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A breath of fresh air

Experts measure pollution near a chemical plant

Pollution control experts in Neath Port Talbot County, Wales, participated in a government study to analyse the differences in effectiveness between utilising a high-tech chromatography-based air quality monitoring system to measure air pollution and a simpler, lower-cost technique using pollutant-specific benzene diffusion tubes at a school near a chemical plant. The test location was the Baglan Primary School located between Neath and Port Talbot near the Baglan Bay chemical works.

The project, which began in 1996, was in response to Local Authority air quality management legislation under the country's Environment Act. The United Kingdom's central government's Department for Environment Food and Rural Affairs (DEFRA) was conducting a series of First Phase studies, of which this was a part.

The benefit of diffusion tubes is their simplicity and the fact that they achieve a time-weighted average, making them ideal for occupational hygiene. The downside is a lower sensitivity compared to pumped monitoring. The results of the nine-month study were intended to help guide the government's decisions about equipment to use in the future routine monitoring of air quality.

Historically, some people in the Baglan Bay area had concerns about possible health effects arising from certain processes at a local chemical plant site. Of particular concern was the presence of volatile organic compounds (VOC's), a range of mainly synthetic, carbon-based substances that are capable of vapourising at relatively low temperatures. VOCs are primarily manmade, but methane also arises naturally from the putrefaction of organic materials and as a result of the process of digestion in animals. Some VOC's are recognised as potentially harmful to health, while others are harmful to the environment.

The UK government's National Air Quality Objectives outlined in 1997 were health-based environmental goals for benzene and 1,3-butadiene, to be achieved by December 2003. It would be necessary for the gas chromatography-based system to not only monitor benzene, but also 1,3 butadiene and other air pollutants.

While the plant facility had reduced its hazardous emissions over recent years, local officials still needed a monitoring system in place to ensure that even the reduced levels of emissions did not present a health hazard to citizens or the environment.

Researchers considered a range of alternatives for a high-tech option that would be appropriate given the guidelines for selecting equipment for the monitoring comparison, including a cryogen-based gas chromatography system and specific benzene, toluene, xylenes (BTX) analysers. As the cryogen-based system required the delivery and use of quantities of liquid nitrogen on a regular basis, it was ruled out because of the potential safety hazards in transporting cryogen and the expense of purchasing liquid nitrogen for use throughout the study. BTX analysers were a more viable option, but could analyse only benzene, toluene and xylene and not other important compounds such as 1,3-butadiene. A third option, a PerkinElmer Ozone Precursor Analyser, had a Peltier-based cooling system and eliminated the need for liquid nitrogen to achieve the cooling required in the sample



collection and concentration stage. Furthermore, use of a hydrogen generator in conjunction with the Ozone Precursor Analyser would eliminate the need for cylinders of hydrogen. The Ozone Precursor Analyser also offered high-quality, reliable and hourly, data-rich reporting. This was the system that was ultimately selected.

The researchers co-located benzene diffusion tubes and an Ozone Precursor Analyser from PerkinElmer at Baglan School to compare the systems.

According to Martin Hooper, pollution control officer, Neath Port Talbot County Borough Council, the Peltier cooling system proved to be a great cost advantage. Its dual column approach allowed the analysis of up to 29 VOCs on an hourly basis, while the more limited diffusion tubes offered only analysis of benzene emissions, in a longer time frame.

The data collection, analysis and data delivery capability in the Ozone Precursor Analyser was also of central importance as the study progressed. The Ozone Precursor Analyser automatically fed data into a centralised pollution database (Monnet) at the Council offices, which was developed by King's College, London. This system allowed rapid quality-assurance of the collected data. It also greatly reduced the amount of time scientists were required to spend on site.

Quality assurance involved the use of traceable calibration gas mixtures and regular checks on the chromatography-peak integration in the calibration runs to ensure that the right compounds were being integrated correctly.

Hooper operated the PerkinElmer unit with scripting software developed by the Environmental Research Group (ERG) at King's College, London. The organisation runs several PerkinElmer Ozone Precursor Analyser systems and the London Air Quality Network. The ERG software organised the three files generated each hour (raw, result and tx0) into daily folders. The files were obtained via modem on a regular basis. Identified peaks and concentrations from the tx0 folder were parsed into the Monnet database running on a SQL-server platform, developed specifically to interact with PerkinElmer units. This enabled Hooper to handle, quality assure and analyse the data efficiently in what otherwise would have been an extremely labour-intensive effort. It also allowed Hooper to generate web pages automatically on an hourly basis to provide up-to-date information for both the study and for public information.

In the first quarter of 2006 after nearly 10 years of reliable performance, the Ozone Precursor Analyser was decommissioned when the concentration levels of all pollutants sank below levels of concern. The progressive closure of the Baglan Bay chemical works had eliminated concerns about benzene and other health risks to the school and the rest of the surrounding community.

As a result of the comparison study, the Ozone Precursor Analyser proved to be more sensitive and accurate than the benzene diffusion tubes. Furthermore, the Ozone Precursor Analyser rapidly and accurately provided additional information on volatile pollutants that were present. The equipment was designed with ruggedness and remote operation in mind and provided smooth and continuous operation throughout the monitoring study.



The Ozone Precursor Analyser from PerkinElmer was designed with ruggedness and remote operation in mind and provided smooth and continuous operation throughout the monitoring study at the Baglan School near the Baglan Bay chemical works in Neath Port Talbot, UK