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A CONTINUOUS, LAMINAR FLOW, WATER-BASED CONDENSATION PARTICLE COUNTER. Susanne V. Hering and Mark R. Stolzenburg, Aerosol Dynamics Inc., Frederick R. Quant and Derek Oberreit, Quant Technologies, LLC.

Airborne particle number concentrations are measured using condensation particle counters (CPCs) that enlarge particles through condensation so they may be detected by optical means. Most common are continuous, laminar-flow CPCs that use an alcohol, such as butanol, as the condensing vapor. These thermally diffusive CPCs rely on the low diffusivity of the condensing alcohol vapor to produce the necessary supersaturation within the condenser region. They do not work well with water because water vapor diffuses too quickly.

Reported here is a new, laminar-flow, water-based condensation particle counter (WCPC). The WCPC uses a novel "growth tube" technology that explicitly takes into account the high diffusivity of water vapor (patent pending). In contrast to the traditional instrument, the condensing region of the WCPC employs warm, wetted walls. Because the mass diffusivity of water vapor exceeds the thermal diffusivity of air, the flux of water vapor to the centerline is faster than the heat flux from the walls. This difference produces a maximum supersaturation along the centerline of the flow. Theoretical modeling indicates that cutpoints as small as 2 nm could be achieved with this approach.

A pair of prototype instruments, operating at a sample flow of 1 L/min, have been constructed and tested. Comparison is made to a butanol-based CPC (TSI 3010) for monodisperse fractions of ambient aerosol, and for laboratory-generated monodisperse aerosols of dioctyl sebacate, ammonium sulfate, and dioctyl sebacate mixed with 0.2% ammonium sulfate. Above 30 nm the data are strongly correlated (R^2>0.99) with a slope=1.0 for each of these four aerosol types. Below 20 nm the WCPC is more efficient than the TSI 3010 for ambient aerosol, for ammonium sulfate and for dioctyl sebacate mixed with 0.2% ammonium sulfate, but less efficient for the pure organic, dioctyl sebacate. The WCPC response time is of the order of 1 s.