TXRF

T-AERO

A complete solution for sampling airborne particulate matter

Air quality and health risks

Air pollution has significant impacts on the health of people worldwide, especially in urban areas, and can shorten life expectancy. Measures to protect the population from air pollution help to prevent the rising healthcare costs and other negative economic impacts associated with poor air quality [1].

The EU enforces air quality regulations by current metrics PM10 and PM2.5 (particulate matter < 10 µm or 2.5 µm, respectively), which considers the pollution of fine dust particles only.

For emissions of heavy metals into the air, which are mainly caused by the manufacturing industry, current regulations only contain "target limits", which may be due to inadequate analytical methods. Standard methods such as ICP require long sampling times and complex sample preparation, which rule out measurements in real time. Recently, the successful application of TXRF in the field with sampling times of only one hour has been demonstrated [2].

T-AERO is Bruker's innovative approach for sampling particles in the air. It is based on a new cascade impactor (image above) with an array of classification nozzles optimized for Total reflection X-ray Fluorescence (TXRF) analysis of the collected particles [3]. The T-AERO impactor is equipped with four stages for fractioning air particles directly onto TXRF carriers (images below).

T-AERO benefits

- Direct sampling on TXRF carriers for subsequent elemental analysis without further preparation steps
- No filters, no digestion steps required
- Total sampling and time to results less than one hour
- Detection limits for toxic elements in the pg/m³ range
- Ready for immediate use on site

First on-site measurement campaigns

The new MI-TRAP initiative (MItigating TRansport-related Air Pollution in Europe, https://mitrap-project.eu/) within the framework of Horizon Europe aims to develop innovative solutions to the challenges of air quality in cities. One objective is to enable dynamic traffic, port, airport, and rail management through real-time air quality monitoring. The T-AERO system was recently tested in Florence, Italy, as part of the MI-TRAP project in an initial campaign.

On-site measurements with a portable TXRF spectrometer enabled the detection of elements such as Cr, Cu, Ni, As and Pb in all runs. Figure 1 shows an example of the development of the mass content of the elements Ni and Pb in the different size fractions during the four-day campaign with 14 sampling runs. Even with a short sampling time of one hour, detection limits in the pg/m³ range were achieved.

Comparative measurements are currently being carried out using reference methods to validate the T-AERO concept in conjunction with TXRF.

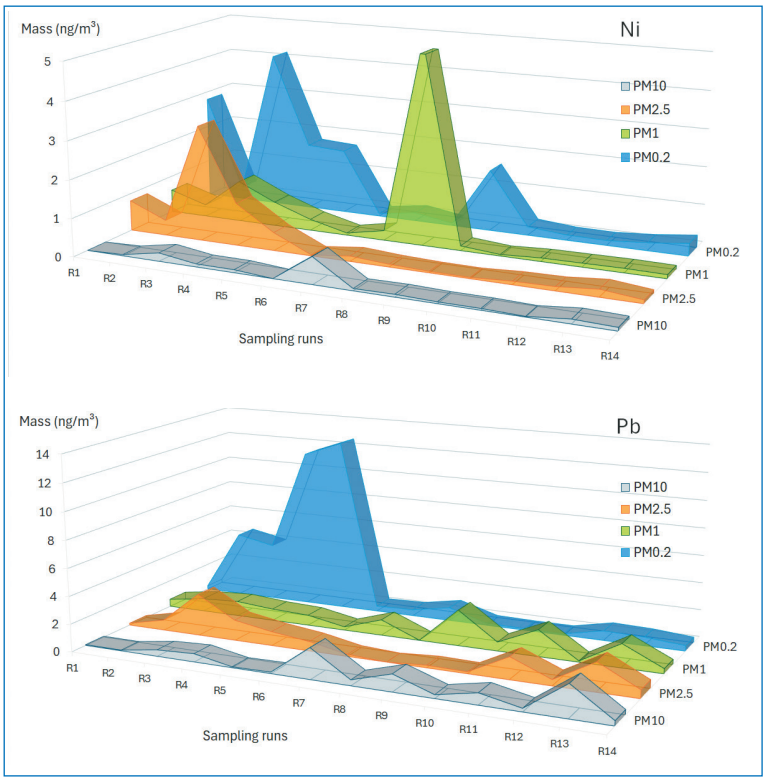

Figure 1 Mass content of Ni and Pb in PM fractions during a 4-day measurement campaign.

T-AERO package content	
Impactor	4-stage (PM10, PM2.5, PM1, PM0.15)
Pump	Membrane pump, fixed flow rate 5 slm
Microcontroller	Touchscreen, pump control, Start/Stop, display of accumulated time and air volume
Accessories	Flow sensor, filter unit, fittings
Transport box	Pelicase™ (ATA certified), rugged case with wheels and handles for safe transport
Additional features	Quantification method, calibration standard

Literature

[1] Europe's air quality status 2024, doi.org/10.2800/5970
[2] Seeger, S., et al., Atmosphere 2021 (12), 309, doi.org/10.3390/atmos12030309
[3] Crazzolara, C. and Held, A. B., Atmos. Meas. Tech., 17, 2183-2194, 2024 doi.org/10.5194/amt-17-2183-2024

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