Assessment of pollutant emissions including ultrafine particles down to 10nm of high-performance motorcycles – lab and real-world evaluation using advanced PEMS technology

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This work presents a comprehensive assessment of pollutant emissions, including ultrafine particles down to 10nm, emitted by high-performance motorcycles. Despite the absence of specific particulate number limits for motorcycles in the European Union, previous in-lab measurements have revealed significant particle number emissions from two-wheelers, with an average particle size of approximately 10-50nm. Notably, a considerable proportion of these particles fall below the current particulate number counting cut-off specified for passenger cars (D50 @23nm).
These investigations further pronounce the presence of high particle formation rates during acceleration, attributable to fuel enrichments, even within the WMTC, the homologation test cycle for motorcycles, which traditionally require moderate power demands. In anticipation of even higher particulate emissions under real-world driving conditions, an evaluation of a lightweight portable emission measurement system (PEMS) is presented. The verification process utilizes a two-wheeler chassis dynamometer with laboratory measurement technology using an RDC, which has a significantly higher power requirement, thereby better reflecting real-world driving conditions than the WMTC.
This evaluation incorporates updated analysers and conditioning systems tailored for assessing solid particle number emissions as small as 10nm. To achieve this, the methodology incorporates calibrated Condensation Particle Counters (CPCs) alongside catalytic strippers in both laboratory and PEMS setups, ensuring accurate quantification of ultrafine solid particles.
Moreover, this paper provides insights into the real-world emissions of a high-performance motorcycle, with particular emphasis on highly dynamic driving scenarios reaching speeds of up to 160km/h. The PEMS utilized in this study is meticulously described, including its design and mounting configuration on the motorcycle, facilitating a detailed understanding of the measurement setup.
In summary, the findings shed light on the previously overlooked aspect of ultrafine particle emissions from motorcycles and highlight the importance of advanced PEMS technology in accurately quantifying these emissions also under real-world conditions.