

A High-Efficiency Condensation Growth Sampler for Collecting Concentrated Aerosol Particles on a Solid Substrate and in Liquids

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Aerosol particle samples are collected with high efficiency using a moderated, water-condensation growth tube and bounce-less soft jet impactor. Particles are collected on a dry solid substrate or into a small liquid vial. The particle samples are inherently pre-concentrated allowing small volume extraction with improved detection/quantification sensitivity using on-line or off-line chemical analysis. The core technology uses a patented, three-stage, moderated laminar-flow condensation method to grow airborne particles to $\sim 3\mu\text{m}$ droplets at moderate temperatures. The sample stream enters a cool wet-walled section to pre-condition the aerosol temperature and relative humidity, followed by a warm activation region that increases the relative humidity to values above 140%, thereby initiating condensational growth of particles. The 50% activation size is $\sim 5\text{-}8\text{nm}$ depending on particle chemistry. A cool, moderating third stage follows allowing droplet growth to continue while reducing the exit flow temperature and water vapor content to below ambient conditions. Droplets may be collected via impaction into a small volume of liquid, or on a solid substrate. To characterize the chemical composition of ambient particles with time-resolution of minutes to hours, the droplet-encapsulated particles are deposited as 1-mm, dry “spots” in a 33-well collection disk. Each sample-containing well is 5.6mm in diameter and can hold up to $80\mu\text{L}$ of extraction solvent. The collection disk is ‘ready to analyze’. Upon return to the laboratory, the collection disk is placed in an autosampler for automated solvent addition, mixing, and injection into a chemical analyzer (e.g. IC or HPLC). This presentation shows performance validation data for a new commercial version of the collector.

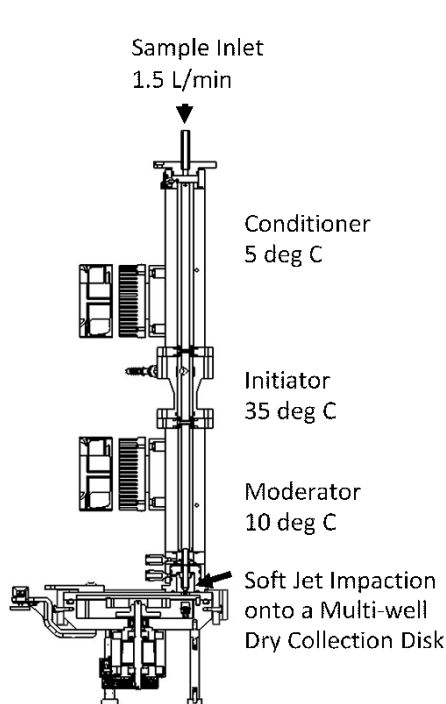


Figure 1. Schematic of the moderated, three-stage condensation growth particle collector.

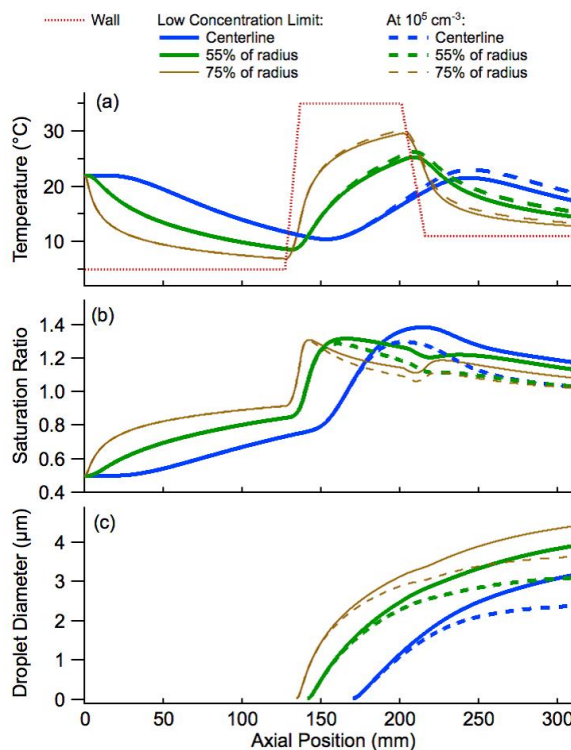


Figure 2. Temperature, saturation ratio, and droplet size in the moderated method (Hering *et al*, 2014).