Real driving solid particle number emissions from a hydraulic hybrid heavy commercial vehicle and diesel sports utilities vehicles in Australia

N. C. Surawski[1], M. Awadallah[1], E. Zhao[2], R. Smit[1,3], and P. D. Walker[2]

[1] Centre for Green Technology, University of Technology Sydney, Gadigal Country, 81 Broadway, NSW 2007, Australia

[2] Transport for New South Wales, PO Box K659, Haymarket NSW 2140

[3] Transport Energy/Emission Research (TER), Launceston, TAS 7249, Australia

email: Nicholas.Surawski@uts.edu.au

Diesel particulate filters (DPFs) are an essential technology for meeting legislated solid particle number (SPN) emission limits. Internationally, real driving emission measurement of SPN is now routine; however, in Australia no data currently exist in the public domain, largely due to lagging behind European emission standards by more than 10 years. Key features of the unique Australian vehicle fleet that make analysis of real driving SPN measurements of interest in an international context include: (i) different fuel quality standards (i.e. especially in terms of sulphur and aromatics content), (ii) variable climate conditions, (iii) slow uptake of electric vehicles, (iv) lack of periodic technical vehicle inspections, (v) a high proportion of heavy passenger vehicles (i.e. sports utility vehicles), (vi) and a high proportion of automatic transmissions and four-wheel drive functionality in the light duty fleet [1].

Our study provided the opportunity to explore DPF regeneration events from a hydraulic hybrid heavy-duty commercial vehicle and two sports utility vehicles (SUVs). During DPF regeneration events (Figure 1): (i) SPN is increased by more than two orders of magnitude for the heavy commercial vehicle and exceeds legislated Euro IV SPN limits by approximately one order of magnitude, (ii) SPN is increased by approximately one order of magnitude for the diesel SUVs; however, the Euro 5 SPN limit is not exceeded. Activation of the hydraulic energy recovery system was successful in reducing SPN by 40% (on average) across three replicate tests.

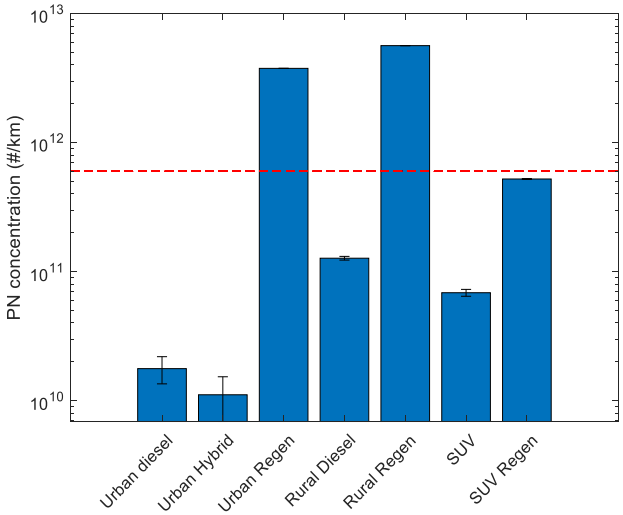

Figure 1: Real driving PN emission rates (#/km) for a hydraulic hybrid heavy commercial vehicle and two Euro 5 SUVs. The Euro PN limit (6×10^{11} #/km) is shown (---). Uncertainties are standard errors of the mean for replicate testing.

At present, the only mechanism to trigger laboratory testing of on-road vehicles in Australia is based on public observation of visible smoke emitted by vehicles and active reporting to the authorities. We recommend that more extensive testing of DPF performance is required in the Australian context to assess their in-use performance that will inform effective SPN control measures and progress towards cleaner mobility solutions.

[1] Smit, R., M. Awadallah, S. Bagheri and N. C. Surawski (2022). 'Real-world emission factors for SUVs using on-board emission testing and geo-computation.' Transportation Research Part D: Transport and Environment 107, Article Number: 103286. doi: https://10.1016/j.trd.2022.103286

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