CONFERENCE FOCUSES ON GAS MONITORING IN AND AROUND ENERGY FACILITIES

Responding to a growing need to monitor gases at installations in the oil, gas and petrochemical sector, Prof Alastair Lewis from the University of York (UK) welcomed delegates to a specialist conference in Antwerp that formed part of the PEFTEC 2017 event. Focusing on the measurement of gases within processes, in emissions to air and in ambient air, the conference provided delegates with an opportunity to share knowledge and experience, and to learn about the latest regulations, monitoring techniques and technologies.

In the first presentation, Alfredo Lopez from Ricardo in Spain described the air monitoring requirements of the Industrial Emission Directive (IED). He said that Best Available Techniques (BAT) Reference documents (BREFs) are applicable to almost 50,000 sites in the EU. After explaining the membership and procedures of the BREF and REF working groups, he described the implications for BREFs on emissions monitoring and referred delegates to Chapter 5 of the BREFs which details the legally binding BAT Conclusions.

Alfredo Lopez-Ricardo presenting on air monitoring requirements of the Industrial Emission Directive

The BREFs on mineral oil and gas refineries ('REF') and Large Volume Organic Chemicals (LVOC) have been reviewed under IED, and there are a number of monitoring BAT conclusions. Petrochemical sites and refinery installations, depending on their activity or manufacturing processes, may also need to comply with other horizontal BREFs such as the "Common Waste Water and Waste Gas Treatment/ Management Systems in the Chemical Sector" (CWW) and/or the Common Waste Gas Treatment for Chemical sector BREF ('WGC').

The European Industrial Pollution Prevention and Control Bureau has recently released a reference document without BAT conclusions (REF) on monitoring methods. This document is not legally binding but contains key information on the monitoring aspects of vertical BREFs to ensure a systematic approach on analytical measurements across BREF series.

Dr Fabrizio Innocenti from NPL (UK) described the development of methods for the determination of fugitive VOC emissions, including the results of validation studies. He included Leak Detection and Repair (LDAR), Optical Gas Imaging (OGI), Solar Occultation Flux (SOF), Differential Absorption Lidar (DIAL), Tracer Gas, and Reverse Dispersion Modelling.

He reminded delegates that several BREFs cover the prevention and control of fugitive and diffuse emissions of VOCs from industrial storage and transfer activities, in particular the BREFs concerned with mineral oil and gas refineries, large volume organic chemicals, and the "horizontal" BREF on emissions from storage. The mandate for this work requests the European standardisation organisations to develop a European Standard that can be used in the determination of VOC emissions to be regulated within permits that are issued according to the Directive.

VOCs are emitted to a significant extent by fugitive and diffuse sources (including non-point sources), although this is difficult to quantify accurately. The requirement for more accurate determination of these important VOC emissions presents a challenge because of their area emissions, and because they require specific measurement and estimation methods that are currently not standardised. However, improving the accuracy of VOC emissions measurements should enable an improved assessment of these losses, and may provide an incentive to reduce such losses, as well as benefits to the environment and human health. He then described the status of the European Standardisation activities in CEN/TC 264/WG 38, which is developing and validating methods for monitoring fugitive emissions.

Mike Hayes from the Linde Group described the global nature of the threat that Mercury presents. He said that Mercury rapidly moved up the pollution control agenda in the European Union, the USA and Asia prior to the legally binding UNEP global treaty on mercury, the Minamata Convention, adopted in 2013 with the aim of protecting human health and the environment from anthropogenic emissions and releases of mercury and mercury compounds.

In late 2011, the US EPA finalised the Mercury and Air Toxics Standards (MATS), the first national Clean Air standards to reduce emissions of mercury and other toxic air pollutants from new and existing coal and oil-fired power plants. In the EU, the Community Strategy concerning mercury was adopted in 2005 and reviewed in 2010. It focuses on mercury emissions to air, the banning of mercury exportation (including certain mercury compounds) and enforcing restrictions on products containing mercury and industrial processes using mercury. The IED addresses the issue via BREFs and the recently updated National Emission Ceiling Directive (NECD) introduced the monitoring of mercury emissions as a requirement. Mike also explained the role of NIST certified gas standards.

In addition to chairing the conference, Prof. Alastair Lewis gave a presentation on the air pollution concerns that relate to fracking, and described an environmental baseline climatology of air pollution that has been established over two years at potential shale gas drilling sites in Kirby Misperton (North Yorkshire) and Little Plumpton (Lancashire).

Unconventional gas extraction has become a major component of the energy sector in the USA, however the development of the industry in Europe has been limited, largely due to concerns over environmental impacts. One of the most frequently cited

Mike Hayes, Linde Group, presenting on the global nature of the threat of Mercury

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public concerns in Europe has been a potential reduction in air quality, through both direct onsite emissions of methane, VOCs and NOx, and more distributed emissions arising from the supply chain and vehicle movements. Within the UK potential future shale gas impacts from individual sites are to be evaluated against an observational environmental baseline. In some cases this has required new measurements to be established in rural locations that do not currently need measurements to be compliant with the EC Air Quality Directives.

Two ambient air quality monitoring stations have been installed at the two UK sites and these are showing very wide annual variations in NOx and PM for example. Interestingly, one of the PM sources has been identified as a protest camp where wood is burned.

He indicated that the most likely impacts of shale sites will be on NOx levels, and that the air quality impact of a new site is likely to be similar to that of a medium sized supermarket. He also said that ozone, as a secondary pollutant, is likely to be a significant issue in the long term.

Iris de Krom from VSL in the Netherlands described the "Traceability for mercury measurements" project (MeTra; European Metrology Research Programme) in which a mercury vapour generator was developed to establish traceability of mercury vapour measurement results, based upon a gravimetric approach, for ambient air levels as well as higher concentrations.

Current measurement capabilities are maintained at levels of 0,25 - 350 µg Hg/m^3, whereas the aim of the novel gravimetric primary standard was to realise metrological traceability for the range 5 ng Hg/m^3 - 60 µg Hg/m^3, with a target measurement uncertainty of 1 %. This would cover the key requirements for ambient air monitoring (1 - 2 ng Hg/m^3), health-based exposure standards (50 ng Hg/m^3), concentrations relevant to stationary source emissions (upwards of 1 µg Hg/m^3) and the minimum alveolar concentration value (20 µg Hg/m^3).

Dr John Thompson from Tracer Systems in the UK explained the difficulty in generating trace vapour standard mixtures of SVOCs for calibration in environmental monitoring and industrial hygiene. He said that it is not really practical or possible using permeation tubes, which are often used for VOCs because the permeation rates are very small and many are oxygen-sensitive. He illustrated the dynamic generation of trace vapour standard mixtures for a wide range of SVOCs using refillable diffusion tubes and the Tracer Cert® Superambient™ Thermostat System Super-AT470 at temperatures up to 470K. Nitrogen is used as carrier gas for oxygen-sensitive SVOCs, such as PAHs, and air is used as carrier gas for SVOCs not sensitive to oxygen, such as siloxanes and PCBs. Examples were shown of applications for a varied range of SVOCs.

Dr Peter Edwards, from the University of York, described wintertime ozone pollution events in regions of intense oil and gas development. He explained that the United States has recently experienced the most rapid expansion in oil and gas production in four decades, partly due to the implementation of new extraction technologies such as horizontal drilling combined with hydraulic fracturing. The environmental impacts of this development have been a matter of intense debate. Air quality impacts are associated with emissions of NOx and VOCs, whose photochemistry leads to the production of ozone, a secondary pollutant with negative health effects. Recent observations in oil- and gas-producing basins in the western U.S. have identified ozone mixing ratios well in excess of present air quality standards, and including the highest levels yet recorded in the USA, but only during winter. Understanding winter ozone production in these regions is scientifically challenging, however, and goes against conventional understanding of ozone as a summertime urban pollutant.

Over the course of 3 winters between 2012 and 2014 detailed chemical measurements were made in the Uintah basin, Utah. These measurements resulted in new understanding of the chemistry leading to these pollution events, and enabled a quantitative analysis of the best emissions reduction strategies to tackle the problem. Reducing VOC emissions was found to be the best mitigation strategy.

Dr Mark Gibbs from Aether Ltd described the uncertainties involved with emissions inventories for facilities such as refineries and large petrochemical plants, and warned that inaccurate information can lead to ineffective regulation, which could be unnecessarily costly to operators and other stakeholders.

Operators and regulators need a fuller understanding of uncertainty and where errors can occur. For instance, a detailed temporal resolution of emissions is especially important for modelling short-duration events such as summer ozone exceedances. Other issues include the use of unrepresentative emission factors, default stack parameters or inaccurate release point coordinates that can lead to invalid assessments of public health risks from emissions. The scrutiny of oil and gas facilities is likely to increase and operators will need to be able to respond with defensible documentation of effective and proportionate operational and environmental monitoring programmes.

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Harald Mahler from Siemens talked about online process monitoring with gas chromatograph systems, which he said can improve plant yield, optimise energy costs and ensure product specification. He said that recent market drivers include requirements for simplification and standardisation. In addition staff numbers at plants are reducing and measurements need to be made at trace levels. Process GC analysers have been developed to meet these needs.

Dr Philip Sulzer from Ionicon described Proton-Transfer-Reaction - Mass Spectrometry (PTR-MS) for sensitive real-time quantification of trace compounds in applications such as environmental research, process monitoring, food and flavour science, threat compound detection, etc. He also described the real-time monitoring of trace gases in syngas in a Fischer-Tropsch process using a multiplexing unit, so that a series of sampling streams can be analysed with one PTR-MS instrument. He explained that his company has developed a new software tool which performs measurements at various ionisation conditions and subsequently processes the data with real-time output.

The full Conference programme and links to abstracts for all of the presentations is available at www.PEFTEC.com.

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