March 21, 2022

Tuning sampling and analysis strategies for UFP: Laboratory and field tests with selected PAH-marker components

E. Eckenberger[1], S. Kraft[1], K. Rautenberg[1], A. Das[2], D. Shukla[2,3], N. Gawlitta[2], J. Orasche[2], J. Schnelle-Kreis[2], M. Sklorz[2], R. Zimmermann[2,3], A.C. Nölscher[1]

[1] Bayreuth Center of Ecology and Environmental Engineering (BayCEER), University Bayreuth, Germany

[2] Comprehensive Molecular Analytics (CMA), Helmholtz Center Munich (HMGU), Germany

[3] Analytical Chemistry, University Rostock, Germany

Polycyclic aromatic hydrocarbons (PAHs) and their derivates bound to the ultrafine fraction of airborne particulate matter (PM) are suspected to expose a potential risk for human and environmental health. Additionally, ultrafine particles (UFPs) exhibit a large surface area where PAHs can influence their atmospheric transport, lifetime and ageing. For risk assessment we need to learn about the origin, behavior, mobility, fate, and toxicity of UFPs containing PAHs. But attempts to analyze their chemical composition in the atmosphere are still rare. Considering the low mass, partial volatility and dynamic character of UFPs, it is a great challenge to separate, collect and analyze them in the atmosphere.

Impactors are useful tools to separate and collect environmental particles from the air with the aim of analyzing their chemical composition. After careful physical characterization of different types of cascade impactors regarding their cut-off characteristic, pressure drop and sampling volume, we report on size-fractionated UFP sampling during the winter season in urban and rural areas in Bavaria, Germany. Different commonly applied impactors were operated simultaneously for different time-periods, partly after their optimization for the separation and collection of the ultrafine fraction. The chemical composition of the collected UFPs was examined off-line with chromatographic analytical methods. For testing our methods, we focused on the following specific marker components of PAHs: Phenanthrene, 2-Hydroxyphenanthrene, Pyrene, 1-Hydroxypyrene, Benzo(a)pyrene and 9,10-Phenanthrenequinone. Due to the low mass of UFPs and the variety of polarity of the chosen marker components, we developed suitable extraction methods adapted to the different analytical requirements. Our aims are, first to draw comparisons between the performance of the impactors, second to investigate different analytical methods for chemical UFP analysis and finally to provide data on the spatial distribution of UFPs containing PAHs. This project is financed by the Bavarian Ministry of the Environment and Consumer Protection.