AIR QUALITY BULLETIN
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AAMG conference report

MONITORING

Monitoring unpicked at 2019 AAMG meeting

Experts gathered for the annual AAMG monitoring conference held by the RSC in London last month. No surprise that low cost sensors dominated the two day conference.

As well as focussing on monitoring, the event has also become an impromptu showcase for the work of Aqeg. The Air Quality Expert Group, now led by Alastair Lewis of York University, has had much to say of late on vegetation, fracking, $PM_{2.5}$ and other issues.

Earlier this year Aqeg covered non-exhaust particles – these are not falling and are becoming an increasingly large fraction of the mix as tailpipe emissions drop dramatically.

Matthew Heal told the conference: "The majority of the non-exhaust emissions arise regardless of the type of vehicle and its mode of power. Whilst the introduction of successive exhaust emissions standards has substantially driven down fleet-average exhaust emissions of particles, no legislation is currently in place to specifically limit or reduce non-exhaust emissions. These are estimated now to substantially exceed those from the exhaust."

There are concerns that vehicles powered by batteries are significantly heavier than conventional vehicles so might increase tyre wear. Brake wear is uncertain said Heal: "There is no question that regenerative braking can eliminate a lot of wear from braking systems but tyre wear may increase due to the greater weight. Autonomous cars may be 'better' drivers than humans but will be even heavier with all the computers and electronics required.

"What was missed out in the report is the detail – while regenerative braking may reduce brake wear in urban areas, on motorways the predominant source of non-tailpipe emissions is tyre wear. Thus the penalty of extra weight will increase tyre wear and as there is little braking going on, there is little benefit from the reduction in brake wear so the total contribution from non-tailpipe particles will go up."

Gary Fuller of Kings College London said there was much uncertainty on electric vehicle behaviour – for instance they have very high starting torque which if used might create more particles – however if drivers have range anxiety they may select low power mode and there be fewer particles.

Dan Wakeling of Ricardo reported on work to characterise brake emissions. Real vehicle measurement data (over 150,000 km driven) was analysed to estimate the energy dissipated to the brakes each second. By combining this with contemporary estimates of brake wear emission rates, brake wear emissions were distributed according to these energy dissipated estimates.

The spatially resolved brake wear emissions results were applied to Ricardo's RapidAir air quality model to see how this affects ambient PM concentrations at a high spatial resolution. The results show that the contribution of brake wear to ambient PM_{10} concentrations

● Continued overleaf

PARTICLES

'Microplastics' warning for air in London

Researchers have warned that Londoners are breathing in resuspended 'microplastics'.

Microplastics is the term increasingly being coined for man made particles such as resuspended tyre dust, or engineered nanoparticles (eg from suncreams, teabags or washing powders) that find their way into the atmosphere then deposited as rain. Researchers disagree on a definition – not least on tyre dust. Rubber is not a plastic but modern tyres contain very little natural rubber.

Kings College London has studied microplastics in the air in London with results released in a new academic paper. Central London riverside rain gauge sampling suggests deposition rates ranging from 575 to 1008 microplastics/m^2/d. They were found in various shapes, of which fibrous microplastics accounted for the great majority (92%).

While the sampling was of rainwater, microplastics get into the rainwater via the atmosphere so are technically respirable – hence the interest in London.

Spectroscopic analysis found that 17% of fibres were

● Continued on page 2

INSIDE THIS ISSUE

IN BRIEF

Wade sentenced

Waverley Borough Council's former air quality officer Ann-Marie Wade has been sentenced having been found guilty of falsifying air quality readings (*AQB Sept p1*).

Additionally she faked mileage claims associated with taking diffusion tube readings around the borough.

She was sentenced at Guildford Crown Court to 12 months in prison, suspended for 12 months, and ordered to pay costs of £1,500.

Waverley Council said: "We acted promptly with an independent audit and subsequently asked the police to investigate.

"We are pleased with the outcome of this case and that justice prevailed."

ADM's David Harvey, a local, played a key role in spotting inconsistencies in the monitoring data. While unadjusted data suggested NO_2 levels were rising, adjusted data enabled the council to claim pollution was falling. Bias factors were found to be incorrect.

Harvey is quoted in the local paper: "She did quite a good job falsifying the data. Yes, she got some of the hours wrong and the number of days in a month wrong. but it looked credible, and what she did was actually quite creative. It only came to light because she made a hash of the bias factor."

Queen's Speech

Air quality was specifically mentioned in the Queen's Speech: "To protect and improve the environment for future generations, my Government will present a bill to enshrine in law environmental principles and legally-binding targets, including for air quality."

This prompted local MP Sarah Olney to remark during questions: "Expanding Heathrow, and the economic benefits claimed for it, does not justify the impact on climate change, air quality and noise."

FROM PREVIOUS PAGE

AAMG (continued from previous page)

is more spatially variable using the new approach, compared to standard modelling assumptions (constant emission rates along road links).

"These results could inform the siting of PM measurement stations to further reduce uncertainties. Currently, air quality monitoring sites are not specifically located in regions where brake wear emissions could be high."

Now this is not an April Fool's joke – a Belgian researcher is suggesting monitoring noise as a proxy for air pollution. The two are of course linked, what Luc Dekoninck told delegates is that they are so closely linked that characterised noise monitoring can predict traffic pollution. "Noise measurements act as a traffic proxy and provide traffic density and flow for air pollution models. Simultaneous measurement campaigns covering all seasons, road types and meteorological conditions enable the disentanglement of changes at the source (traffic density and flow), impact of meteorology (wind speed) and the ambient contribution of non-traffic sources. Pilot data from Belgium, New York City and India illustrated the technique.

"This principle was used to assess the impact of short-term traffic changes on the personal exposure of cyclists. Researchers mimicked a traffic intervention by measuring the traffic noise during a holiday period (July/August) and compared it to a period with normal traffic density.

After calibrating the air pollution exposure model using high-quality instruments, this methodology can be scaled up to the city-wide applications by deploying low-cost noise sensor networks acting as a traffic proxy. It provides a long-term, multidisciplinary and cost-efficient policy support tool with an unprecedented spatial and temporal resolution.

He showed the conference a series of graphs of noise versus measures such as black carbon and there was indeed high correlation. Bear in mind air quality monitoring is highly sensitive to where the measurement is done eg at the kerbside, and which way the wind is blowing, relying on noise as a proxy for air might not be as daft as it sounds.

Ricardo's Jon Andersson is finishing off an Aqeg report on vehicle emissions. The report addresses:

- The emissions that are produced by vehicles operating with internal combustion engines;
- The impact these emissions have on air quality, especially in urban areas;
- What new exhaust species may need to be controlled in the future;
- How technology will evolve for the next stage of emissions legislation (including retrofit).

He warned that driving styles can have a huge impact on emissions, especially for diesels.

Mark Packham of Cambustion reiterated fears that stop-start technology and no idling rules can be counterproductive for pollutants. Most vehicles produce a "spike" of emissions when the engine starts and therefore the effectiveness of a "no idling" rule depends upon the balance of accumulated idling emissions vs those from a (re-)start. He analysed data from three diesel passenger cars from different Euro emissions categories and calculates the idle time equivalent to their restart NO_X emissions.

The results show that for the Euro 5 diesel, it is detrimental to switch off unless an idle time of approximately 30 seconds is expected. This contrasts starkly with the Euro 6b vehicle (fitted with automatic stop/start) where the equivalent restart idle time is three seconds.

For the latest generation Euro 6d vehicle, the NO_X emissions are negligible at idle and restart and it might be considered that its engine should therefore always stop instead of idle."

The difficulty is that if the engine is not hot enough, then exhaust clean up does not work properly and while idling may reduce CO_2, it may worsen polluting emissions unless the system is set up carefully.

Aircraft engines have traditionally been seen as 'clean' however there are growing concerns about ultrafine particle emissions. Brian Stacey of Ricardo has found increased ultrafines near Heathrow and Leon Hibbs of Reigate and Banstead Council has found raised ultrafines downwind of Gatwick.

Paul Williams of Manchester University noted that in 2017 ICAO set a standard for ultrafine particles from new aircraft engines. He is part of the AVIATOR project (Assessing aViation emission Impact on local Air quality at airports: Towards Regulation) which will adopt a multi-level measurement, modelling and assessment approach to develop an improved description and quantification of the relevant aircraft engine emissions, and their impact on air quality under different climatic conditions.

Engine particulate and gaseous emissions in the INTA test cell and on-wing from an in-service aircraft will be measured to determine pollutant plume evolution from the engine and auxiliary power unit exhaust.

Anja Tremper of Kings College London gave further insight into research near Gatwick of ultrafine particles, This was initially a noise project but morphed into one comparing ultrafines upwind and downwind of Gatwick.

Sources from the airport caused peaks in particle number concentrations that reached 94027 p/m^3 but contributed 16% to the long-term mean, but in the short term contribute 80% of ultrafines measured.

Positive matrix factorisation was used to identify the sub micron particles which could be split into aircraft factor, split and aged road traffic factor, urban factor, secondary aerosol factor and cooking aerosols could also be identified.

The link with noise deserves further analysis – it is possible that aircraft particle number could be confounding epidemiological studies surrounding aircraft noise.

Rod Jones of Cambridge University is involved in the Breathe London network of AQMesh sensors. "These have had their challenges but are now working well."

He told the AAMG conference: "London already has a good local network of monitors and the Breathe London network sits on top of this. This gives us the perfect opportunity to test a network of sensors which could then be used elsewhere which does not have a network."

Calibration can be very time consuming: "By making measurements more rapidly (at 1 minute intervals), pollutants emitted locally can be distinguished from those due to longer range transport, if the sensors are all showing the same regional signal this can lead to an innovative cloud-based method for remote calibration of the entire network for both gases and particulates."

Jones said precision was down to 19.5% – better than can be had with reference instruments.

"Inclusion of CO_2 measurements can provide direct measurements of emission indices allowing enhanced diagnosis of interventions such as the ULEZ, expand ULEZ, LEZs, clean air zone and inventory characterisation."

Sharon Goddard of NPL focussed on antimony and barium – and how concentrations could be used as indicators of non-exhaust traffic emissions.

Based on the strong correlation with copper at urban and traffic locations, indicative annual UK atmospheric emissions estimates for antimony and barium in brake and tyre wear were calculated as 6 and 19 tonnes respectively.

The average antimony concentration found across all the network sites was 1.84ng/m^3; the average barium concentration was 6.33ng/m^3. The range of antimony concentrations observed was 0.13–8.02ng/m^3; barium concentrations ranged from levels below the detection limit of 0.18ng/m^3 to 39.9ng/m^3. There are no legislative limits for antimony and barium in ambient air, but the maximum concentrations found are well below the workplace exposure limits specified by the UK Health and Safety Executive.

The highest concentrations were found at roadside sites situated to monitor traffic environments, supporting the suitability of antimony and barium to be considered tracer elements for traffic emissions sources. Strong correlations were observed between antimony, barium and copper, indicating they share a common traffic-related source.

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