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Formation of Carbon in Combustion: The Influence of Fuel Additives

Fine Particle Measurements at the EMPA

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ETH Hönggerberg, Zürich, 7.8.97

EMPA

EMPA Swiss Federal Laboratories for Materials Testing and Research

- Research institute within the Swiss Federal Institutes of Technology (ETH)
- About 770 employees
- Activities in four different fields: research and development
  offical tests and consulting
  collaboration in the preparation of standards and regulations
  participation in the enforcement of federal ordinances

- Area in Dübendorf consists of four departments

building materials

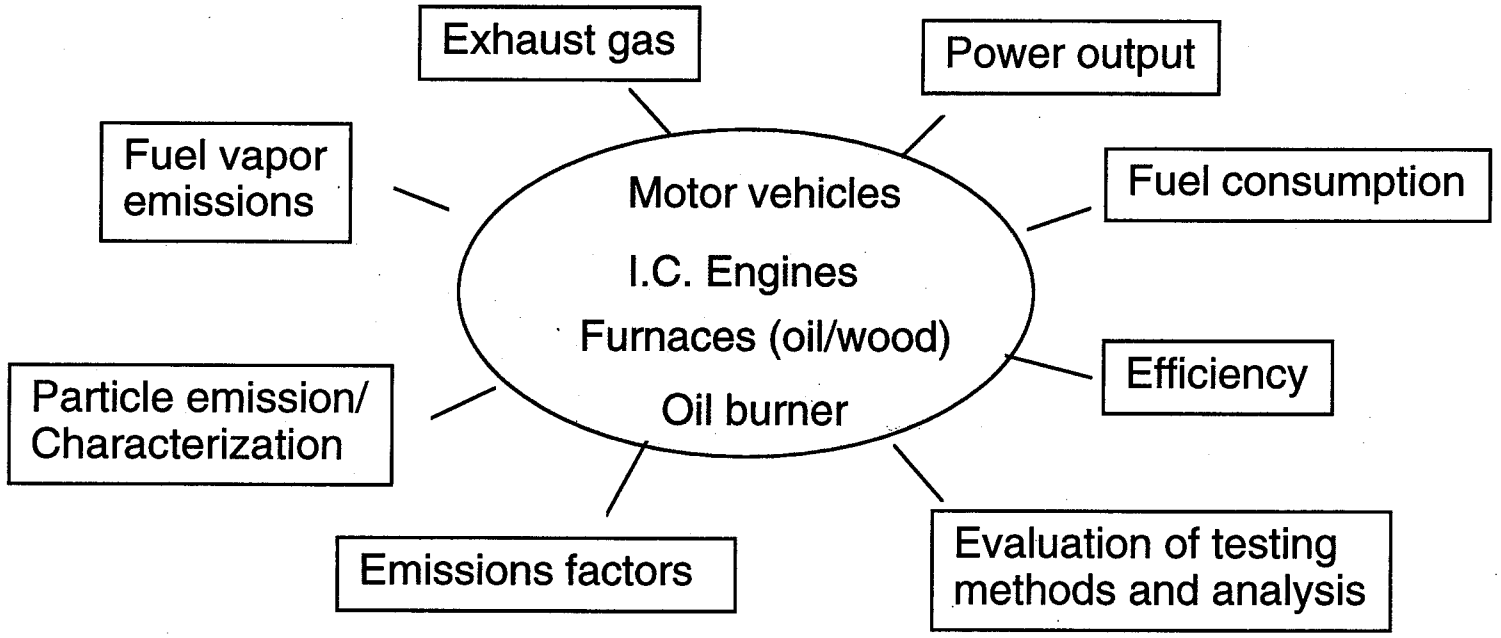
metallic & ceramic materials

chemistry

special services

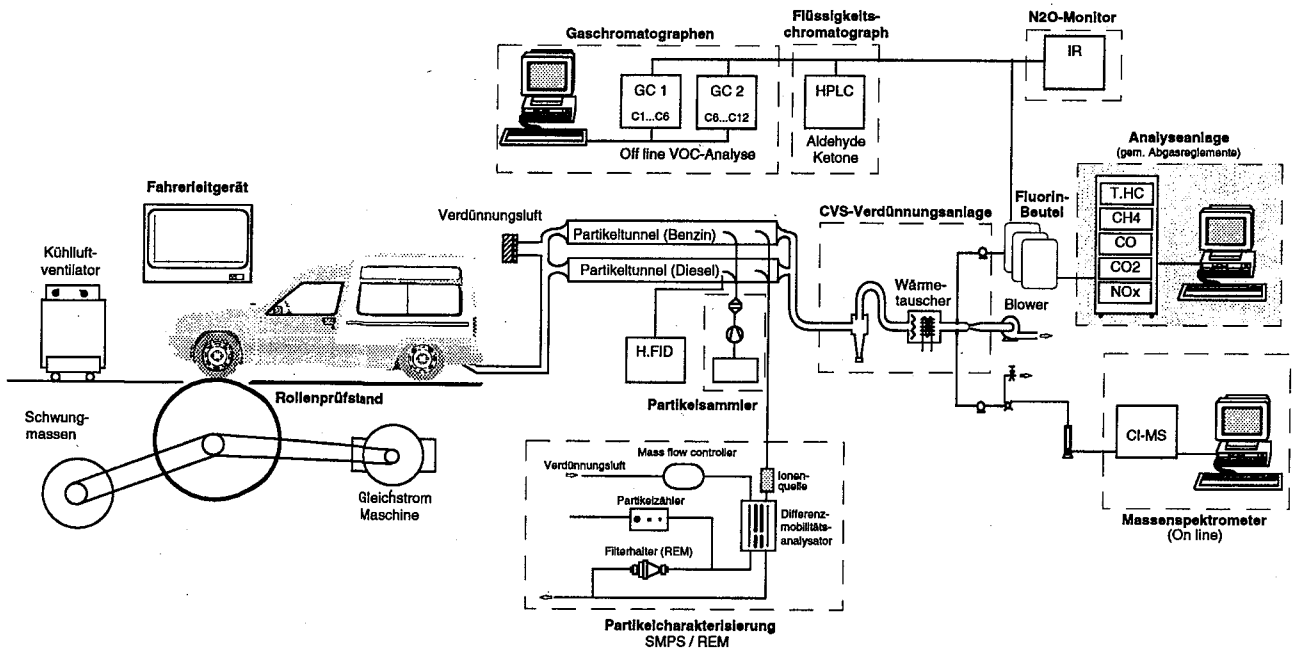
- Inorganic Analytical Chemistry/Characterization of Solids
- Analytical Chemistry of Organic Compounds
- Motor Fuels/Combustibles
- Air Pollution/Environmental Technology
- Corrosion/Surface Protection
- **I.C. Engines/Furnaces**

Activities in Section I.C. Engines/Furnaces



Project: Effect based assessment of Automotive Exhaust (WOBA)

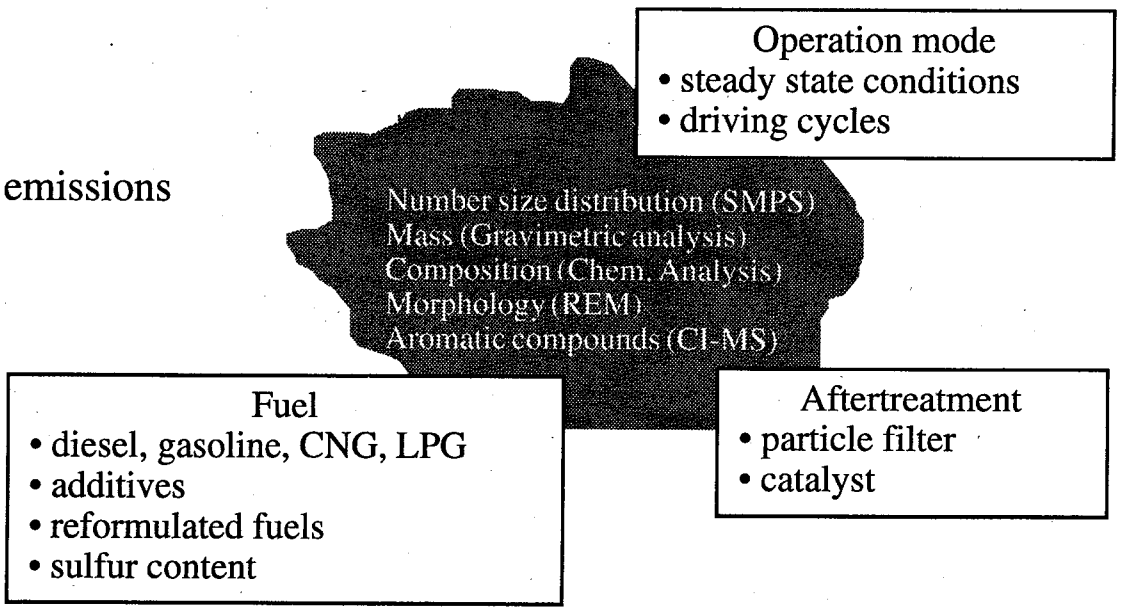
In this project the impact of emissions of four different fuels is investigated. All tests are carried out with the same modell of a passenger car and with and without catalyst (TWC and oxidation cat, respectively).



Sketch of the experimental setup

Field of particle activities at Section I.C. Engines/Furnaces of the EMPA

•Impact of parameters on particle emissions

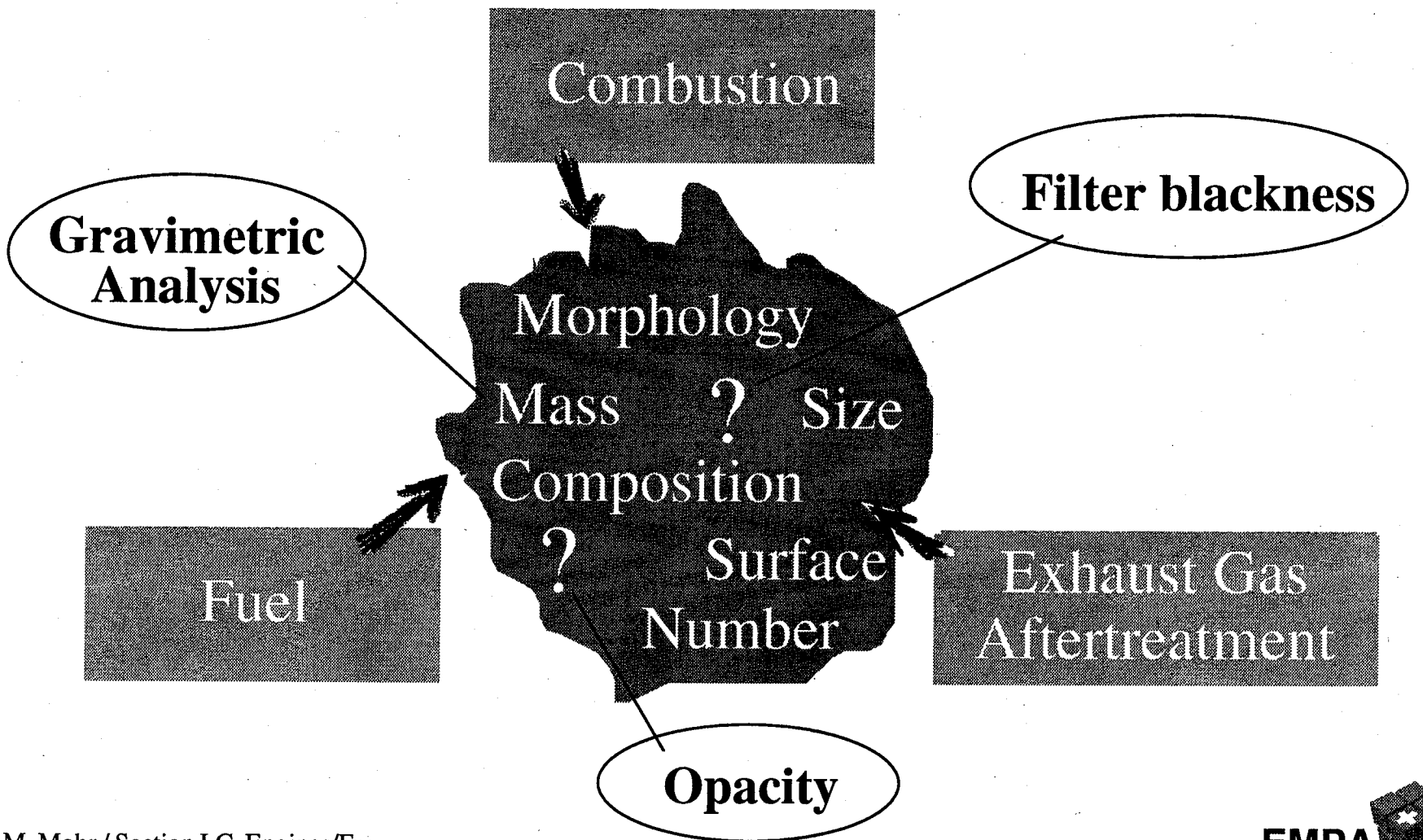


•Particle emission of gasoline vehicles (fraction of solid and semi-volatile compounds)

•Development of improved particle measurement procedures for offical testing

•Evaluation of measurement procedures for determination of emission factors

How are particle emissions characterized by measurement techniques used for official testing?



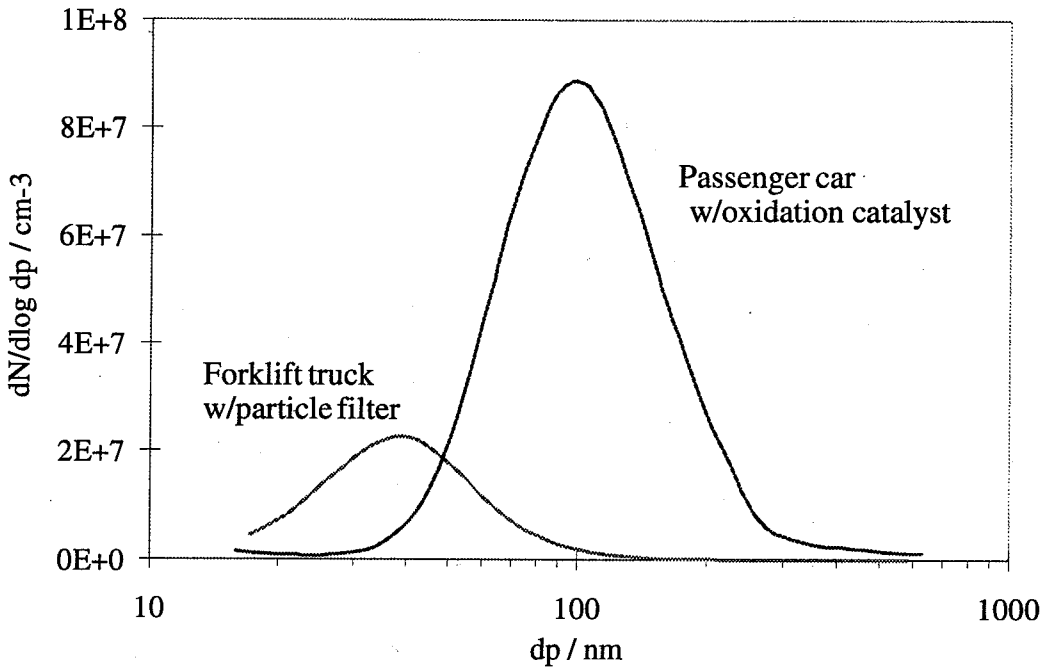
Measurement of number size distributions with DMA and CNC

Application

- **investigation at steady state operation modes**
  e.g. filter testing
  impact of fuel

Features

- **time resolution: about 1 min and more**
- **excellent size discrimination**
  i.e. 64 channels/decade



Number size distributions for two different diesel vehicles (moderate load) with different exhaust gas aftertreatment techniques as measured with a DMA and a CNC. It can be seen that the median siz and the total number of the distributions can significantly change for different vehicles and conditions.

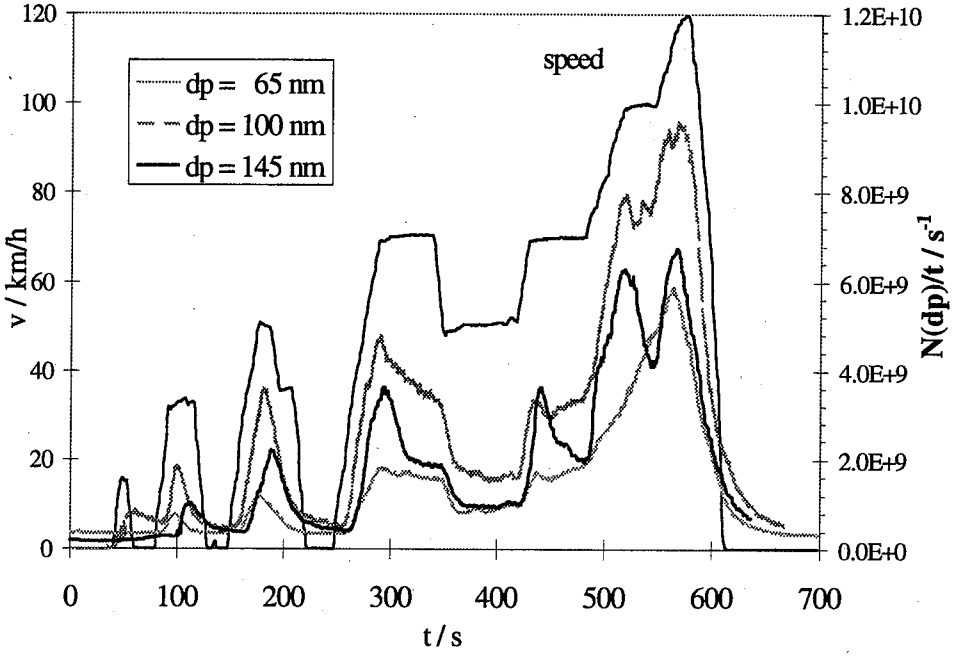
On-line measurements with DMA and CNC

Application

- **investigation of transient operation modes**
  e.g. driving cycles
  load cycles

Features

- **time resolution: < 5 s**
- **no size discrimination**
  i.e. monitoring of total number or of one narrow size class



Variation of particle emissions is shown for three different narrow size classes for a diesel passenger car as measured with a DMA and a CNC. It can be seen that the number size distribution does not change significantly in size over the cycle (4th part of ECE + EUDC), i.e. median size keeps roughly constant. The number of the particles correlates well with the velocity signal. However, as larger the particles as more significant they are affected by the acceleration. Note the the decrease in number after acceleration periods for dp = 100 nm and dp = 145 nm .