of ownership and maintenance.

After outlining the financial and environmental costs of fugitive hydrocarbon emissions, Derryck Reid from Heriot-Watt University explained the advantages of laser-based active FTIR spectroscopy for simultaneous and quantitative hydrocarbon emissions monitoring in and around petrochemical sites, at landfill sites and in agriculture. Critically, he said that the ability to measure methane and ethane simultaneously makes source attribution possible.

James Diekmann from VUV Analytics described the techniques available for real-time monitoring of industrial chemical processes and explained the potential offered by vacuum ultraviolet spectroscopy (VUV). Almost every compound absorbs in the VUV range and spectra are unique for each compound, which means that spectral deconvolution techniques can be applied for compound identification and quantification during process gas analysis. In addition, selectivity can be achieved in some cases using spectral filters, looking at VUV wavelength regions where compounds do not overlap. Most of the current applications for VUV are as a GC detector (VGA), but in another configuration, SVGA, it can be used to make instantaneous determinations for mixtures such as xylenes.

Continuing the theme of multi-component analysis, Pawel Kluczynski from Airoptic described a new C1-C5 analyser for process control which uses a room temperature distributed feedback inter-band cascade laser array. Requiring no consumables and no in-field calibration, it lowers cost of ownership. Pawel reported a response time of just 3 seconds for a safety-critical acetylene measurement.

Gilad Shpitzer from Atmosfir Optics Ltd described advanced remote sensing solutions for petrochemical/chemical industries. He said that the main challenge for automatic, multi spectral analysis technology has been to provide real time validated results with low detection limits. Continuous spatial monitoring with source location has been shown to prevent emergencies, assist with root cause analysis and reduce overall annual emission rates.

Reflecting a requirement to speed up the utilisation of biogas,

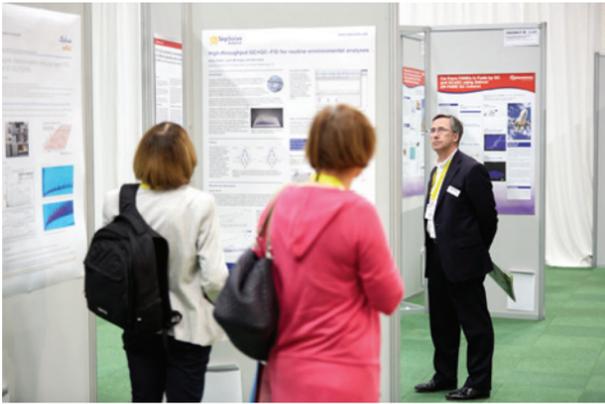
Ewelina Zalewska from VSL Dutch Metrology Institute said that regulators, gas grids, refuelling stations, and testing laboratories urgently require harmonised and validated test methods to enable the transportation of biomethane as well as clear financial transactions without disputes. VSL has therefore developed gas standards and test methods for impurities such as siloxanes, halogenated volatile organic compounds, hydrogen chloride, hydrogen fluoride, ammonia, and amines in biogas. The methods employ GC and spectroscopic techniques, and enable SI traceable calibration and accurate measurement results.

Methane Number (MN) is a measure of the resistance of fuel gases to engine knock, and the operators of large scale gas engines can use this measure to improve efficiency and reduce maintenance by tuning and operating engines under optimum conditions. Larry McDermott from MKS Instruments discussed this issue and explained how a fast spectroscopic sensor based on the MKS Tunable Filter Spectroscopy (TFS) platform has been evaluated for this purpose.

Continuing the theme of biogas analysis, Ronan Cozic from SRA Instruments described the employment of a dedicated 19" rack MicroGC for this application. He said the technology provides fast and accurate on-line analysis of biomethane, calorific value and contaminants such as hydrogen sulfide, carbonyl sulfide, terpenes, ketones and odourisation products.

At the beginning of the second day, the Laboratory and Process Monitoring Conferences merged for a keynote presentation by Eric Little from OSTHUS entitled: Enhancing the Petrochemical Space with Big Analysis.





Eric said that the petrochemical sector needs a data evolution or revolution. He described the changing environment for data integration and analytics and how the petrochemical industries could benefit from adopting these practices. He discussed 'big data' and how there is a movement to 'Big Analysis' - where the focus is on utilising data to answer complex questions. He also addressed data science in terms of the role semantic technologies play along with statistics for understanding data, which provides a means for capturing context and meaning to data in diverse environments within changing market needs.

The application of Big Analysis to enterprise environments was addressed particularly in coordination with machine learning and other forms of statistics-based algorithm development. His focus was not so much the volume of data but more the variety and veracity of data.

PwC recently said that \$1 trillion of expenditure is up for grabs in oil and gas digital innovation in the next 7 years, but Eric warned that some companies regard data as an 'exhaust gas' and don't see it as an asset. He referred to a project with BP which studied data and found ways to connect refineries with the most appropriate supplies, and emphasised the growing role of meta data. He also said that data management needs to be FAIR (Findable, Accessible, Interoperable, Reusable) so just like IoT devices in the home, industrial systems need to be able to define themselves so that the system can categorise them with a lightweight semantic integration layer. He warned that cleaning and integrating data before you know its value is wasteful.

Continuing the Big Data theme, Brian Rohrback from Infometrix highlighted developments in technology and reminded delegates that "there is no cloud - it's just someone else's computer." He explained why the term Big Data implies a systematic approach to extracting the information content from multiple, byte-dense raw and meta data sources. Effective extraction of this information leads to improvements in decision making at all industry levels. He said it will be necessary to combine traditional approaches in statistics, database organisation, pattern recognition, and chemometrics with some newer concepts tied to better understanding of data mining, neurocomputing, and machine learning. In order for industry to release the improvements that AI promises, it will be necessary to address the issues of data silos, security concerns, and the danger that we might be only partly-right in the answers we attain. Brian also explained why knowledge of process systems and the underlying chemistry is critical to success in the Big Data world.

Alan VIDAL from GAZOMAT discussed the reliability of measurement data and its role in making improved decisions in the leak remediation process. GAZOMAT has developed a fully integrated web-based remote emissions monitoring system which helps identify and track all data related to methane and VOC leak detection using stationary and portable detection equipment as well as field survey software solutions.

Patrick O'Driscoll from Rebellion Photonics explained the role of AI in machine learning for real-time event monitoring. He described the development of a fire detection system that combines physics with AI in a system with high levels of reliability in fire detection. Recent advances in Machine Learning (ML), especially deep learning, have demonstrated 'superior to human' performance for a variety of decision and recognition tasks. Together with advances in computational hardware and hyperspectral optics, Patrick said that affordable real-time ML based hazard event detection has become a reality.



Brian Rohrback then gave another presentation in which he discussed calibration in optical spectroscopy, an increasingly important source of process chemistry knowledge, due to its advantages of speed, sensitivity, and simple safety requirements. As the number of optical systems increases, companies have been reducing the number of employees tasked with their management. Calibrations are generally being undertaken monthly or possibly quarterly, so there is a need for improved efficiency. In addition, calibration mistakes are being made. Brian suggested that spectroscopy systems should be able to handle the application and communicate results, and if performance does not match legacy standards, the system calls for help. This systematic approach should not be constrained by the brand of hardware or software vendor and, as such, the approach can be used to manage any new or any in-place system.

Jonathon Speed from Keit Spectrometers described a year in the life of an application scientist. He said that FTIR spectroscopy is a well-established quantitative analysis technique, but its application in petrochemical plants has to-date been restricted by the inherent fragility of Michelson interferometers and fibre probes. Keit's IRmadillo FTIR has no moving parts, and so overcomes these obstacles allowing the measurement of concentrations of multiple species of interest simultaneously. He described the methodology for calibrating the same spectrometer to work in a number of different processes in the petrochemical and bulk chemical industries, and discussed the monitoring of BTEX levels in water, total acid number, alcohols in gasoline, water in glycol and water in solvents.

Louis Vivola from Chromatotec described the online analysis of sulphur compounds in fossil fuels using a system with GC-ED. Emphasising the importance of measuring sulphur compounds, he explained the disadvantages of other detection methods, particularly with reference to their applicability in the petrochemical sector. He also described instrumentation for the monitoring of VOCs, odours and odorants.

The measurement of Total Organic Carbon (TOC) in brine is undertaken for quality control and asset protection - preventing membrane damage for example. Jens Neubauer from Suez Water Technologies explained why TOC is a reliable method to assess organic impurities. Recent analytical improvements, method development, and upgrades have enabled accurate and precise TOC analysis in brine solutions even at low levels of TOC. Jens outlined desalted and chlor alkali case studies measuring a range of different brine solutions.

Michel Zoontjes from Malvern Panalytical then explained how advanced online elemental analysis enables sharper blending and also adds value. If the sulphur content in fuels is within regulated limits, car engines operate in a more environmentally friendly way and refining operations can achieve a higher return on production process investments. Recent advances in energy dispersive X-ray fluorescence (EDXRF) technology offer the possibility to apply on-line elemental analysis simultaneously, repeatedly and at the required low concentration levels. Michel described an on-line EDXRF analyzer for blending control in refineries and fuel blending facilities. He said that EDXRF has the advantage that multiple elements can be measured simultaneously over a wide concentration range, down to a few mg/kg, for elements between sodium and americium in the periodic table. The obtained precision and accuracy allows for much tighter process control in processes like blending and feed control. Further, by employing



this new on-line, multi-element analyser in other refinery processes (desalination, hydro treatment), the simultaneous monitoring of other elements such as Cl, Ca, Ni, V, Fe can help to optimise process conditions.

In the final presentation, Gianluca Stani of SRA Instruments described the application of an on-line liquid injector valve system (OLIS) for non-discriminating analysis of condensate and liquids by GC. He said that if the column is the heart of the GC, the injection system is the Achilles heel.

The OLIS valve assembly is intended for an automatic homogeneous introduction of pressurised liquid samples into GCs equipped with split/splitless capillary inlet. The GC injection of liquid samples with a wide boiling point range (i.e. petroleum fractions) has a quantification problem due to discrimination between light and heavy compounds. The OLIS injector valve can be successfully applied in the automatic and unattended GC injection of pressurised liquid samples without compromising the efficiency and resolution of the capillary column. Application examples were presented such as solvent impurity and light liquid hydrocarbons analysis.

Analytical Conference

Entitled: From Crude to Customer – Developments in Analysis for the Petro Industry Supply Chain, the first day began with a session focused on the latest developments in high resolution mass spectrometry (HRMS) applications which continue to provide exciting new insights into the composition of complex petroleum based samples. The opening plenary was given by one of the fathers of Petroleomics and Director of the Future Fuels Institute at Florida State University, Ryan P. Rodgers. Ryan, as usual, brought several new insights into petroleum characterisation and discussed the use of online HPLC/HRMS and showed data to confirm that the Boduszynski Continuity Concept was valid and how detailed compositional analysis could be used to facilitate accurate boiling point predictions. He then turned to asphaltenes and the long-discussed controversy between proposed island and archipelago structures in this very important class of compounds and by using fractionation together with selective ions isolation and HRMS fragmentation techniques proved that both types do exist in real samples. Moving to environmental applications Ryan used HRMS data from the Macondo incident to demonstrate the existence of photo-oxidation, photo-decomposition and photo-polymerisation as the key mechanisms of oil spill compositional changes due to weathering in the environment.

Christopher Ruger from the University of Rouen described the use of direct-inlet probe HRMS with adapted data processing and statistical data analysis for the rapid characterisation of petroleum heavy ends and particularly for bitumen and polymer modified bitumen samples. Uwe Kafer from the University of Rostock and Helmholtz Zentrum Munchen discussed the use of high resolution time-of-flight mass spectrometry coupled to GCxGC, direct inlet probe and thermogravimetry, all combined with principal components analysis, for the fingerprinting and mapping of marine fuels. This is important for those working to meet the impending IMO legislation to reduce the sulphur content in open sea marine fuels from 3.5% to 0.5% in 2020. Anupam Giri from SABIC GTC-EUR described the application of high-resolution MS coupled to photoionization-GCxGC for petrochemicals characterization and particularly for pyrolysis oil feedstocks





resulting from a very hot topic, namely, the recycling of mixed plastics in a bid to create a true circular economy.

The rest of day one focussed on improvements in hardware and software for GC and GCxGC applications. In software applications, Aaron Parker from Sepsolve described improved software to simplify and speed up the characterisation of complex hydrocarbon mixtures by GCxGC and Walter Spieksma from Still Peaks described fast detailed hydrocarbon analysis (DHA) by GC with customised pattern recognition software to produce D86 Distillation curves from GC data.

For hardware applications, Yusuke Takemori from Shimadzu Japan described the barrier ionisation discharge detector for GC and its application in combination with ionic liquid columns for the determination trace water in LPG and liquid petroleum samples and Ryan Schonert from VUV Analytics USA described the fast analysis of non-traditional gasoline additives using GC with component deconvolution and identification using their proprietary vacuum ultraviolet spectroscopy detector.

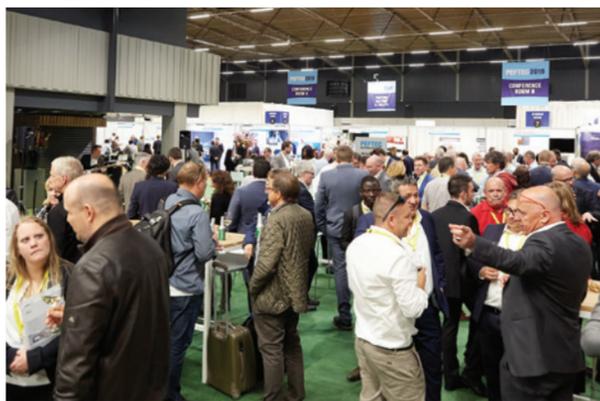
The Analytical and Process monitoring conferences merged at the beginning of the second day to address the hot topic of 'Big Data and Big Analysis' with a plenary by Eric Little. A summary of Eric's presentation is given in the Process Monitoring Conference report. This theme was then continued by Henning Kayser from Bayer who described how the pharma industry have formed the award-winning Allotrope foundation to standardise and formalise analytical data generation through its complete lifecycle. The aim is to make the intelligent analytical laboratory a reality – an automated laboratory where data, methods and hardware components are seamlessly shared between disparate platforms, and where one-click reports can be produced using data generated on any analytical instrument. Phil Kay from the SAS Institute completed the session with a talk on how insight and efficiency can be gained from applying modern data analytics like Neural Nets, Clustering, Decision Trees and visualisation techniques to analytical chemistry data.

The analytical conference continued with two presentations from Southampton University on the re-emergence of Supercritical Fluid Chromatography (SFC) as a mainstream analytical technique. John Langley gave a keynote overview focusing on the power of coupling SFC with mass spectrometry and Andreas Panagiotopoulos discussed the separation and detection of fuel components in gasoline gum by UHPSFC-MS.

The final session of the second day covered elemental and molecular spectroscopy and opened with a plenary lecture titled Gas Chromatography - Vacuum Ultraviolet Spectroscopy: A Versatile Tool for Analysis of Gasoline and Jet Fuels by the team from VUV Analytics. VUV spectroscopy has developed rapidly in recent years into a powerful technique for hydrocarbon type analysis and has now been developed into several methods for different fuel types which have either already been, or are currently undergoing, approval as standard methods by ASTM. The remainder of the session concentrated on trace elemental analysis in petrochemical samples including combustion-based organic elemental analysis – for C/N/S/Cl (Angela Groebel, Analytik Jena), Ultra Low P, S, Cl analysis in liquids by benchtop WDXRF (Wolfgang Kloeck, Rigaku) and the quantification of trace elements in naphtha by ICP-OES (Sebastian Wuenschel, Analytik Jena).

Methane Monitoring Conference

Methane emissions are responsible for around 25% of current global warming and the oil and gas sector is one of the largest anthropogenic sources of methane, so monitoring has a key role to play in tackling this important issue. As a result, there was standing room only in the hall as 33 speakers from around the world delivered presentations describing international initiatives to meet this challenge.



The first keynote speaker, Brendan Devlin from the European Commission, discussed the potential EU methane strategy. He came to the conference with one simple message: if industry does not sort out methane emissions, there will be regulation to make that happen, and the EU is currently asking industry to suggest credible solutions.

With €0-36 billion of lost revenue globally from methane emissions, Brendan explained that it is important to know who and what is responsible. The emissions are visible on satellite images, but it will be necessary to resolve differences between bottom up and top down measurements, and he was glad to see the variety of monitoring solutions on show at the PEFTEC exhibition.

Subsequent speakers emphasised the importance of this issue in the context of climate change and described both regulatory and voluntary initiatives to identify and reduce methane emissions. In addition, many of the speakers described research which not only measured methane emissions but also evaluated the technologies available for doing so.

ASTM sponsored Conference on Standards

In the morning of both days, delegates were able to learn about ASTM's latest standards development activities within ASTM Committee D02 on Petroleum Products, Liquid Fuels and Lubricants. Speakers explained how to access the latest ASTM standards with automatic updates and instant version comparison. They also described ASTM proficiency testing programs, eLearning courses and how to streamline internal document development using the same tool ASTM uses to develop ASTM standards.

PEFTEC 2019 Exhibition

All of the PEFTEC Seminar rooms, as well as the Process Monitoring Conference, the Analytical Conference and the Methane Measurement Conference, were all located in the same hall as the PEFTEC Exhibition. This provided delegates with a great opportunity to see the technologies being discussed in the presentations and to discuss them with experts.

Featuring over 250 world class providers of analytical and process testing/monitoring equipment and services, PEFTEC provided visitors with an opportunity to discover the latest advances and to find out which products are leading the way in meeting the testing challenges of the petrochemical, oil and gas sectors.

Visitor Zahid Salim from Signal Group said: "PEFTEC provided me with a valuable snapshot of the sector; bringing me up to speed with the latest developments. I also met several prospective customers and European distributors that were browsing the exhibition stands, and was delighted with the level of interest they showed in our new SOLAR Series IV FID gas analysers."

BA Systemen displayed a wide range of industrial safety and environmental monitors including the Blackline G7c Wireless Personal Gas Detector which has lone worker and push-to-talk capability.

XOS showcased the recently released Petra MAX Autosampler, which improves workflow and efficiency over traditional carousel automatic sampler systems, and is the first XRF benchtop autosampler with sample tracking and continuous flow.

With a large, eye-catching stand Zematra displayed a wide range of instruments including its own condition monitoring equipment and instruments from manufacturers such as Cannon, Tanaka, Eralytics and Tintometer.



Agilent announced the latest additions to its portfolio of intelligent GC systems. Touch-screens replace buttons, and on-board diagnostics, counters and early maintenance feedback, greatly reduce unplanned downtime. Agilent believes that this combination of intelligent features enables users to spend more time on what matters most; delivering results, analysing data and attending to customers.

The Malvern Analytical stand featured on-line liquid analysis with the Epsilon Xflow, which provides a solution for fast and accurate control of process parameters. Employing EDXRF technology, this solution provides simultaneous multi-element analysis with real-time results and high repeatability.

Zeltex displayed both lab and field portable NIR Octane/Cetane fuel analysers, and offering substantial savings over helium based GC solutions, Sion Technologies gave live demonstrations of the UCS-1000, which uses hydrogen as the carrier gas while eliminating the release of split gases into the laboratory environment.

The Turnkey Instruments stand featured a range of environmental monitoring equipment offering instruments for dust, noise and vibration. Leasing options for air quality monitoring equipment were available from Jantril Monitoring Systems, offering fence line monitoring for gases and particulates.

The Environnement Process & Analyse stand featured the new GC9200 which is dedicated to mudlogging and drilling applications, and Chemplex featured the Etnom thin-film sample support which is designed for utilisation with hydrocarbons.

European Lab Services (ELS) promoted its unique ability to perform on-site ISO 17025 accredited verification of petroleum analysers, and Optimus Instruments launched the Phase Technology DFA-70Xi, a 4-in-1 diesel analyser measuring cloud point, pour point, kinematic viscosity and density.

The PAC stand displayed a number of leading global instrumentation brands and the company highlighted its work in standards development; helping to establish benchmark procedures that scientists and analysts around the world can rely on to build better products and a cleaner environment.

LAR Process Analysers AG presented two innovations in TOC measurement. The QuickTOCtrace for ultra-pure water and the QuickTOCultra analyser for complex water applications.

Da Vinci promoted the Liquefied Gas Injector: an alternative and fast GC method which features a direct injection of liquefied gases and eliminates the need for sample evaporation.

The Omnitek stand featured the latest range of compact, benchtop automated viscometry systems for the analysis of Newtonian fluids. Key features included fast analysis time, small sample size and low solvent consumption.

Many laboratory and process monitoring instruments require speciality gases, and experts were available from Air Products and Nippon Gases (formerly Praxair) which is now part of the Taiyo Nippon Sanso Corporation.

Summarising, event organiser Marcus Pattison said: "We were delighted with the quality and breadth of the presentations delivered during PEFTEC 2019, and it was great to see almost all of the world's leading laboratory and process analyser suppliers at the exhibition.

"It was also very gratifying to see the diversity of the visitors, which included analytical chemists, process scientists, researchers, academics, process operators, regulators, consultants, laboratory personnel and environmental managers.

"I would like to thank every participant that helped make this event such a success, and I look forward to welcoming them again at PEFTEC 2021 which will take place in Rotterdam on 19th-20th May 2021."

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