Oxidation Kinetics Determination of GDI Engine Soot by a Radio-Frequency Sensor

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Introduction:

For past EU6 exhaust gas legislations a monitoring for the exhaust after treatment seemed to be possible. Therefore it is necessary to find the best solution for the diagnose of a gasoline particulate filter.

One option to monitor is a radio-frequency system. With this system it is possible to see the complete oxidation of the soot in the particulate filter, a damage of the particulate filter and the current state of the soot load.

Preliminary Investigations:

In a first step fast soot loading settings (Lambda < 1 ; lower fuel pressure and earlier start of injection) were used to calibrate the radio-frequency-system. In a next step "normal" soot loading conditions were used, which are time consuming. The result shows that there were differences in the radio-frequency sensor response (S21) signal between "normal" and "synthetic/fast" soot loading conditions.

There are a few possible reasons for this behavior:

- Different amounts from volatile components on the soot particles
- Different primary soot structure and size
- Different soot deposit mechanism of the soot in the particulate filter → spatial distribution

For the first point the high temperature furnace was used. The results are shown in this Poster. The second and third point are under investigation and are not part of this presentation.

Methodology:


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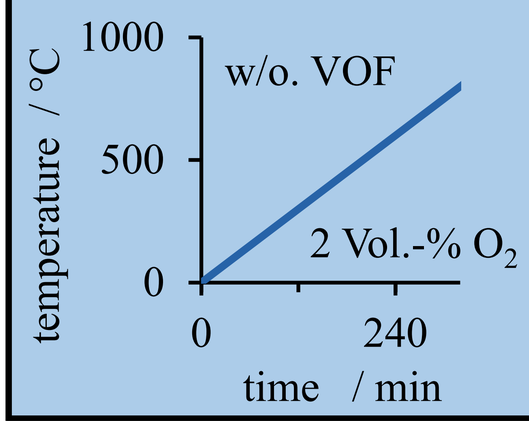
1. Application variations
2. Printex U
3. Cold start

Next steps:

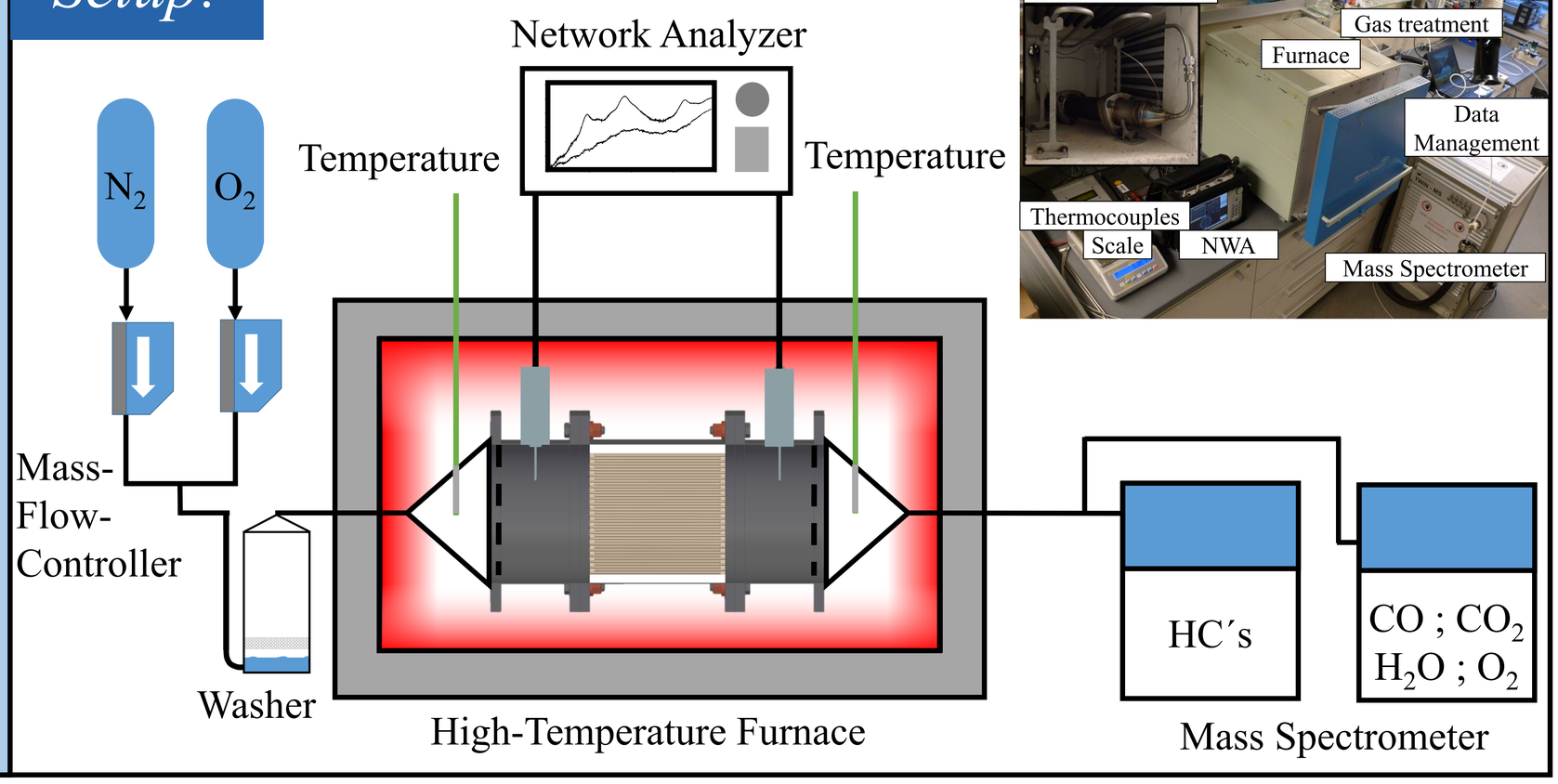
4. Different fuel qualities
5. Transient

Soot Loading with 1.8 l gasoline direct injection engine

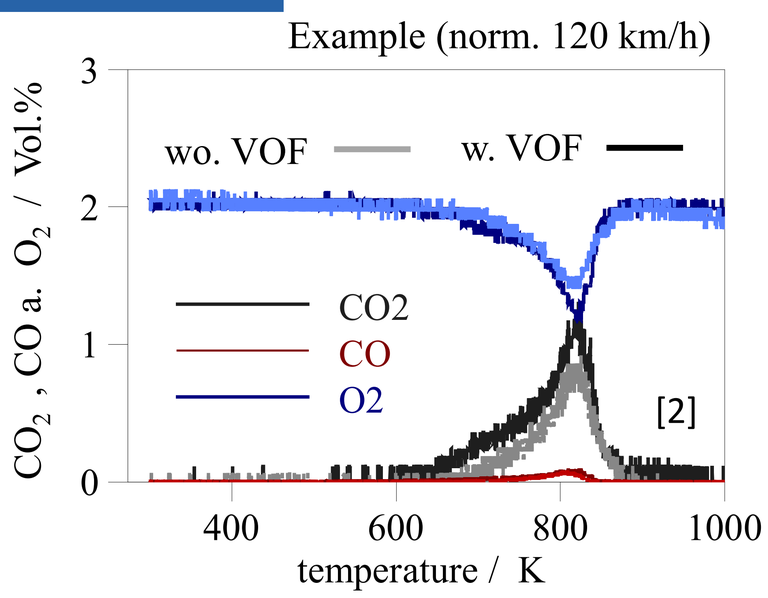
Half of the samples were heated up to 600 °C under N_2-athmosphere to clean the filter from volatile compounds

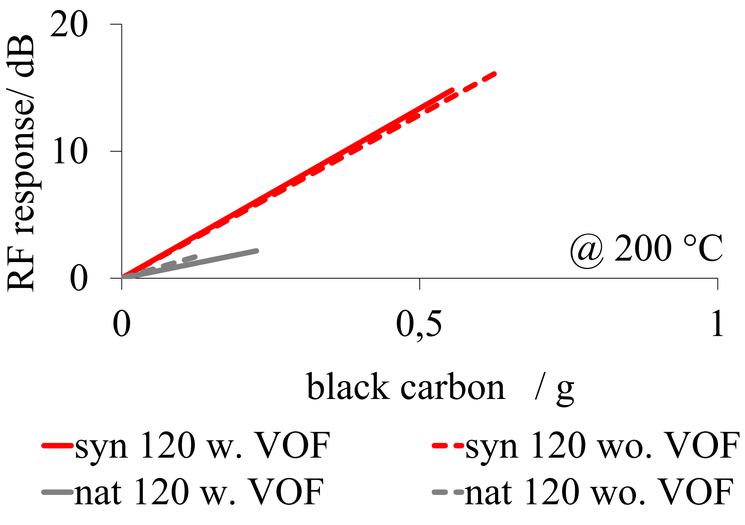


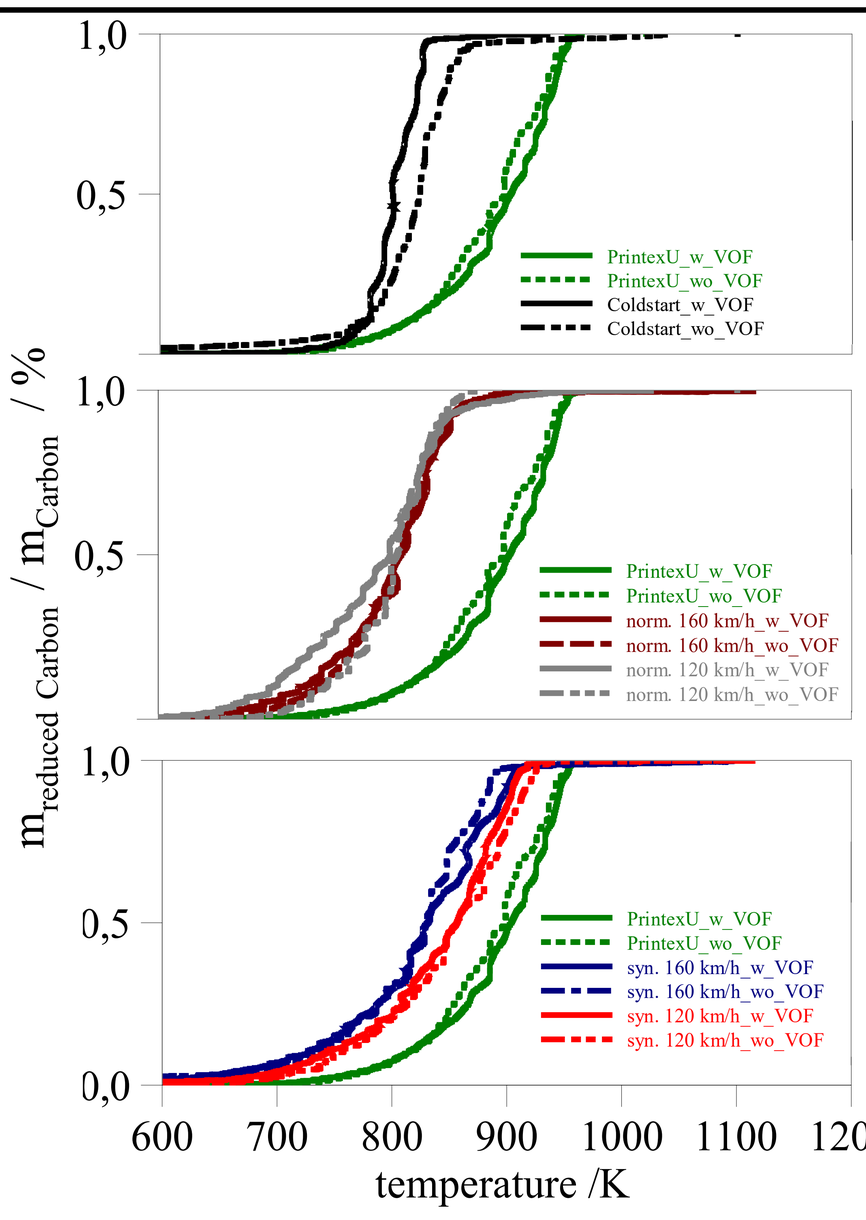
Setup:



Results:







Conclusion/Outlook:

- Influence from VOF on the signal of the radio-frequency sensor low
- Difference on the signal from the radio frequency sensor between "normal" (Lambda=1) soot loading conditions very low
- Signal from the radio-frequency system for soot loading with Printex U differs from "normal" engine soot
- **Bigger difference for "synthetic soot loading conditions"**

  Possible reasons:
  - Different primary particle size distribution
  - Storage of the soot in the particulate filter

Next steps:

- Different fuel qualities, transient soot loading

Have a look at our LAB

References:

[1] https://www.tsi.com/product-accessories/flow-splitter-(4-way)-3708

[2] Peter Schwanzer_Monitoring von Partikelfiltern für den Einsatz in Fahrzeugen mit direkt- einspritzenden Ottomotoren mit einer Radio-Frequency (RF) Antenne Jahreskolloquium des Bayerischen Wissenschaftsforum

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