Integrated PN measurement system performance and VPR requirements

Erkka Saukko, Kauko Janka

Pegasor Oy (Hatanpään valtatie 32C, Tampere, Finland)
erkka.saukko@pegasor.fi

Volatile particle removal (VPR) is a requirement for certified particle number (PN) emission measurement from the exhaust sample measurements to allow reproducible measurement of the exhaust particle concentration. The volatile particles are particles as well as the soot, but since they are in vapour phase when passing through the exhaust aftertreatment system and more importantly, can transform between different phases outside of vehicle, even in the measurement system.

Vehicle type approval requirements (PMP) effectively specify a method for volatile particle removal instead of performance to achieve a required result [1]. This requirement is based on fully specifying the measurement system to avoid reproducibility issues with different vendors. In the case of periodic technical inspection (PTI) the requirements in several countries specify performance for the devices instead of a method [2]. This fundamental difference in the requirements has opened the field on PN measurement to many different technologies resulting in constant optimization and continuous improvement.

We present a solution that passes the tests for VPR performance at much lower temperature than PMP requirement. The active part of the instrument is kept at high temperature and the construction is integrated, combining the VPR and sensing unit. This allows the volatile particle removal to be achieved at significantly lower temperature than in the vehicle emission type approval specification. This simplicity of construction and measurement operation allows for more robust and economical construction and operation than previously possible.

We present results from PN measurements from vehicle emissions as well as validation against tetracontane challenge particles, using Pegasor G2 sensor developed and certified for PN measurement for particle size range from 23-200nm.

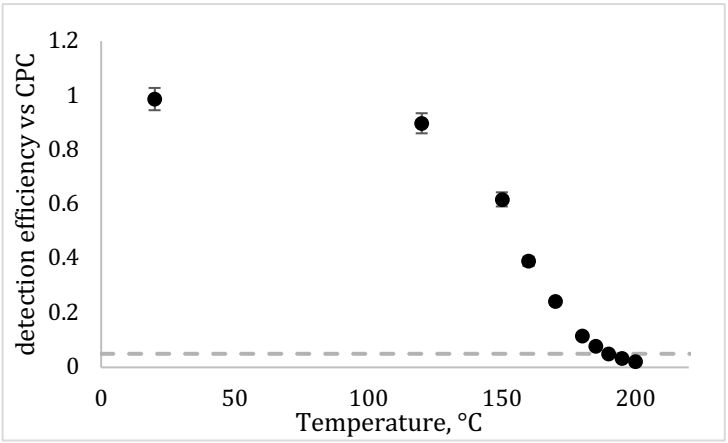

Figure 1 Pegasor G2 detection efficiency for 116000 #/cc, 30 nm tetracontane particles versus VPR temperature. Dashed line shows regulatory requirement.

The VPR has an essential role in vehicle exhaust PN measurements, but when overspecified, especially method-driven requirements cause additional costs, safety issues, error sources and complexity compared to technology neutral, performance-based requirements. Pegasor G2 has certified, unique approach to VPR that brings benefits to end user, while fully committing to the measurement quality and requirements.

Acknowledgement
VPR Tetracontane tests measured at METAS by Kevin Auderset

[1] AMENDMENTS TO UNECE REGULATIONS, REGULATION No. 83, ECE/TRANS/WP.29/GRPE/2007/8/Rev.1, 2007
[2] EU: Periodic Technical Inspections (PTI) https://dieselnet.com/standards/eu/pti.php