Applications

> Automotive:

Real-time vehicle exhaust analysis
Monitoring of combustion engines

CAR EXHAUST ANALYSIS WITH PTR-MS

Volatile organic compounds (VOCs) and their atmospheric photochemical reaction products have lately drawn much attention due to their negative impact on the atmosphere and their dangers to public health.
PTR-MS is an analytical technique to quantify hydrocarbons and VOCs with high sensitivity and in real-time.
The capability to monitor emissions on-line is particularly useful to investigate the fast changing conditions in the combustion process and to evaluate the impact of control technologies. Especially the initial cold start phase in cars, which is responsible for a large fraction of emitted compounds, as well as hard acceleration phases, require a real-time analysis. Looking at the exhaust composition allows investigating which processes and parameters are responsible for those emissions.

MAJOR REASONS FOR USING PTR-TOFMS

▶ Emission rates change rapidly with engine operating conditions, thus a high time-resolution is important.
▶ In contrast to offline methods, on-line analysis allows the measurement of critical compounds. For example, acrolein is an unstable compound which may easily get lost in offline sampling procedure.
▶ High sensitivity and effective separation of isobaric compounds are benefits of PTR-TOFMS instruments.

PTR-MS

> High time-resolution and sensitivity
> Critical and unstable compound analysis
> Large linearity range
> Immediate results

Find out more:
www.ionicon.com/automotive

REAL-TIME ENGINES EMISSION MONITORING A SHOWCASE: THE CALIFORNIA ARB

At the California Air Resource Board (CARB), an IONICON PTR-TOF 8000 is used in studies of automotive vehicle exhaust. As a first step, Matsunaga et al. [1] validated the PTR-TOF setup against a method utilizing the gold standard, a GC-FID system (SOP MLD 102/103). The study showed that measurements of BTEX vehicle emissions with the PTR-MS agreed with GC-FID to within 15%.

DIESEL EXHAUST

In dynamometer vehicle testing, on-board diagnostics (OBD) signals are used to monitor vehicle parameters. Combining OBD data with PTR-MS measurements of a variety of emitted VOCs such as acrolein, ethanol, styrene, formaldehyde, acetone, ethylbenzene, benzene, acetaldehyde, xylene, trimethylbenzene, 1,3-butadiene, toluene, and naphthalene makes correlation studies possible.

GASOLINE/PETROL EXHAUST

Matsunaga et al. [1] also studied the emissions from gasoline vehicles and found that the VOC emissions from unburned fuel are extremely high at the beginning of a cold-start drive cycle but quickly vanish as the vehicle warms up. The PTR-MS is unique with the ability to quantify multiple VOC species in real-time.

GASOLINE/PETROL AND ETHANOL BLENDS

Gasoline is often blended with ethanol, such as E10 (10% ethanol in 90% gasoline), which has economic as well as environmental considerations. Impacts of ethanol/gasoline ratio on emissions are actively studied elsewhere. For such analysis, a real-time instrument like a PTR-MS is a powerful tool for revealing the relationship between emissions and vehicle parameters.

■ Learn more here:
http://www.ionicon.com/automotive

■ Source [1]:
Matsunaga et al. (February, 2015): Motor Vehicle Exhaust Analysis with a Proton-Transfer-Reaction Mass Spectrometer (PTR-MS) – Comparison Study with Conventional Methods for BTEX and Other Toxic Air Contaminants. Poster presented at CRC Mobile Source Air Toxics Workshop, Sacramento, CA, U.S.A.

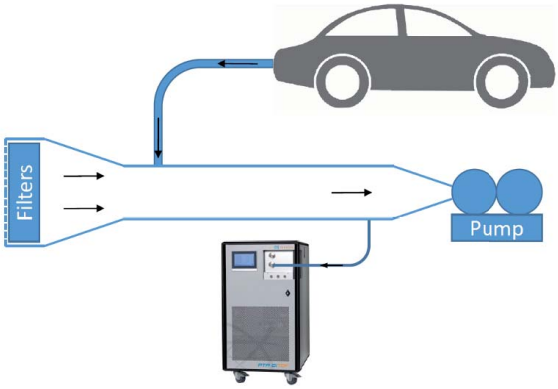

Fig. 1: Typical setup for real-time automotive exhaust monitoring with an IONICON PTR-TOFMS instrument. It includes a dilution system, such as a constant volume sampler and a heated sampling line to minimize surface interaction of semi volatile compounds.

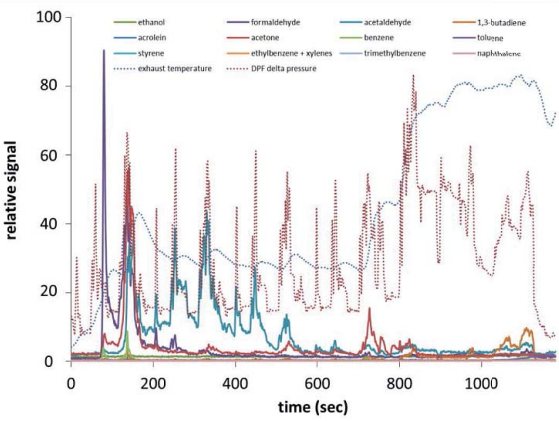

Fig. 2: Emissions from diesel vehicle exhaust.
From [1] Matsunaga et al.

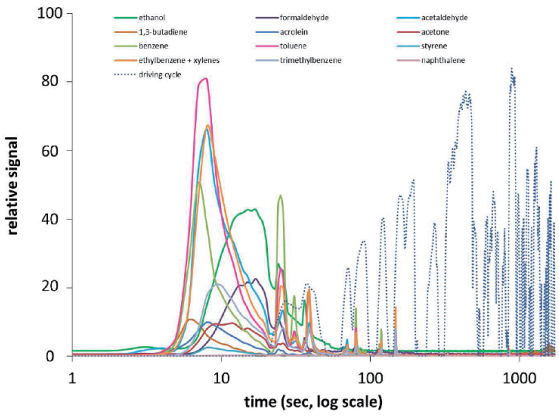

Fig. 3: Emissions from gasoline vehicle exhaust.
From [1] Matsunaga et al.