Environmental Analysis

Environmental Analysis in the 21st century

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Today, although the modern environmental analytical laboratory is more and more dependent on sophisticated instrumentation, emphasis on quality and robust procedures for analysis are, if anything, more important than ever. Recent changes in demands for performance testing and validation of methods are aimed at ensuring data is fit for purpose across the very wide range of matrices and contaminants found within the environmental industry. As well as more stringent quality demands, the main drivers within our industry fall into the following categories.

Legislation

Starting with the implementation of the Environmental Protection Act back in the early 1990s, a wealth of legislation has followed from the EU. Examples of these that have impacted heavily on environmental testing include the Water Framework Directive (with numerous daughter directives), covering drinking water, bathing water, river water and surface water, Integrated Pollution Prevention and Control (IPPC) covering air emissions and discharge consents, and the Landfill Directive (preventing the co-disposal of hazardous waste). Two Directives due for implementation in 2007 include the Soil Framework Directive and the Environmental Liability Directive, both of which are likely to impact on environmental testing laboratories,

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with increasing demands for soil testing and characterisation of potentially contaminated sites, and emphasis on the 'polluter pays' principle. The water directives (and others) include lists of target compounds which the laboratory must analyse – there are 33 major priority pollutants listed for waters, with 28 more under consideration for addition to the list – there is an organisation (NORMAN) specifically monitoring emerging priority pollutants.

Detection Limits

The limits of detection that laboratories must reach have decreased significantly over the last 20 years, as Environmental Quality Standards (EQS) values in the directives have become more stringent. In many instances, clients demand analytical limits of detection that are a factor of ten lower than the appropriate EQS value, and this can stretch methodologies and instrumentation to their limits. Laboratories need to implement procedures such as extracting larger volumes of water, concentration of extracts, more aggressive extraction techniques, and the use of clean-up procedures, in order to reach the required limits of detection. Instrument manufacturers are under pressure to develop greater sensitivity in their equipment, and costs (of equipment and analysis) have risen in accordance with these requirements.

Quality Standards

All laboratories supplying data within the environmental market should be accredited to ISO 17025 for the majority of the methods they offer. The requirements of UKAS when auditing laboratories to this standard have become more exacting over the last few years, as the emphasis on validation and performance testing has become the norm. The implementation of Monitoring Certification Scheme (MCERTS) by the Environment Agency has placed greater emphasis on these protocols, in that all methods must demonstrate fitness for purpose across a range of matrices. MCERTS is in place for air monitoring, soil testing, online water monitoring equipment, and DTA (Direct Toxicity Assessment), and will be introduced for laboratory water testing in the near future. Performance testing involves analysing each parameter across at least three matrices at 20 per cent and 80 per cent of the calibration range, usually for a minimum of 11 days in duplicate. This can cause significant resource issues within the laboratory, which will require additional equipment, staff and standards to comply with the regulations. Targets are set within the MCERTS standards for precision and bias on every method, and UKAS will review the validation data and audit the laboratory to ensure all criteria are met. Ongoing Analytical Quality Control (AQC) performance must also meet defined requirements, and again, UKAS will review this data at every audit. For

laboratories offering microbiological analyses, asbestos or low-level radiological testing, other legislation and standards need to be met which are specific to these contaminants.

Turnaround

Laboratories are constantly under pressure to provide results in shorter and shorter timeframes – consultants and contractors often have expensive plant standing unused on site until laboratory data is received. Fifteen years ago, the standard turnaround within most environmental laboratories was 15 working days – now, over 65 per cent of the work received at ALcontrol Laboratories (and most others) is required on five days or less. This places significant pressure on the staff, methods and equipment, as timeframes of this duration are difficult to meet within the constraints of the quality systems. For example, soils are received, logged in, scheduled for testing, homogenised and put for drying (usually overnight) before testing can commence (although some analyses are performed on the as received soils). Extraction or digestion procedures can then take another day, before the sample is ready for analysis.

Although most instruments may have autosamplers for 24-hour running, data must still be processed and reviewed by an analyst, which can be time consuming, particularly with organic analyses. If any AQC samples have fallen outside their acceptable limits, the samples must be repeated, and this usually includes the extraction process, so to complete all this within five days (or less) is not easy. Laboratories (and instrument manufacturers) are constantly looking for more rapid procedures, including automation so maximum use is gained from an instrument, faster chromatography columns to reduce run times for organic analyses, robotics for sample preparation, and better software for faster processing of data. Many laboratories operate shift systems, and are moving towards full 24/7 working in order to meet the demands of the industry. Another area to speed up the process is for clients to pre-schedule analyses onsite and for results to be accessed over a web link.

Technical and Logistical Support

Most clients of laboratories also require additional services, apart from the actual analytical testing. These include provision of sample containers, collection of samples from site, assistance with interpretation of analytical data and provision of training courses. It is essential for site staff to use correct sampling bottles and preservatives, in order to maintain the integrity of the samples. Most environmental consultants and contractors do not employ a chemist, and may need assistance with understanding different methods and the limitations/uncertainty of the data supplied by the laboratory.

Summary

All major environmental testing laboratories need to employ a team of technical specialists whose role is to review constantly all existing methods to ensure compliance with the above requirements and to develop new methods as needed. There has been significant consolidation within the laboratory testing market over recent years, and it is now more difficult for smaller laboratories to meet the stringent quality requirements necessary to compete with the larger laboratories, and this will also prove to be a barrier to new players entering the market. It is likely that further legislation from the EU will continue to ensure the science becomes more exacting in the areas listed above, and that laboratories will become more highly regulated to comply with these requirements. It is also important for laboratories to be aware of changing requirements, and participation in the EIC working groups is a useful mechanism for keeping up to date with forthcoming legislation and for obtaining feedback from their clients.