Researchers in Greece are using a Gasmet FTIR multiparameter gas analyzer, deployed in a mobile van (MOBILAB), to undertake exhaust gas analysis for comparison with ambient air quality data. “This enables us to undertake temporal and spatial air quality measurements from within traffic, measuring emissions during different traffic conditions,” says Apostolos Tsakis, from the Aerosol and Particle Technology Laboratory (APTL) of the Centre for Research and Technology-Hellas (CERTH) in Greece. The MOBILAB has been employed in numerous EU funded academic research projects in addition to work sponsored by diesel particulate filter manufacturers.

The ‘real-world’ monitoring of emissions from diesel engines is believed to provide a more accurate measurement of important pollutants and recent announcements from the European Commission indicate that a requirement for Real Driving Emissions (RDE) testing is likely to come into force in the EU during 2017.

Background

Traditional ambient air quality monitoring stations are mains powered and fixed in one location. As a result, it is usually not possible to locate them where traffic is most congested and air quality is at its worst. Urban air quality is therefore often modelled, which risks ignoring pollution hotspots – at highway junctions and in road corridors for example. Such models can be improved with a higher density of monitoring sites, but this incurs high capital and operational costs. Similarly, the measurement of exhaust emissions in the laboratory assumes that it is possible to recreate real driving conditions.

Urban air quality, particularly in relation to vehicle emissions, is the subject of great concern, with many of the world’s major towns and cities failing to meet air quality guideline levels established by the World Health Organisation, the European Union, the Unites States Environmental Protection Agency and others. For example, in the UK, where urban air pollution

results in the premature deaths of around 29,000 people per year, the Supreme Court has quashed the UK Government's plans to cut levels of air pollution, and ordered it to deliver a new strategy, with faster air quality improvements, by the end of the 2015. The ruling will save thousands of lives by forcing the Government to urgently clean up pollution from diesel vehicles, the main source of the illegal levels of nitrogen dioxide. Some commentators believe that similar court cases could now take place in other countries, so it follows that there will be increasing international focus on diesel vehicle emissions.

In recent years, there has been a move to diesel vehicles, encouraged by governments and by tax incentives, and with the support of vehicle manufacturers. The objective has been to reduce carbon dioxide emissions and help fight climate change. However, whilst diesel engines emit less CO2 than petrol engines, they emit higher levels of nitrogen dioxide and fine particulates. Clearly, governments that undertake initiatives to reduce one pollutant need to be conscious of the effects of such actions on other pollutants, and this is one of the reasons for the deployment of an FTIR multigas analyzer, the Gasmet CR2000 in the Mobilab.

FTIR

As an FTIR analyzer, the Gasmet CR2000 simultaneously measures multiple analytes in a complex gas matrix, detecting virtually all organic and inorganic gas-phase species. Data from the CR2000 are analyzed by Calcmet™ software which identifies and quantifies up to 50 different gas components simultaneously. Measured spectra are stored, providing an opportunity for retrospective analysis to identify unknowns by using reference spectra from a library of over 5000 gases.

In addition to its deployment in the MOBILAB, the Gasmet FTIR analyzer is also utilised in the laboratory, and in part due to the flexibility of FTIR, CERTH also has another Gasmet FTIR for the evaluation of catalytic activity of powder samples. In this work, the FTIR is utilised for the analysis of the remaining reactants as well as the produced gases (CO, CO2, NO, NO2, H2O, HCs).

Real Driving Emissions (RDE) testing

During May 2015, the EU's Technical Committee - Motor Vehicles voted in favour of a proposal

to amend Regulation (EC) No 692/2008 and introduce RDE test procedures at the Euro 6 level for light-duty vehicles. Campaigning group Transport and Environment welcomed the news, adding: “It will require vehicles to be tested on roads rather than in laboratories, overcoming obsolete tests and ‘cycle beating’ techniques used by carmakers to achieve results in tests many times lower than actual air pollution emissions on the road.” The proposal is expected to come into force in September 2017, but the RDE test emission limits and the dates of applicability are scheduled to be decided later this year.

Gasmet’s Antti Heikkilä also welcomed the EU initiative: “This is very good news for European air quality, and as the manufacturer of an extremely robust FTIR multigas analyzer, we are obviously excited about the prospect of helping test laboratories to develop mobile monitoring equipment for RDE testing.”

MOBILAB

The Mobilab van is a 2.2 litre diesel Mercedes-Benz Sprinter with a Diesel Oxidation Catalyst (DOC) and a Diesel Particulate Filter (DPF), and emissions that meet the Euro IV regulations. The on-board instrumentation was acquired after thorough examination of weight, space and cost restrictions, as well as considerations for the specific needs of a mobile laboratory, such as power consumption, durability, on-board operation capability, etc. Three platforms of instruments have been established. The first platform contains a gas monitoring system dedicated to ambient air measurements. The second includes the Gasmet FTIR exhaust gas monitoring system, and the third measures particulate matter in both ambient air and exhaust gas.

Explaining the value of the mobile laboratory, Apostolos Tsakis says: “We have deployed the Mobilab in a variety of locations and in several countries, and it has proved to be an extremely useful tool in the concurrent analysis of both vehicle emissions and ambient air quality, which has been useful in the assessment of the vehicle’s exhaust emission reduction system. The results have shown that particle emissions, carbon monoxide and hydrocarbons from the vehicle were very effectively lowered, but that the emission reduction system actually caused a significant increase in nitrogen dioxide under real driving emissions.

“The use of the Gasmet FTIR has been extremely important, because it has enabled us to monitor all of the toxic gases that have the potential to be significant; not just the main pollutants, but also non-regulated compounds such as ammonia.

“The CR2000 has proved to be extremely reliable, working under RDE testing conditions, so with the upcoming changes in EU Light and Heavy Duty Vehicle testing regulations and with the right modifications on the analyser, we foresee a high demand for this capability.

“Our studies have shown that Mobilab can effectively monitor pollution in areas with higher or lower traffic density, delivering both spatial and temporal pollution variation data. Furthermore, on-road pollutant concentrations can be significantly different to those obtained from fixed stations so the results of our work are helping to create a better understanding of the relationship between vehicle emissions and the air that people are breathing.”