A Silver Particle Generator for PN-PEMS Calibration and Validation

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There currently exist few commercial options for the consistent and reliable generation of solid aerosol particles in the 1-50 nm size range. These options include spark generators, tube furnaces, electrosprays, and gas burners utilising diffusion flames. Thus, there is a need for additional options for a simple-to-use, particle generator capable of producing sufficiently high concentrations of small, solid aerosol particles. Uses for such a device include the calibration of condensation particle counters, measuring filtration efficiencies, and the calibration and complex measurements made possible with specialist aerosol equipment, including cutting-edge emissions measurements such as PN-PEMS. The efficiency of PN-PEMS is checked with monodisperse aerosol, and linearity is checked usually with polydisperse aerosol in order to reach high concentration levels [1]. Silver particles can be used as a proxy for soot particles and given their single elemental composition this approach may offer reduced uncertainties to other generation techniques. Tube furnaces can be used to generate silver nanoparticles for calibrated CPCs, but aside from the size, cost, and inconvenience of a tube furnace, it is challenging to generate repeatable concentrations and size distributions from a typical tube furnace.

Here we present the characterisation of a new Silver Particle Generator, capable of producing sufficiently high concentrations of particles in the 1 - 50 nm size range. Data presented include CPC calibration, and repeatability measurements across its operational range. This novel Silver Particle Generator solves several key aspects associated with the production of metallic nanoparticle aerosols. By fixing the location and surface of metal exposed to the supplied gas stream, the stability of the nanoparticles produced is greatly enhanced compared to a typical tube furnace. Further, day-to-day variability is greatly reduced, in both concentration and size domains. The SPG has been finely tuned to generate a repeatable solid aerosol size distribution for each set point, and thermal cycling has been optimised, such that the device is operational from standby in under 10 minutes. Importantly, our novel and patented design allows for a more compact device that allows for lower energy consumption.

[1] Barouch Giechaskiel, Real Driving Emissions (ROE): Particle Number (PN) Portable Measurement Systems (PEMS) calibration, EUR 29036 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978·92-79-77482-9, doi: 10.2760/553725, JRC110424