

8th ETH Conference on Combustion Generated Particles

Zurich, 16th – 18th August 2004

# Comparison of PAH in the soot made by propane, gasoline and diesel using the CAST technique

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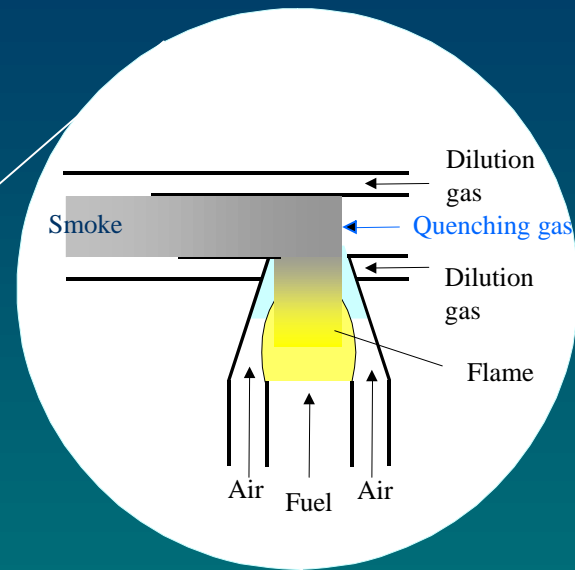
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Zurich, 16th August 2004

# CAST – a generator of real soot particle

- CAST = Combustion Aerosol Standard
- Soot particles are
  - generated in a diffusion flame
  - quenched subsequently
- Product = real smoke



# What does a CAST do?

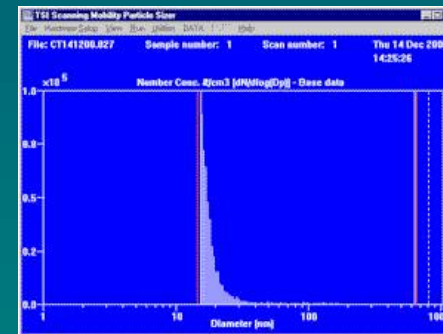
Steady soot generating with high reproducibility



Reference soot particle



Particle size adjustable

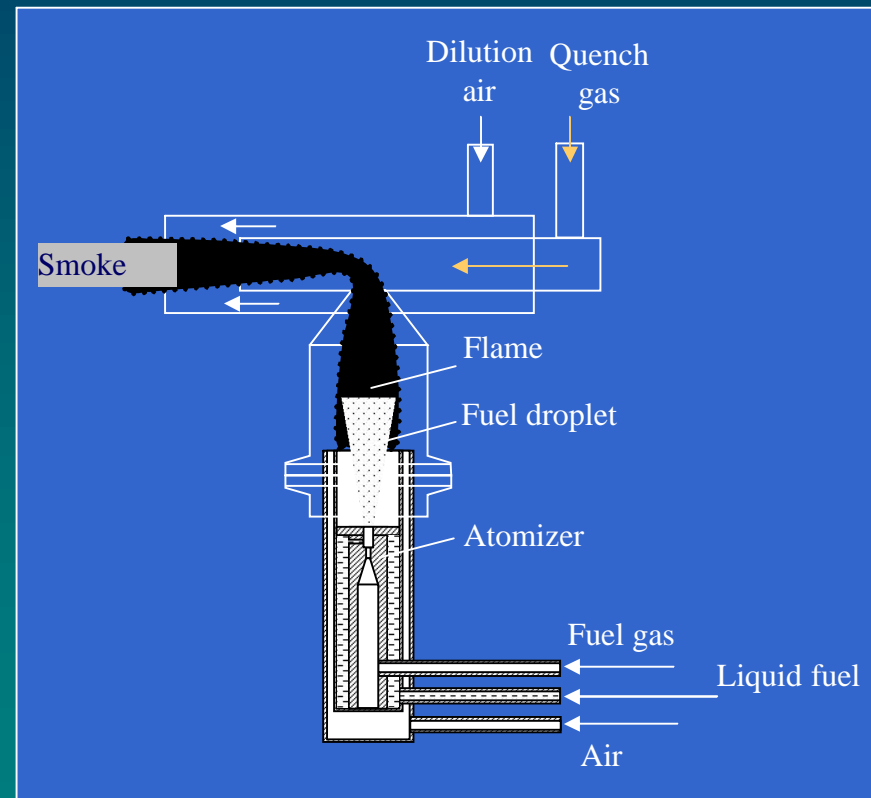
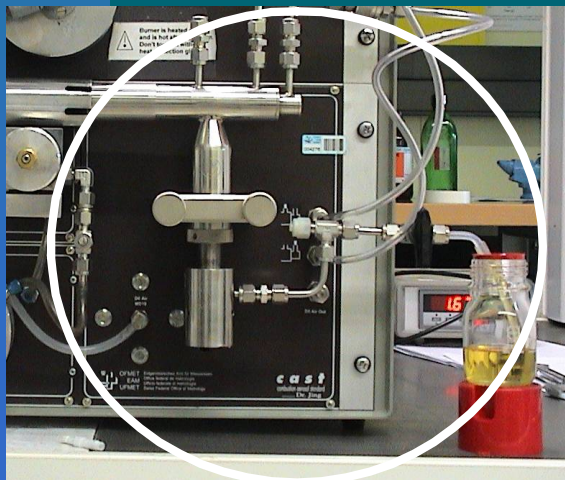


Soot sample with adjustable composition



# CAST-liquid for liquid fuel

New possibility to investigate soot from different fuel under **controllable** and **comparable** conditions



# Applications of CAST-liquid

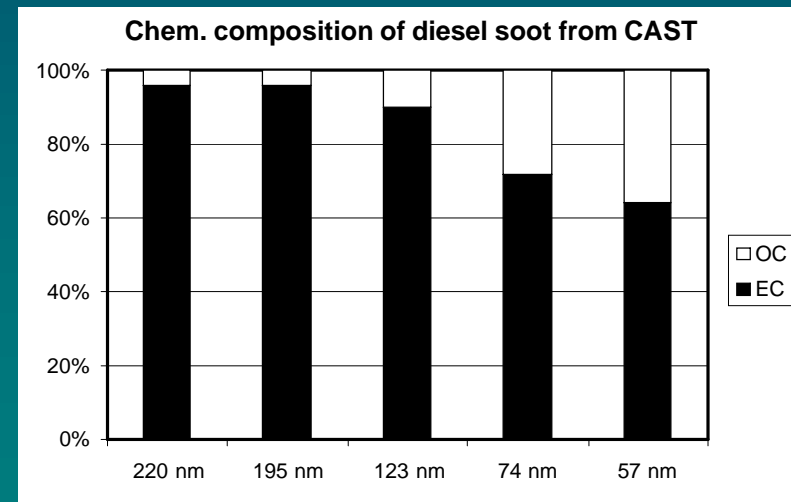
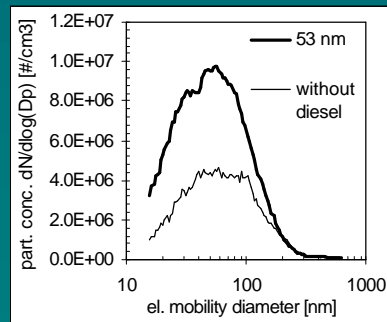
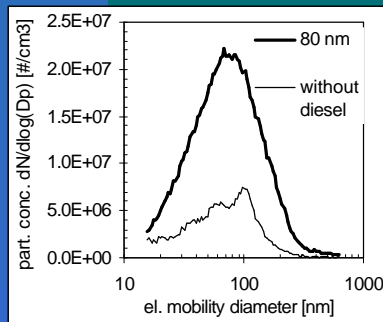
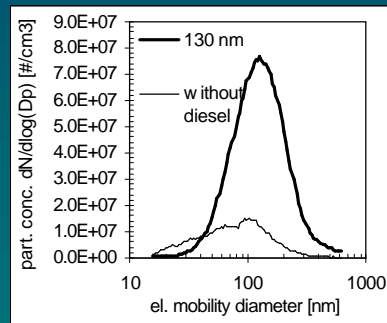
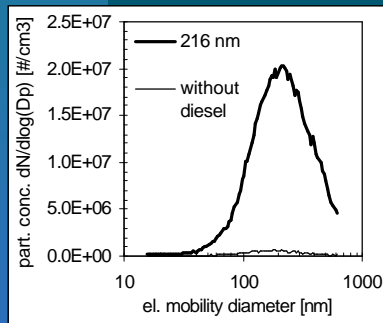
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## *Independent from engine type*

- Comparison of fuel in regards to their sooting potential
- Investigation of the influences on soot emissions due to fuel quality (a cheaper and more efficient alternative)
- Investigation of the influences of fuel additives
- Reference soot and particle for research and calibration purposes

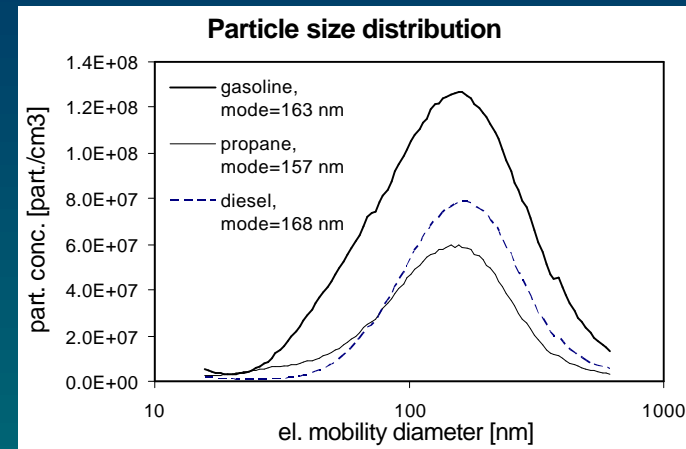
# Examples of diesel soot

1. Adjustable particle size
2. Diesel soot predominant
3. Soot from smaller mean size contains more OC.



# PAH analysis – Part 1

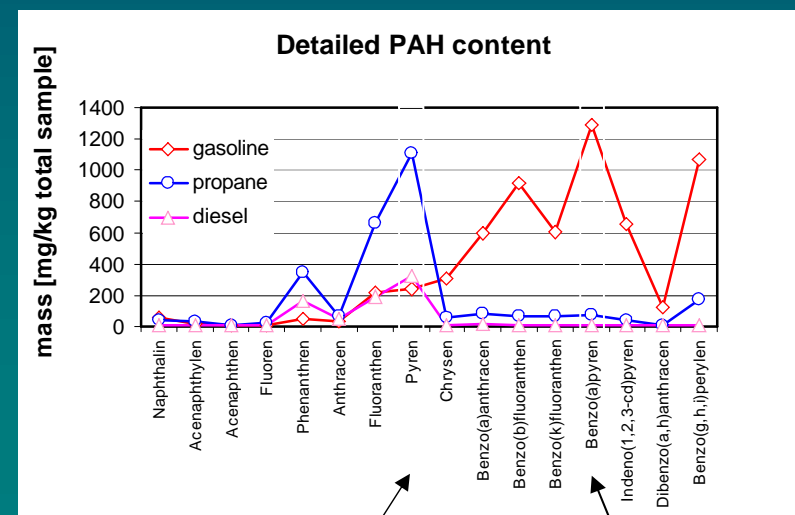
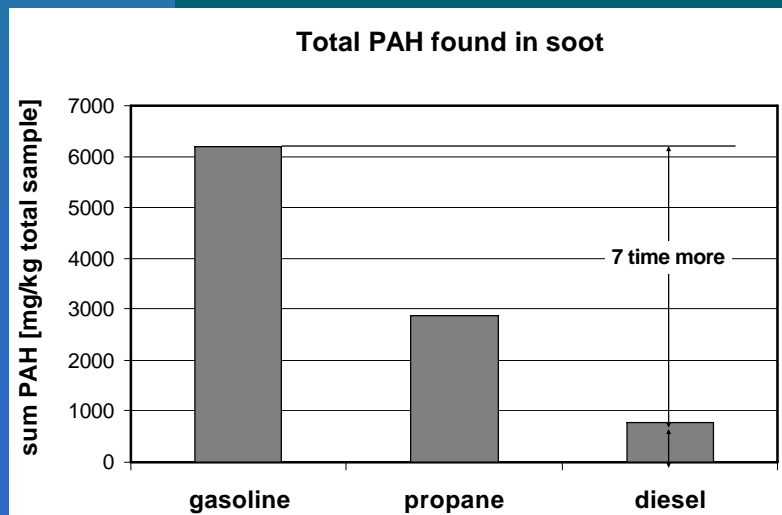
1. Soot from diffusion flame of
  - \* Gasoline (direct injection)
  - \* Propane
  - \* Diesel
2. Mode of 3 size distributions are placed close to each other.
3. Gasoline soot contains more OC than diesel soot.
4. Soot from gaseous fuel is drier than from liquid fuel.



soot type	EC	OC
gasoline	93%	7%
diesel	96%	4%
propane	98%	2%

# PAH analysis : Part 2

1. Gasoline soot contains (7x) more PAH than diesel soot.
2. Gasoline soot: large PAH predominant
3. Diesel soot: small PAH predominant
4. Propane soot: small PAH predominant
5. Propane soot contains more PAH than diesel soot

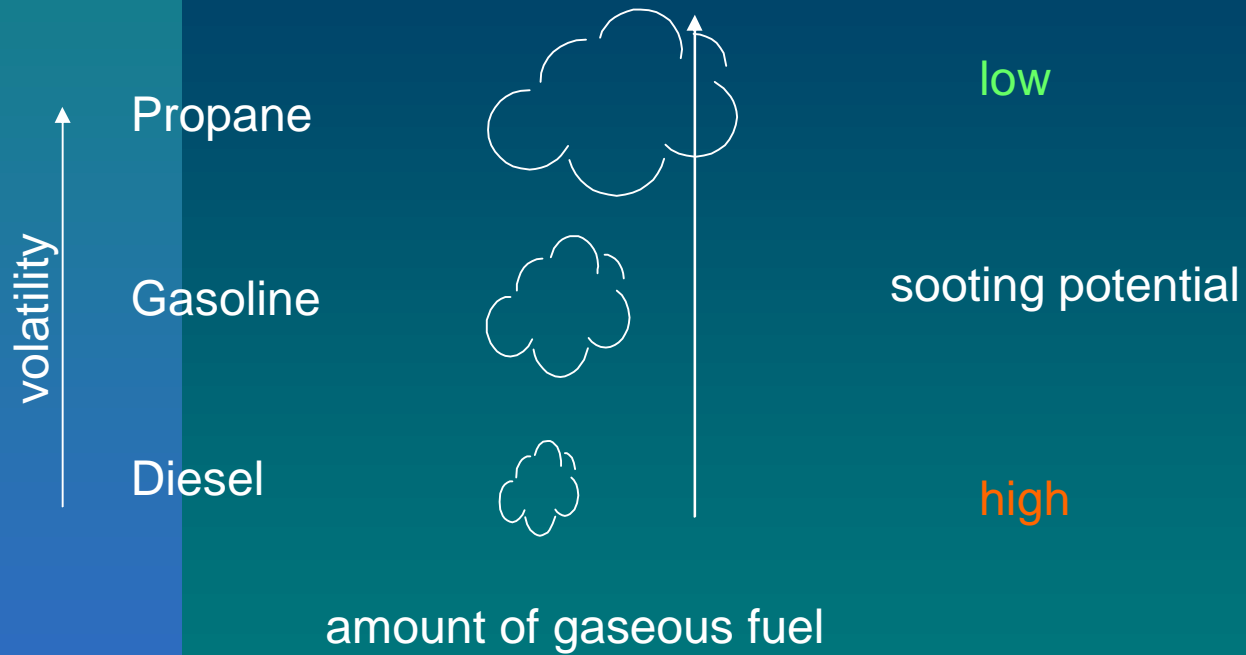


Pyren

Benzo(a)pyren

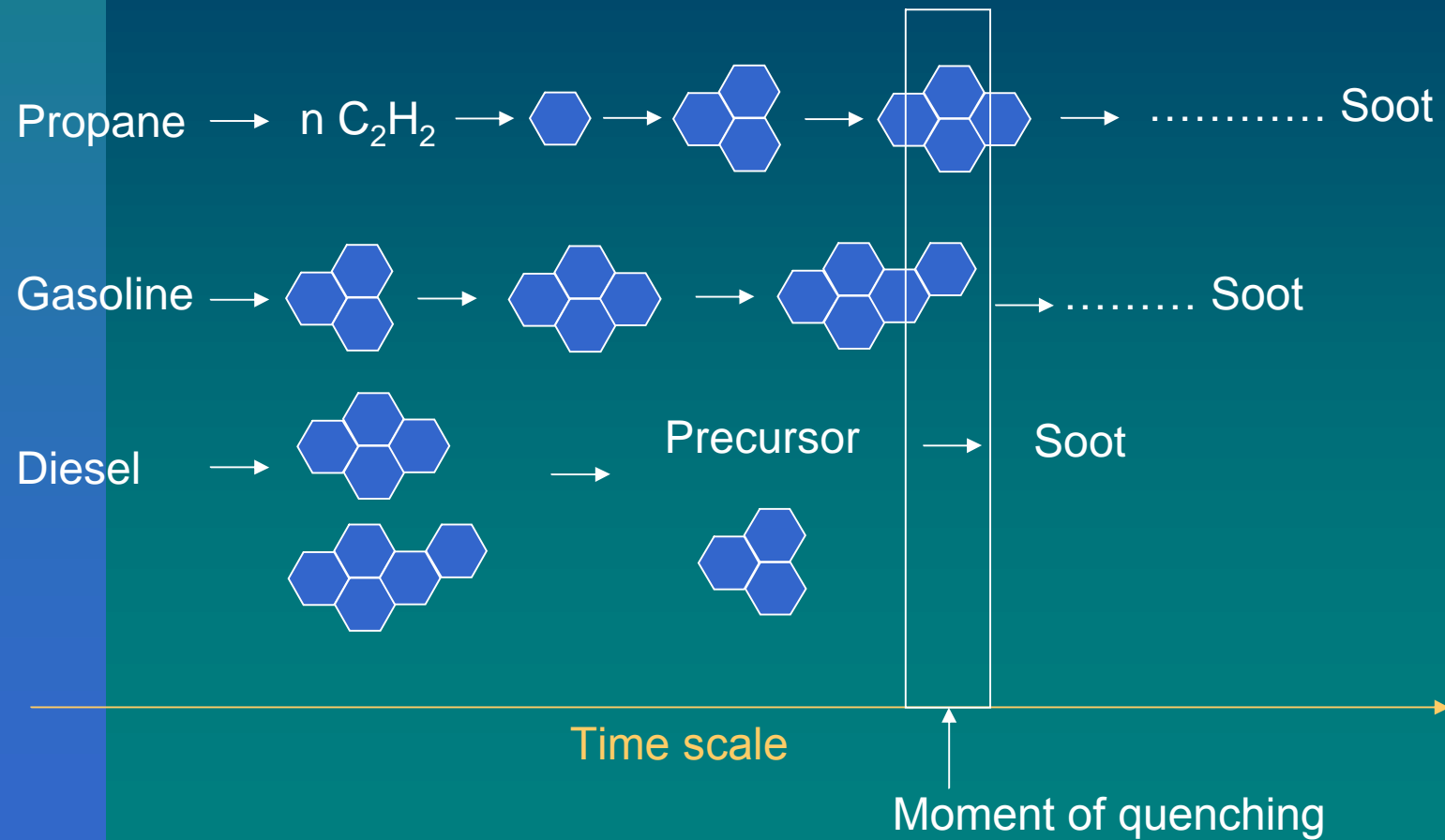


# Explanation



# These

Beside the soot there are following components in the diffusion flame



# Conclusions

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- CAST is not only a reference particle generator, but also an appropriate device to investigate soot formation and particle emission.
- PAH amount depends on the volatility of fuel: the more volatile, the more PAH.
- Size of predominant PAH depends on the size of fuel molecule.
- Gasoline soot contains much more PAH and is to be recognized as more harmful than Diesel soot.
- A important reason for the control of the particulate emission from gasoline and nature gas engines.

# Acknowledgements

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- Swiss Agency for the Environment, Forests and Landscape (BUWAL)
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