

CONTINUOUS MONITORING OF BTEX AND PAHs USING AUTOMATIC THERMAL DESORPTION-GAS CHROMATOGRAPHY

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Polycyclic Aromatic Hydrocarbons (PAHs) are a group of over 100 different chemicals that are known to be formed typically during incomplete combustion of organic matter at high temperature. Due to their carcinogenic/mutagenic effects, 16 PAHs are currently listed as priority air pollutants. Actual analytical methods dedicated to monitor PAHs require multistep sampling preparations and are not suited for continuous monitoring. Automatic Thermal Desorption-Gas Chromatography equipped with Flame Ionization Detector (AUTO-TD-GC-FID) is the standard method for the monitoring of volatile and semi-volatile hydrocarbons. This technique allows for identifying and quantifying continuously hydrocarbons from ethane to naphthalene, including the BTEX. The main goal of this work was to implement a new and simple method for sampling and determination of BTEX and PAHs in gas and solid phase in ambient air by using thermal desorption technique followed by gas chromatography equipped with two detectors: a FID and a Mass spectrometer. A detailed study was carried out to optimize the experimental method in each of its phases, including sampling, thermal desorption, analytical separation, and detection. First, the limits of use were determined during the laboratory phase using certified cylinders for VOCs (BTEX and PAMS 58) and liquid standards for the 16 PAHs. Then the applicability of the novel methodology was tested in real environment, namely, at 200 meters from a highway analyzing BTEX and PAHs.

Naphthalene in air

Analyzer configuration: airmoVOC C6-C12

Permeation tubes

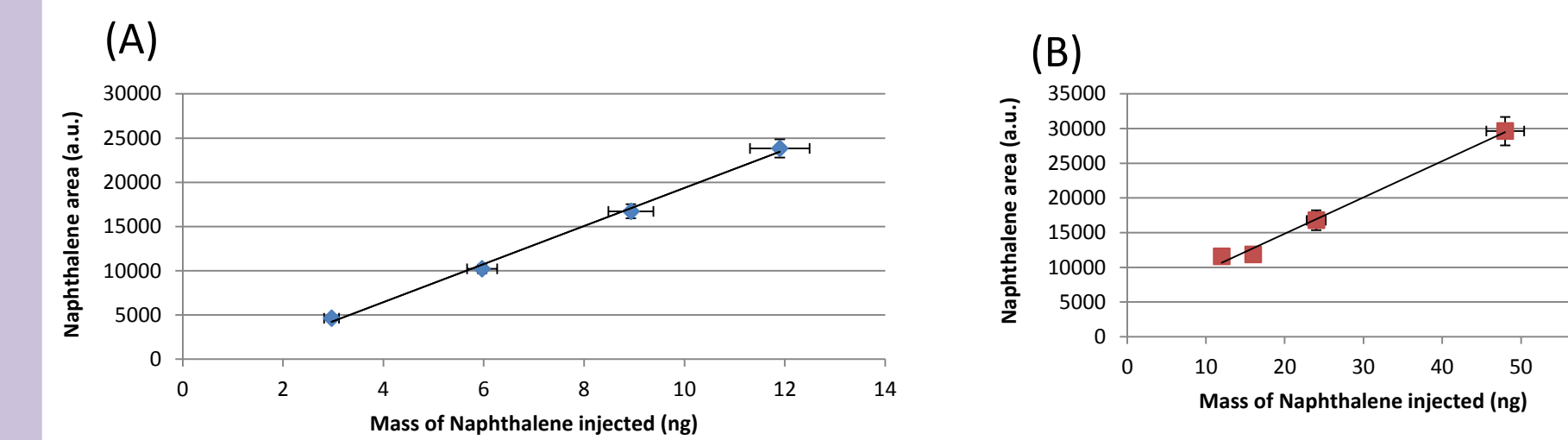
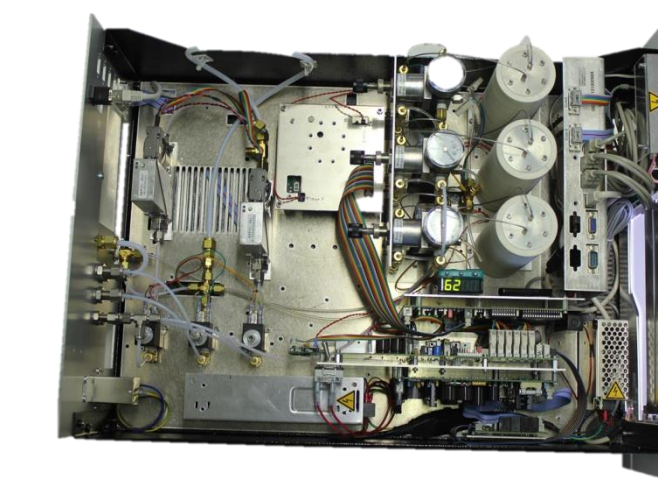
- 20 ng/min
- 60 °C

-Analytical conditions

- Sampling times
 - 300 s – 1200 s
 - At 3 ppb (naphthalene)

-Mass

- 10 to 50 ng



Calibration curve for Naphthalene changing the sampling time (A) and Naphthalene concentrations (B)

Naphthalene in water

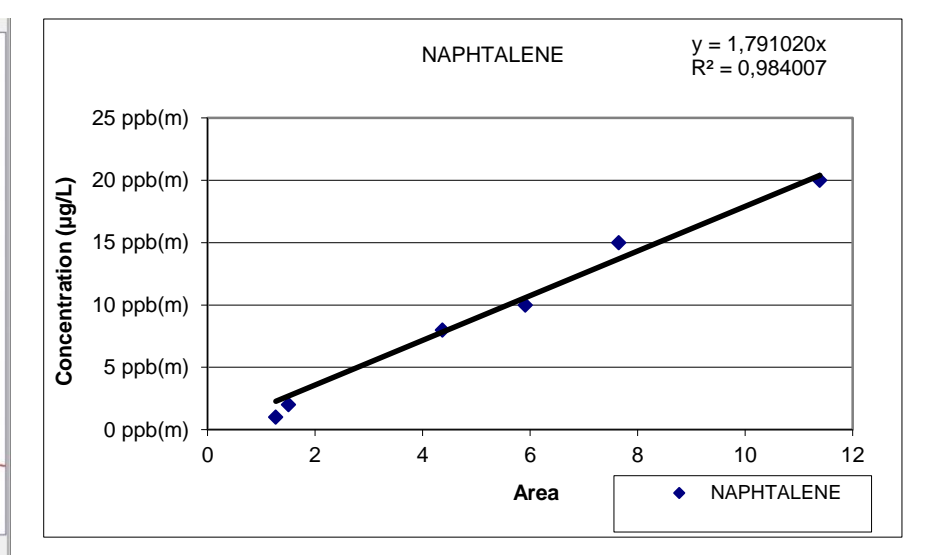
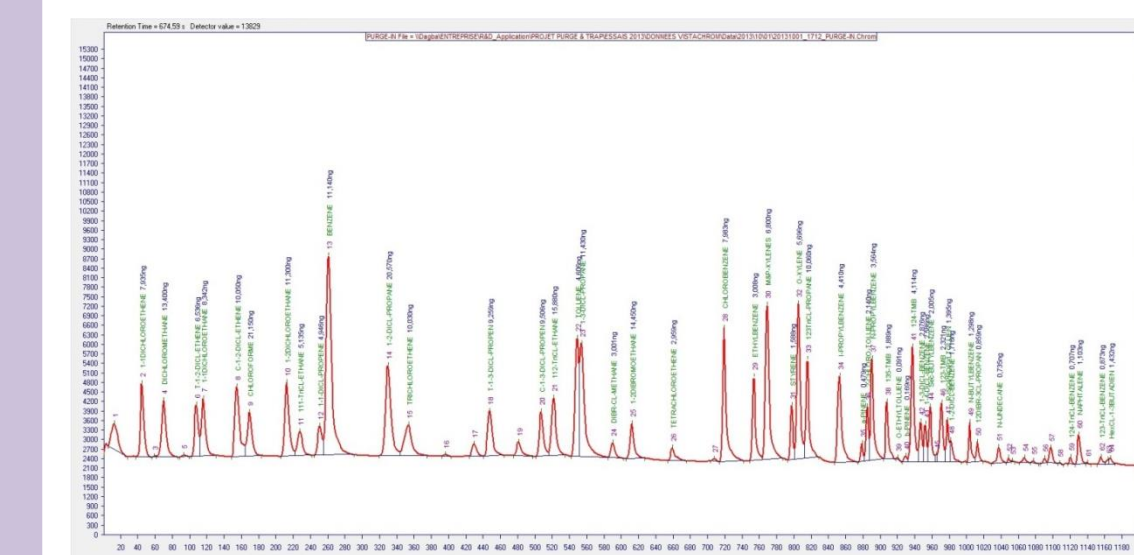
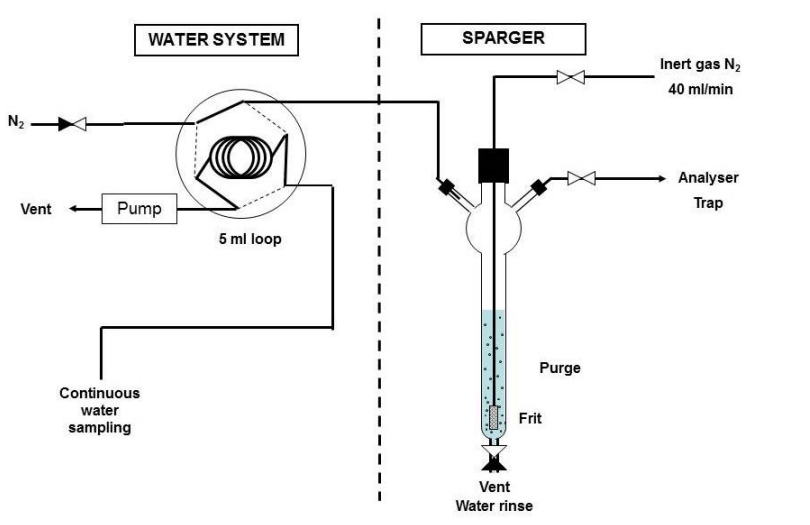
Analyzer configuration: airmoVOC C6-C12

Liquid standard

- 502.2 CAL2000 MegaMix Mixture (Restek)
- 2000 µg/L

Analytical conditions

- 2,5 – 500 µl in 5 L of water



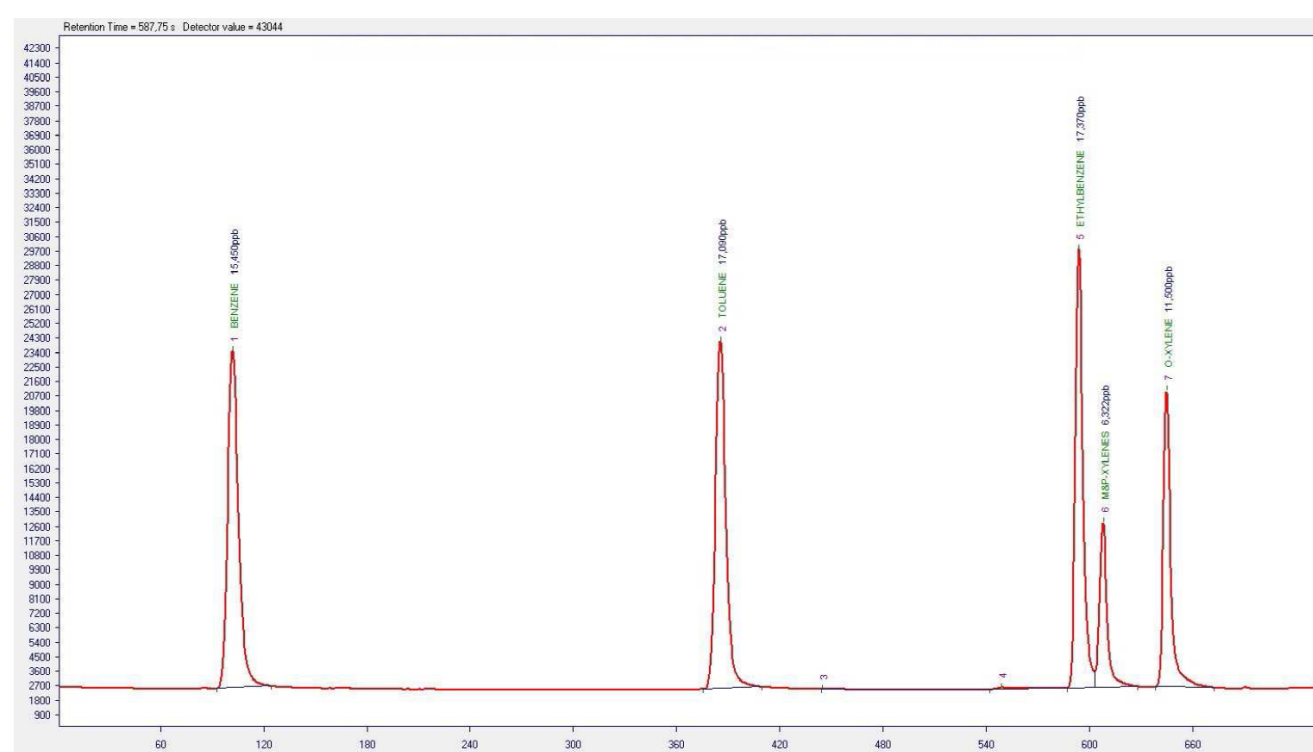
Chromatogram obtained with FID detector

Calibration curve for Naphthalene

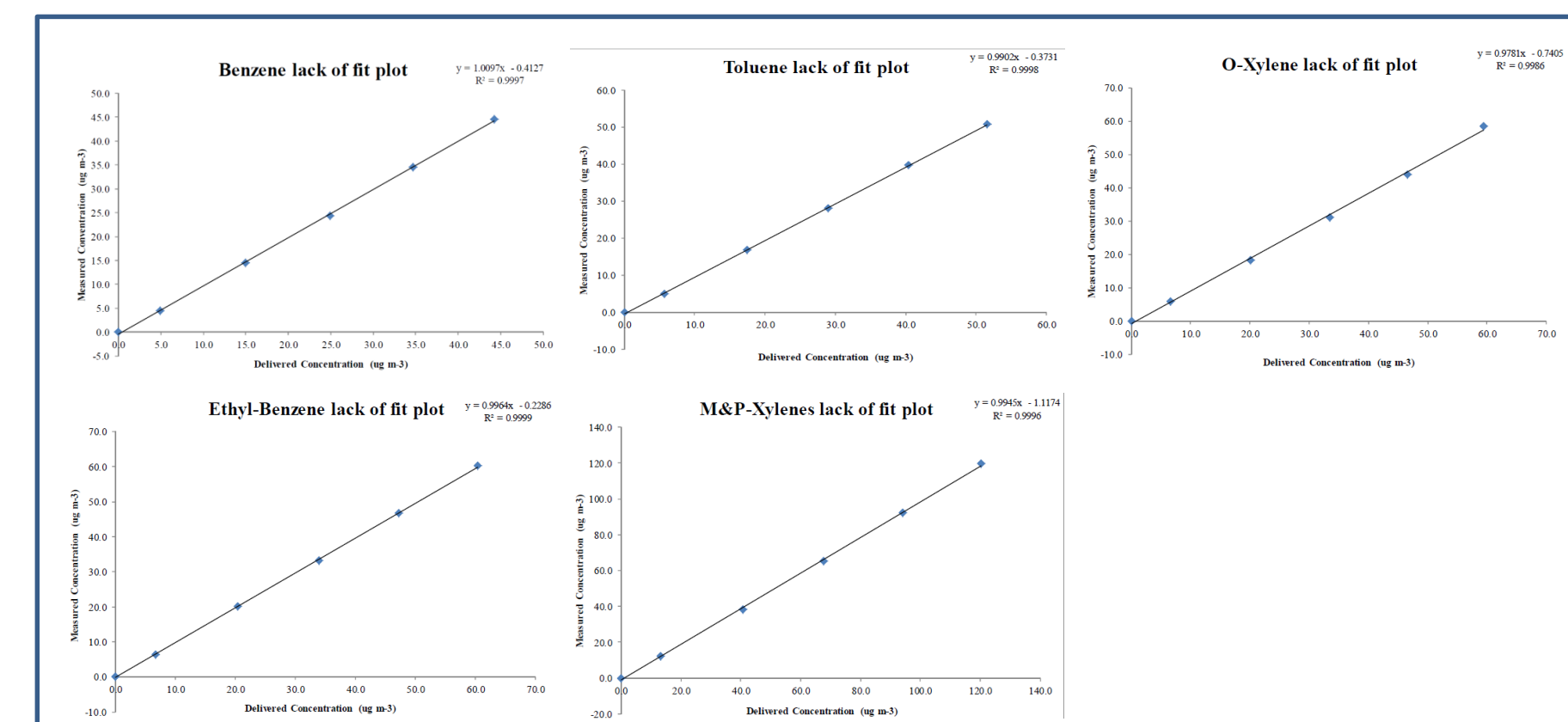
BTEX analysis

Analyzer configuration: airmoVOC C6-C12

Test carried out using NPL certified cylinders: Concentrations from 0.5 up to 45 µg/m³



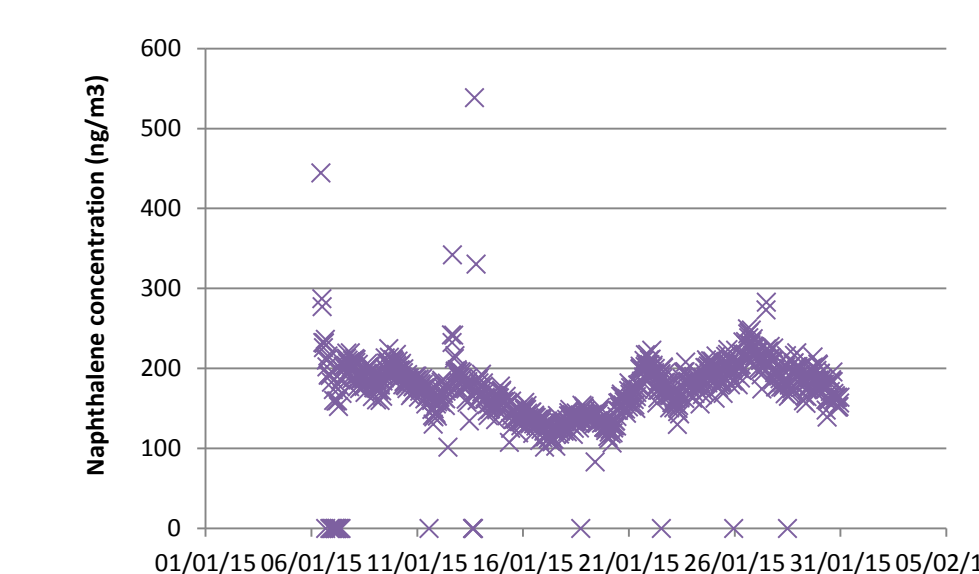
Chromatogram obtained with FID detector for BTEX sample¹



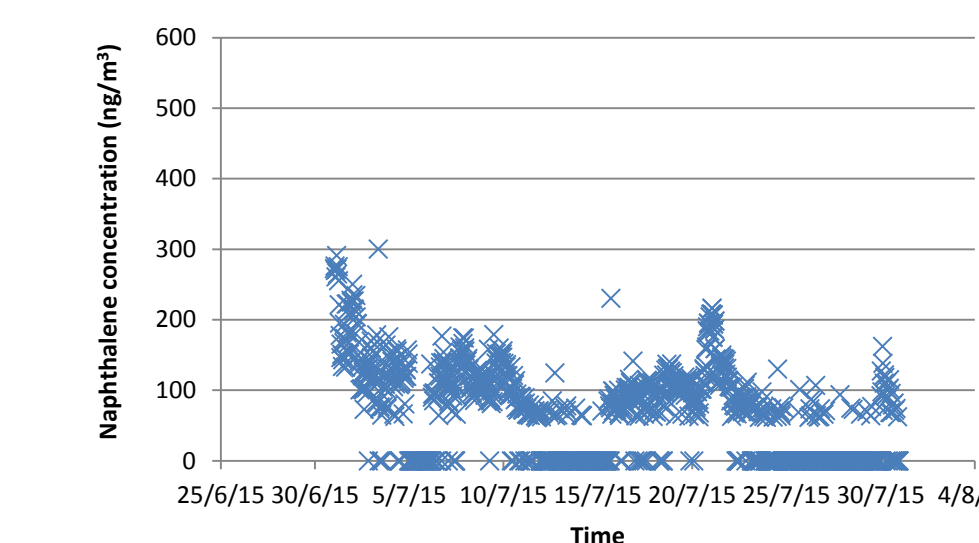
Calibration curves for Benzene, Toluene, Ethylbenzene, M&P-xylenes and O-xylenes¹

Naphthalene trends near Bordeaux

Analyzer configuration: airmoVOC C6-C12



171 ng/m³ in January 2015



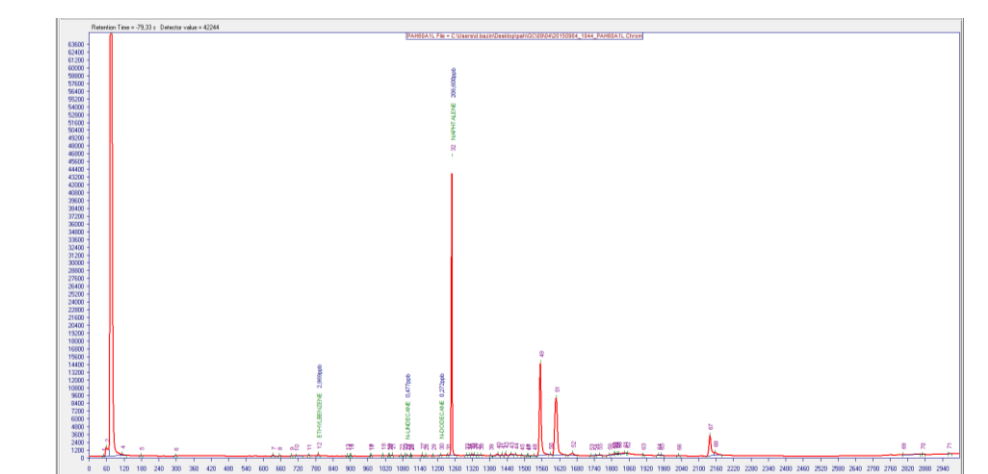
70 ng/m³ in July 2015

PAHs analysis

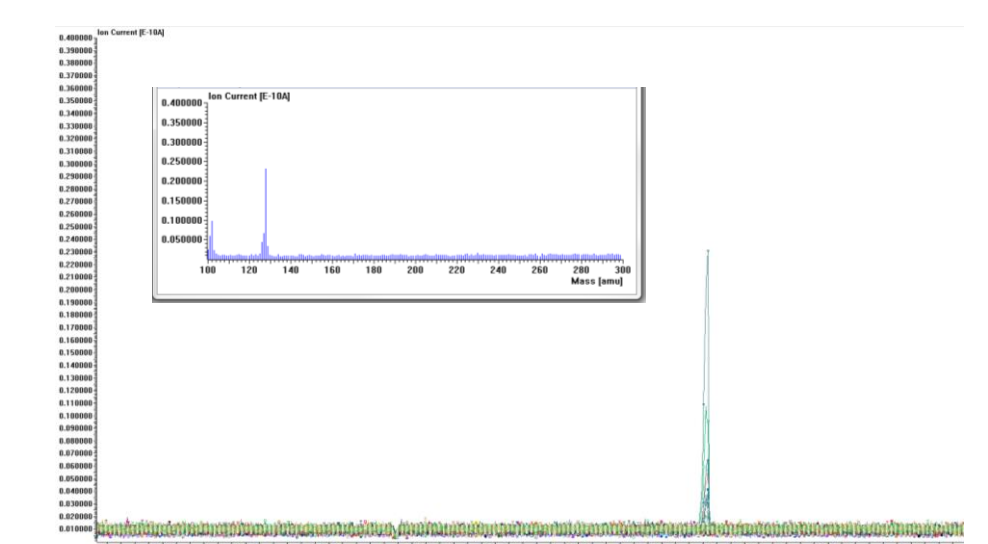
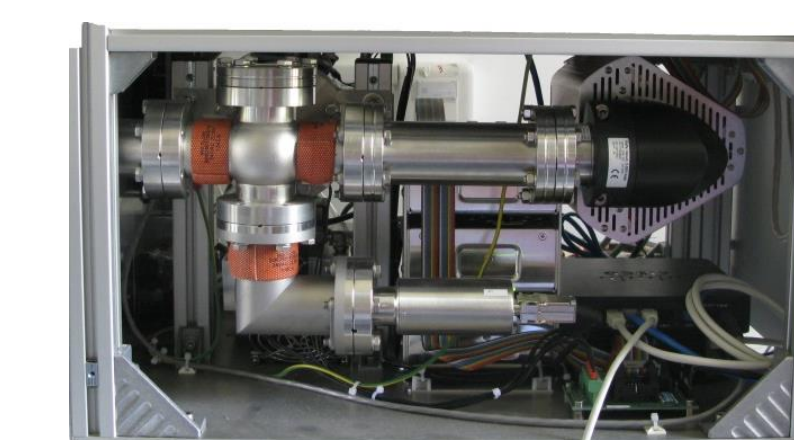
Analyzer configuration: airmo C10-C20⁺

Sample

- SV Calibration Mix #5/610 PAH Mix (Restek)
- 16 components
- 2 mg/ml in dichloromethane



Chromatogram obtained with FID detector

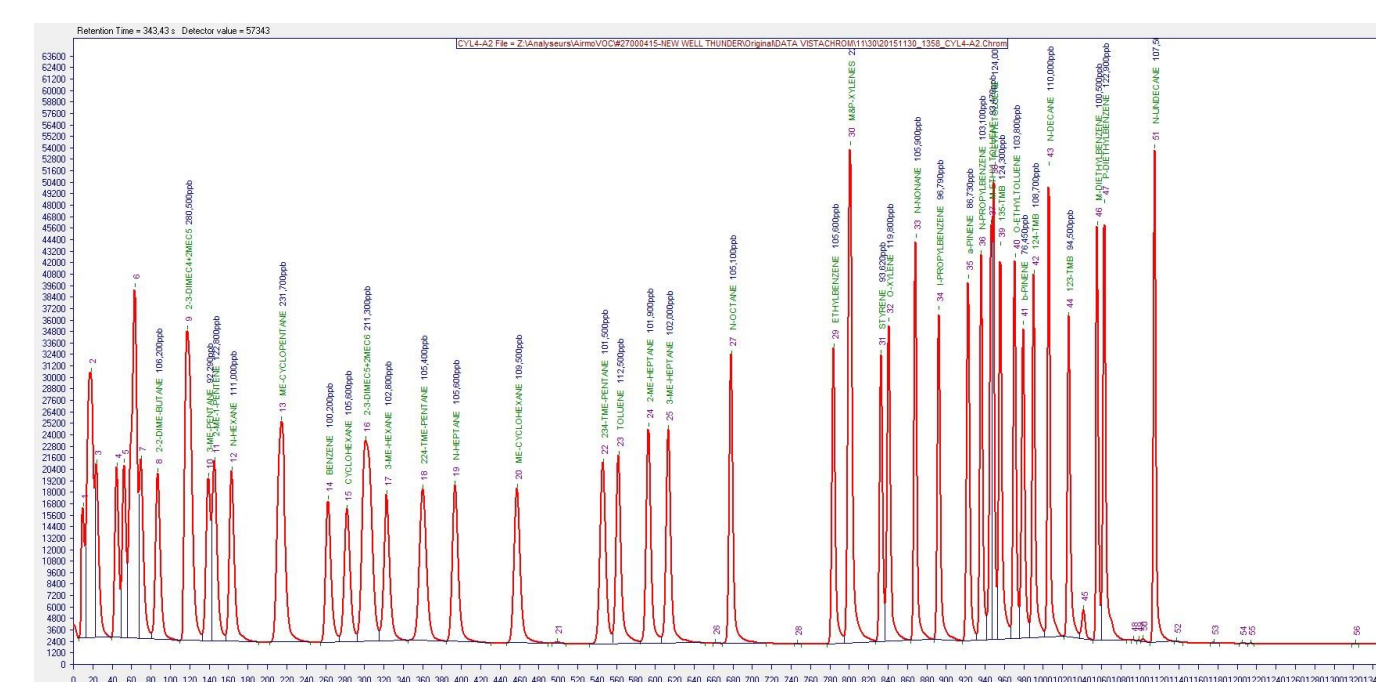


Chromatogram obtained with MS

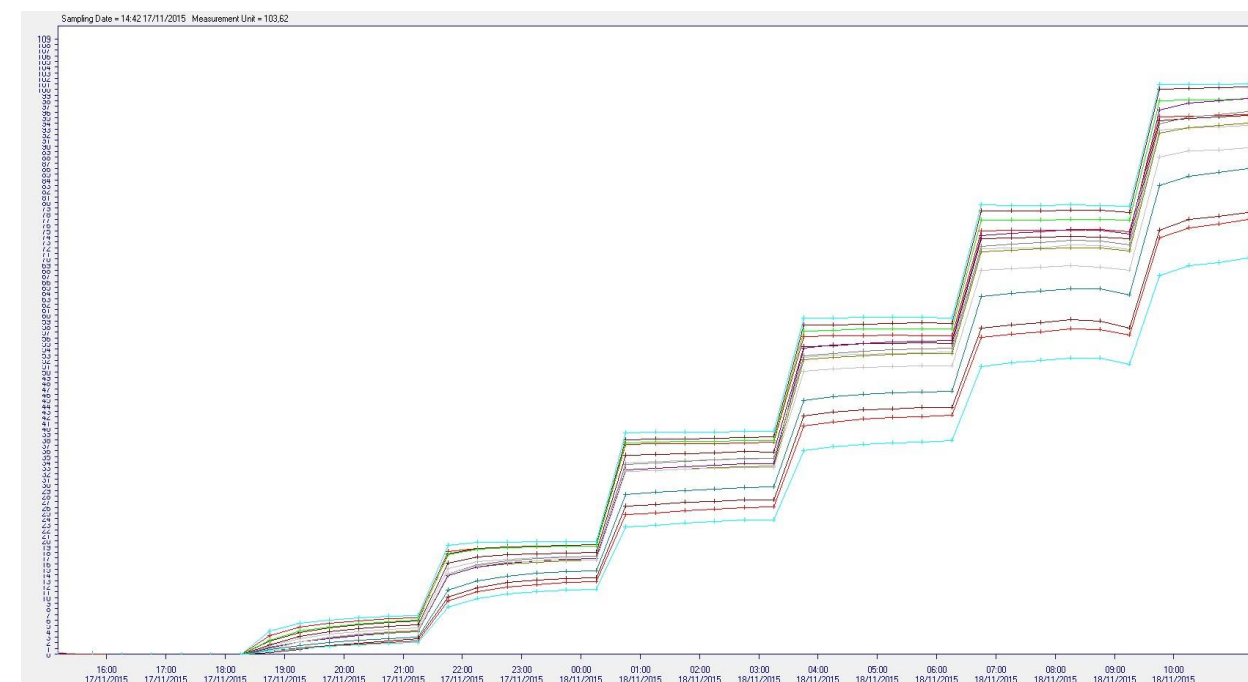
PAMS 58 analysis

Analyzer configuration: airmoVOC C6-C12

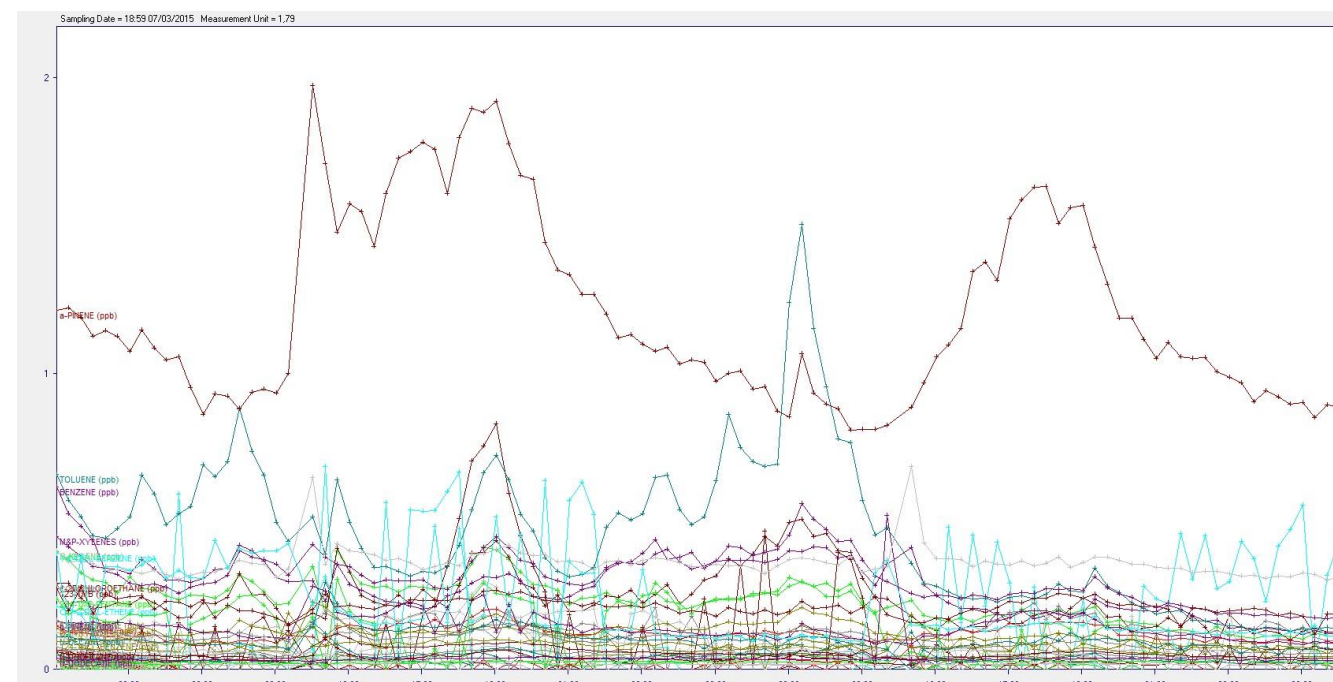
Test carried out using PAMS 58 certified cylinders: Concentrations from 0.5 up to 45 µg/m³



Chromatogram obtained with FID detector for PAMS 58



Calibration curves for PAMS 58 compounds



Concentration trends of ambient air

The results show that the airmoVOC C6-C12 is suited for the measurement of BTEX, PAMS 58 compounds and Naphthalene in air and in water. The measured concentrations of Naphthalene in ambient air were 171 and 70 ng/m³ in January and July respectively. The airmo C10-C20⁺ is capable of measuring the first PAHs. Further studies will characterize the capability of the system for the measurement of PAHs in the gas and particle phase.