Health Relevance of Aerosols from Biomass Combustion in Comparison to Diesel Soot
Indicated by Cytotoxicity Tests

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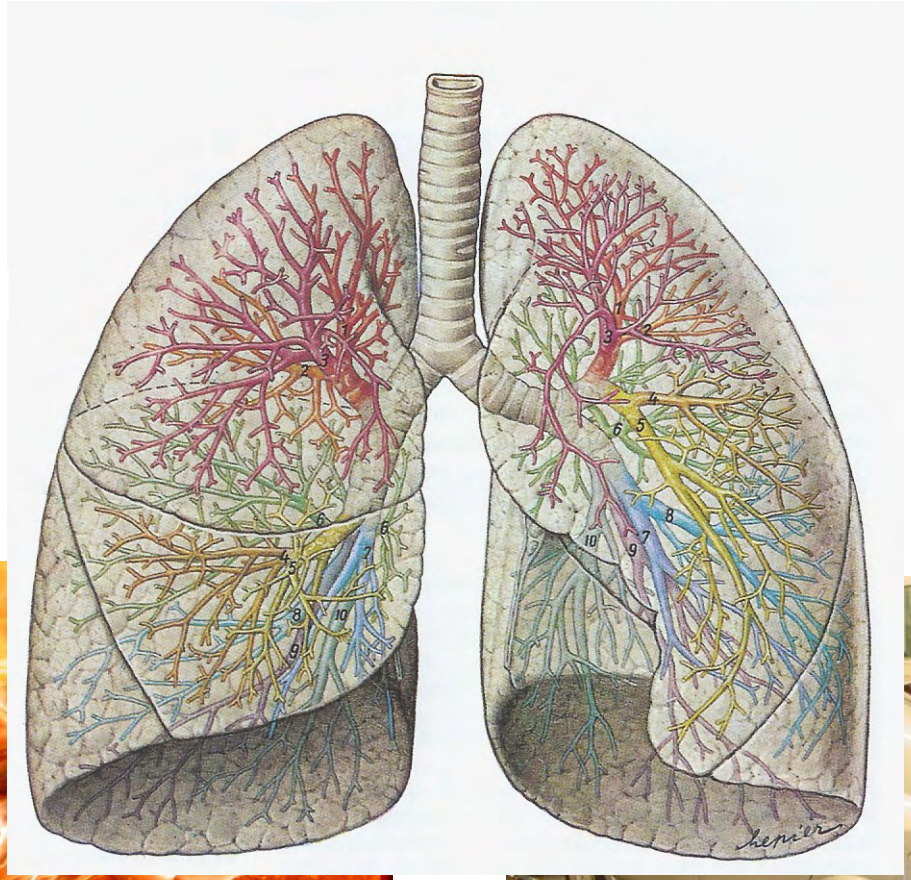
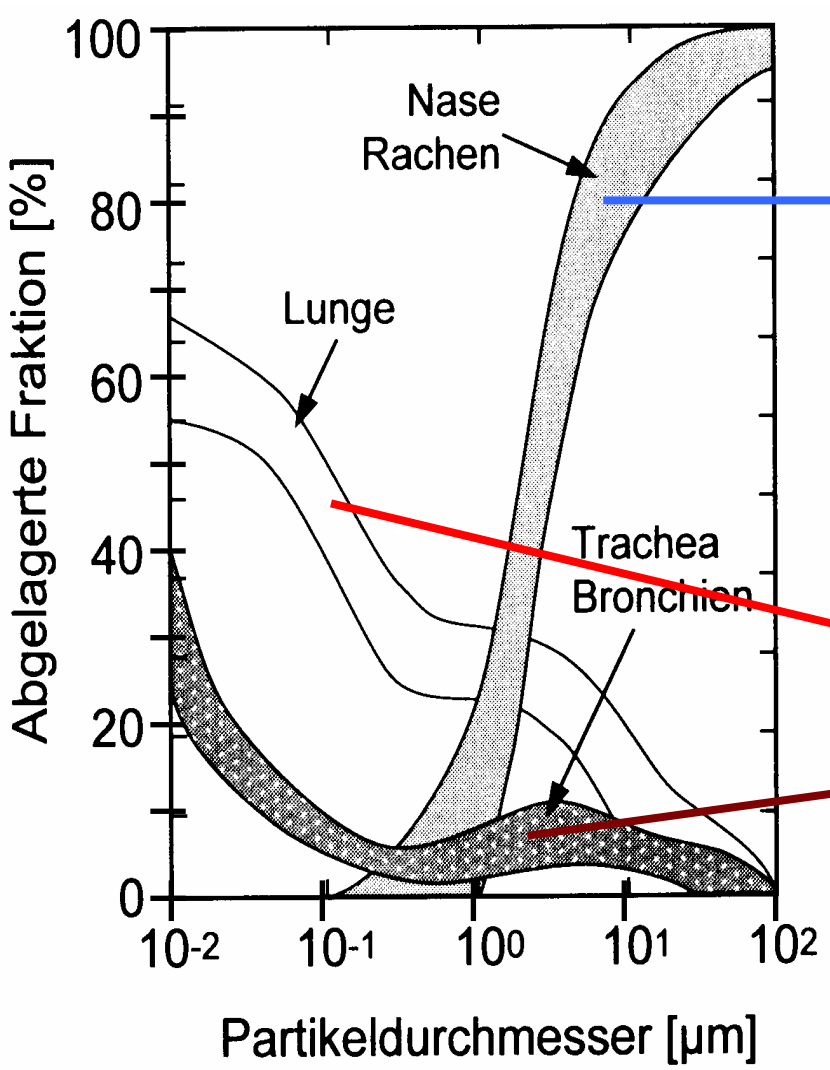
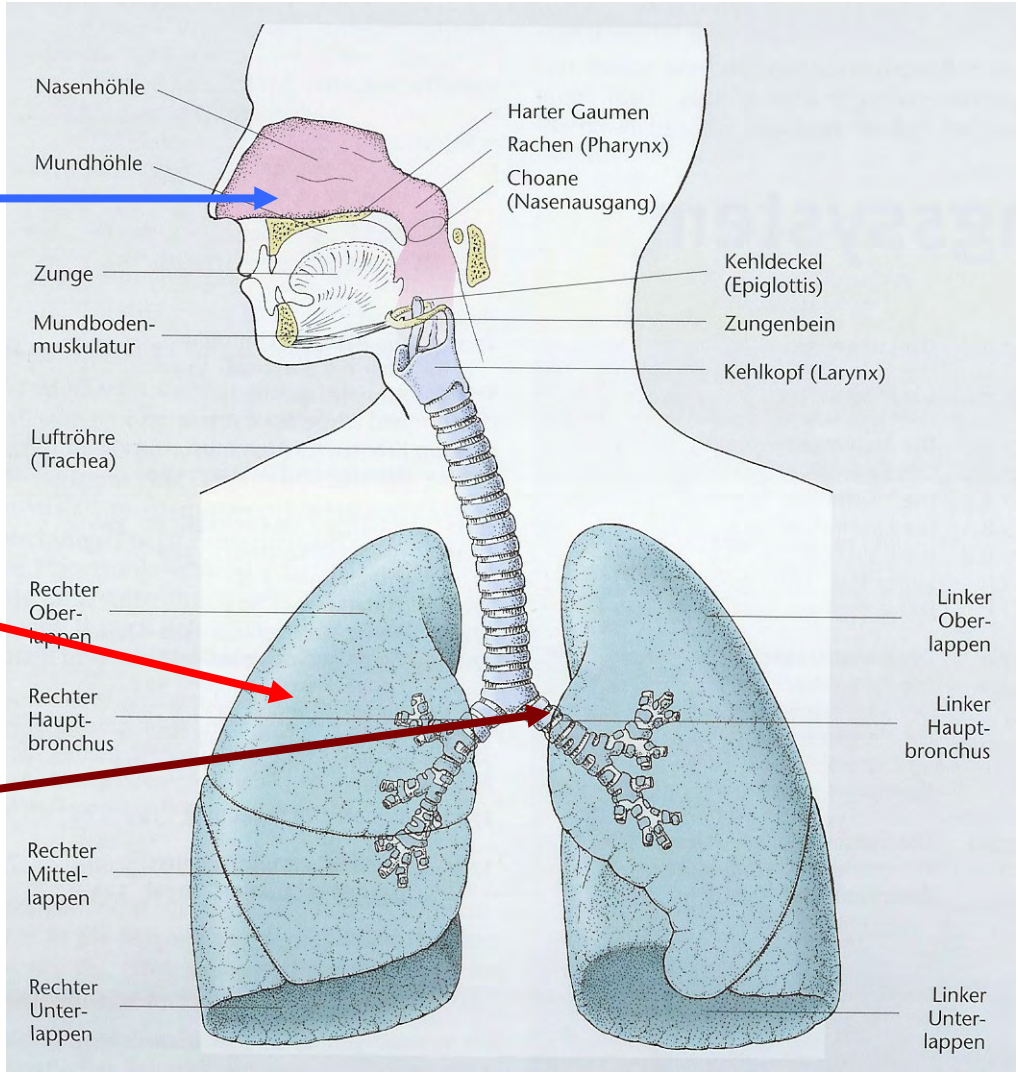
How do different combustion particles influence human health?



Particle deposition in respitatory tract





[Health Phys. 12, 173]

[Huch et al., 2003]

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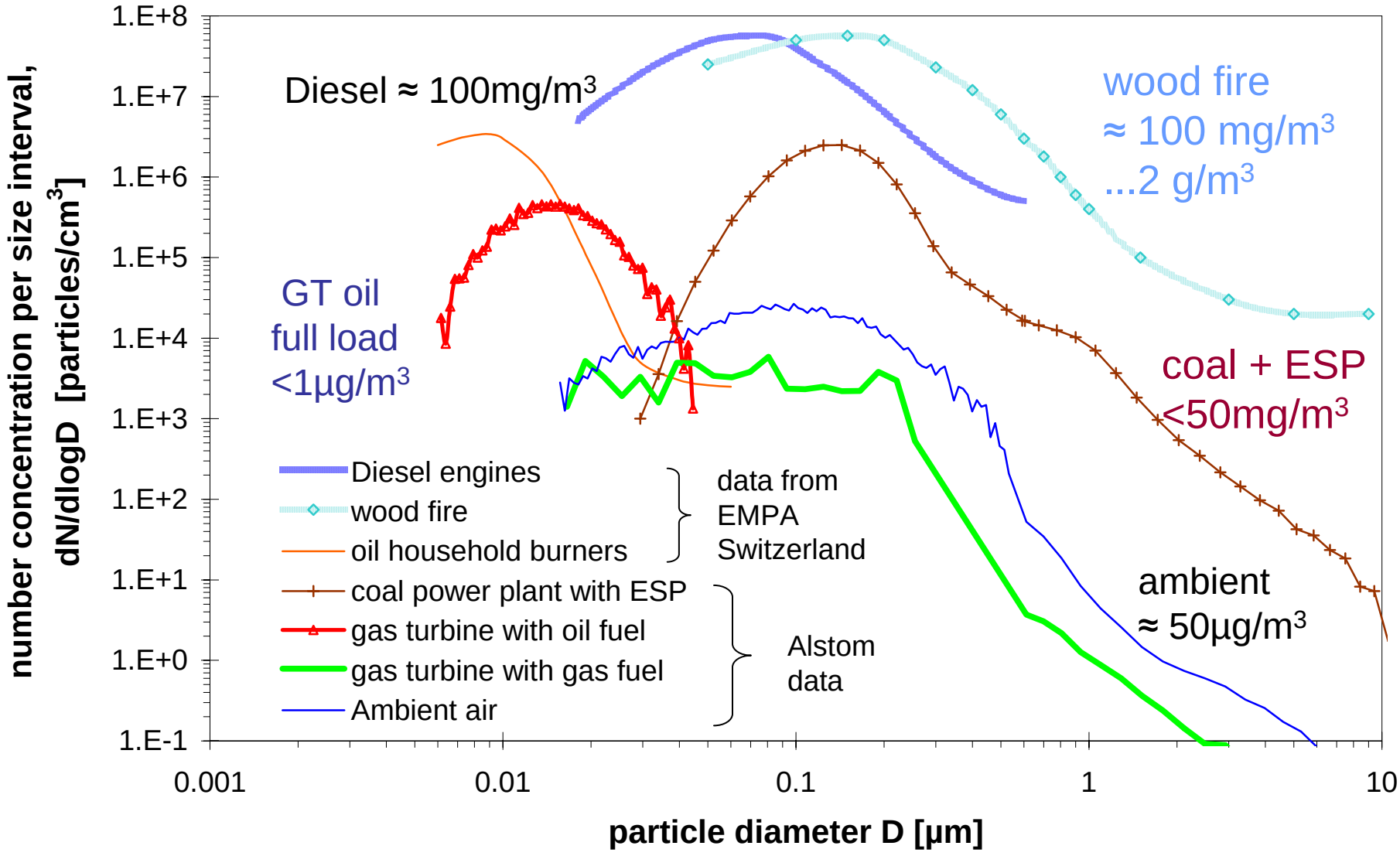
Comparison: PM10 emissions of different sources

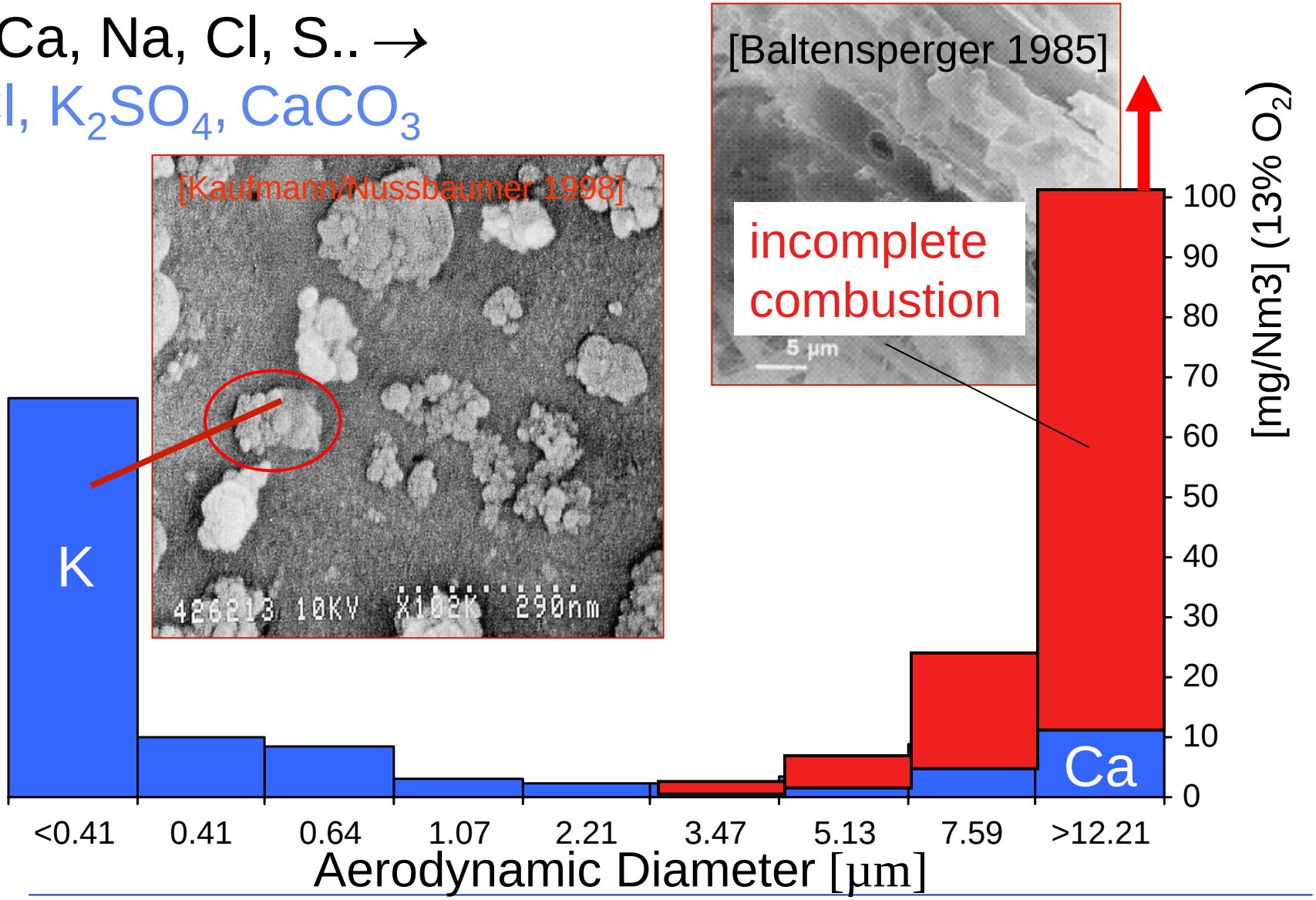


PM10 Emissions of Different Sources

- Main *specific* emitters in particle mass:
  - badly maintained wood fires, old furnaces, open fires with wet wood and/or contaminants
  - old generation Diesel engines
- Main *specific* emitters in particle number, i. e. submicron particles
  - all types of wood furnaces
  - all Diesel engines without particle filter
- Do they also cause similar health effects?

Chemistry of particles from wood firing

K, Ca, Na, Cl, S.. →
KCl, K_2SO_4, $CaCO_3$



[Oser et al. 2000]

Wood combustion and Diesel engines

- Chemistry of emitted particles is different:
  - Diesel: mainly unburned carbon (soot)
  - Wood:
    - mainly salts of K, Ca, Cl, SO_4
    - <5% organic material in modern automatic furnaces
    - high content of unburned material (organic carbon, soot) under bad combustion conditions only
- What is the impact on health?

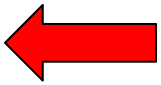
Health effects of Diesel and Wood

- Ultra fine particles penetrate into lung
- Influence on lung tissue can be very different due to chemistry
- Toxicity of different substances can be investigated by cell culture tests
  - first estimate on toxic reactions inside lung
- Both wood and Diesel particles applied to culture of lung cells of Chinese hamster (V79 standard cells)

Samples generated for health study

Particles sampled after:

A. Diesel engine (Euro III passenger car) 

B. Automatic wood furnace:
   1. Standard operation  eval. in present study
   2. Low-Particle-concept (50% lower particle emission)
   3. Non-optimal operation (higher emissions)

View of particle sampling after wood furnace

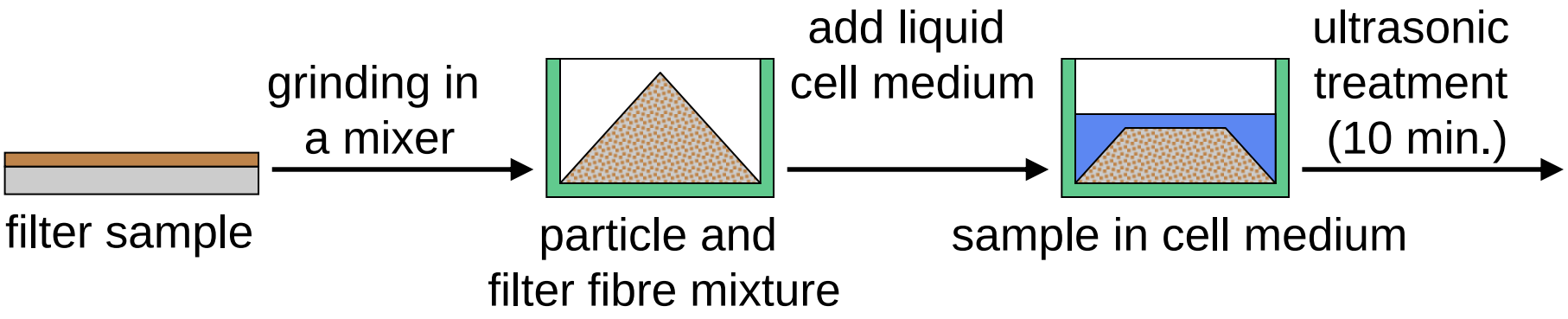
filter for particle sampling

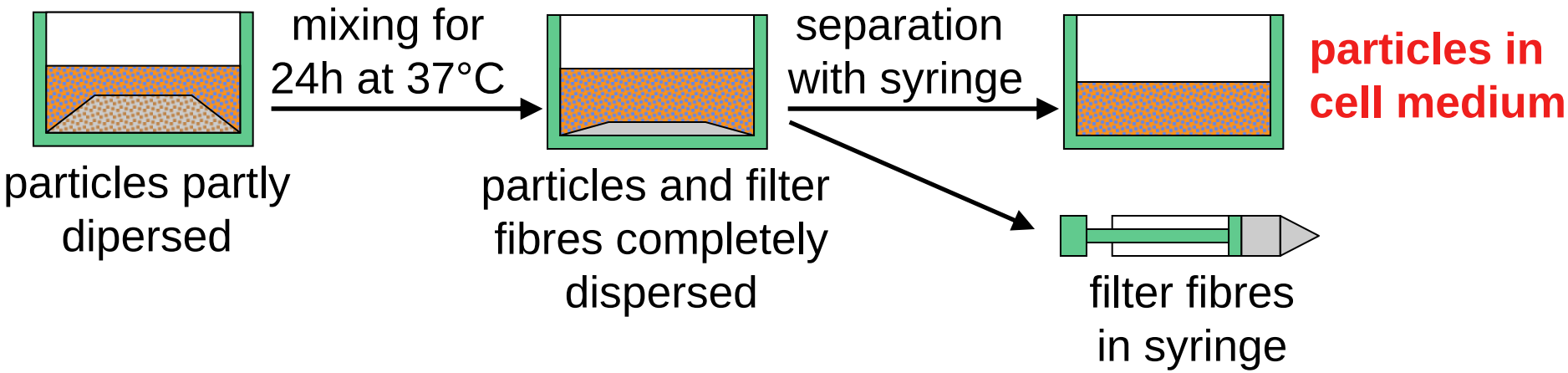
Particle filters after sampling

0.5 g particle mass

2 g particle mass

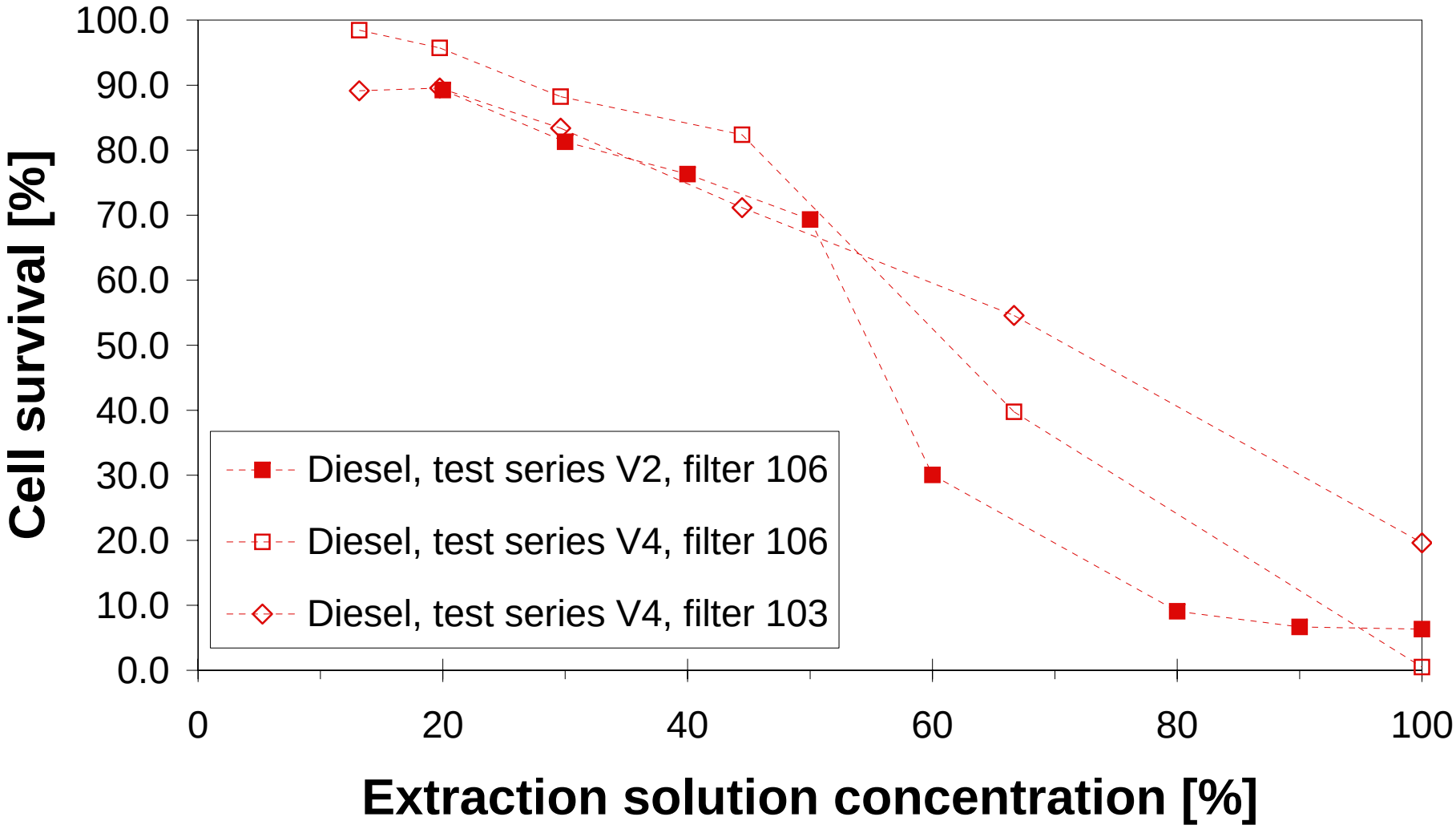
Sample preparation



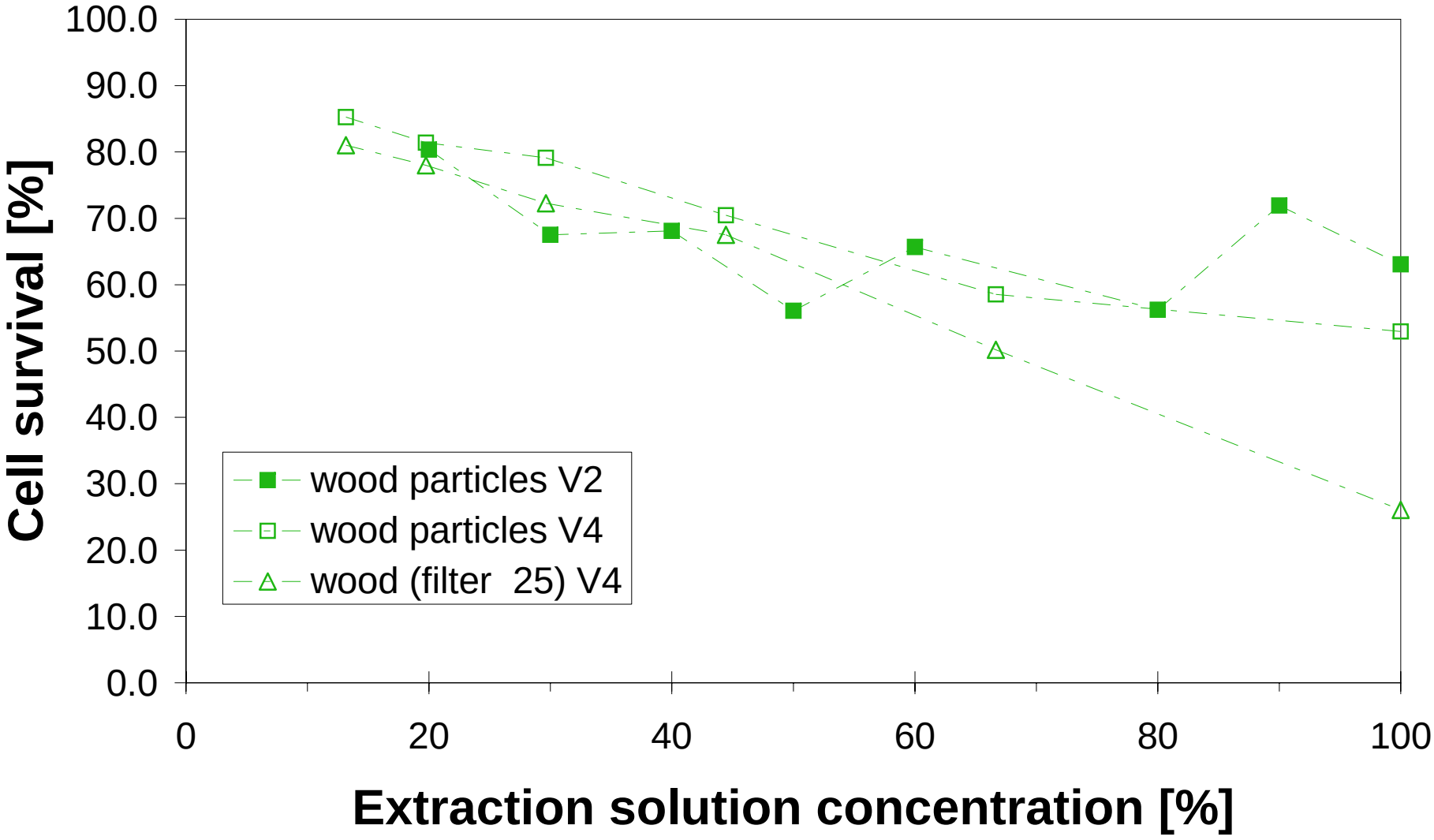


Investigation of cell cultures

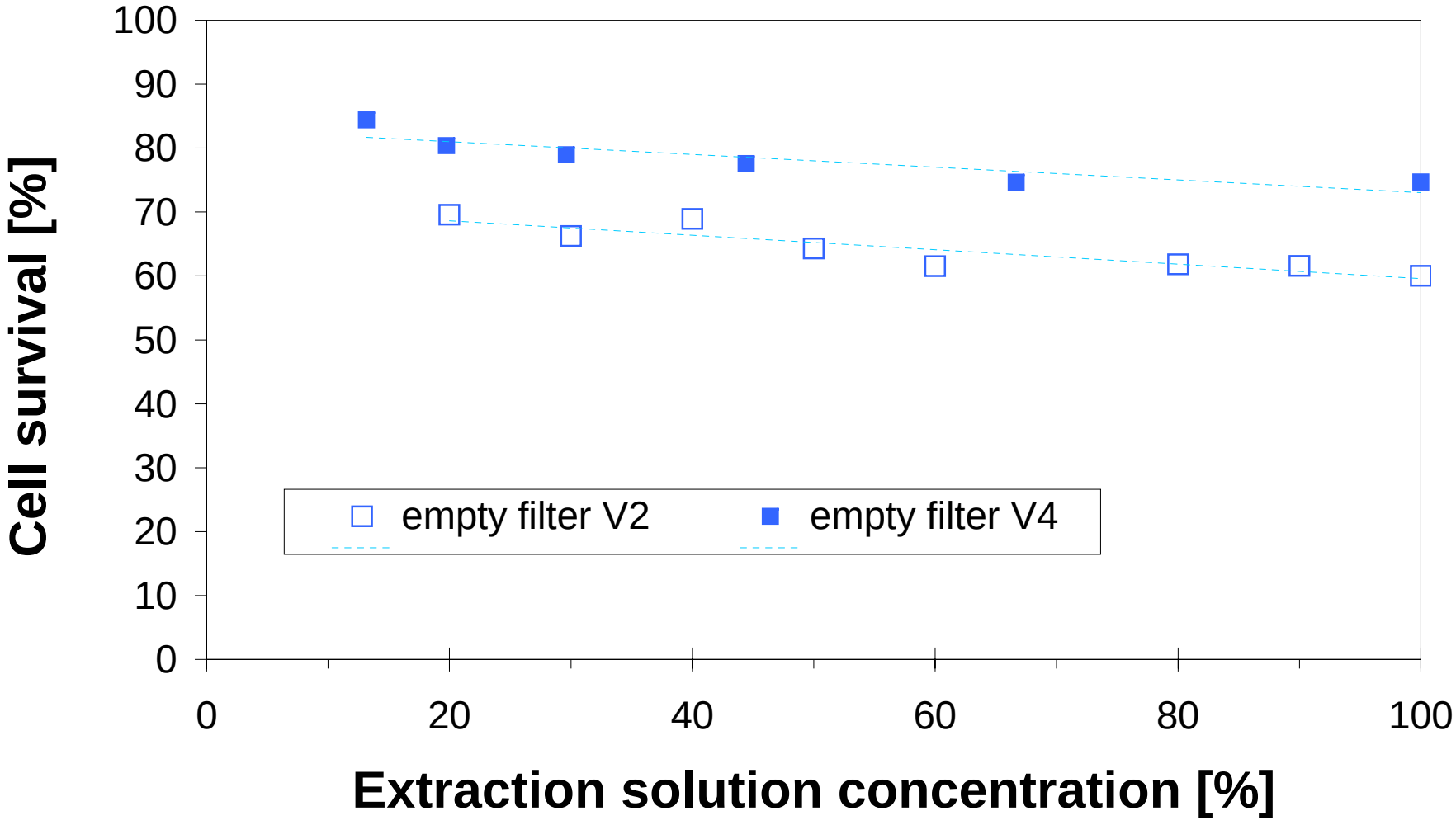
Toxicity test results: Diesel particles



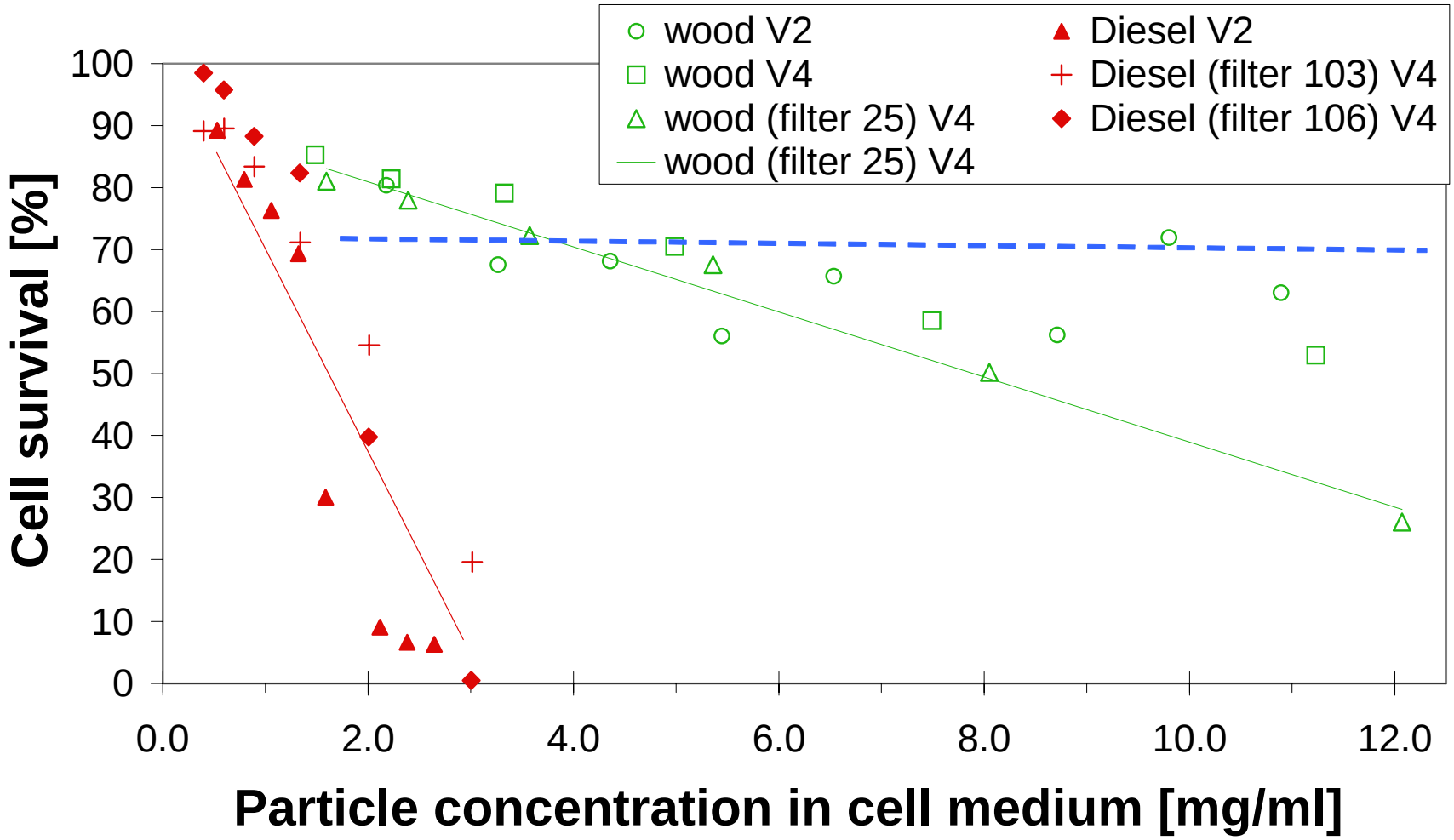
Toxicity test results:
Particles from automatic wood furnace



Control test with empty filter material



Comparison between Diesel and wood particle toxicity



Conclusions

- In very high concentrations both particle types are toxic
- Toxicity of Diesel particles is significantly higher at the same particle concentration:
  - up to 100% of cells dead at 3mg/ml
  - at this concentration, toxicity for wood particles is at detection limit of present study
- Ultra fine particles from automatic wood furnaces are less toxic than Diesel soot

Outlook

- ✓ Lower toxicity shown for wood combustion particles, consisting mainly of salts
- Direct cell tests with K – salts in progress for comparison and better quantification
- What is the impact of unburned carbons, which result from bad combustion conditions?
- To which extend can health impact further be reduced by low particle firing concept?
- ➢ Next tests with already generated samples

Acknowledgements

- Swiss Federal Office of Energy (BFE), Berne
- Swiss Agency for the Environment, Forests and Landscape (BUWAL), Berne
- Swiss Federal Institute of Material Testing and Sciences (EMPA), Dept. Combustion Engines, Dübendorf
- RCC Cytotest Cell Research GmbH, Darmstadt (Germany)