Metal Fibre Based DPF for Wide Range of Applications

Feng MEI

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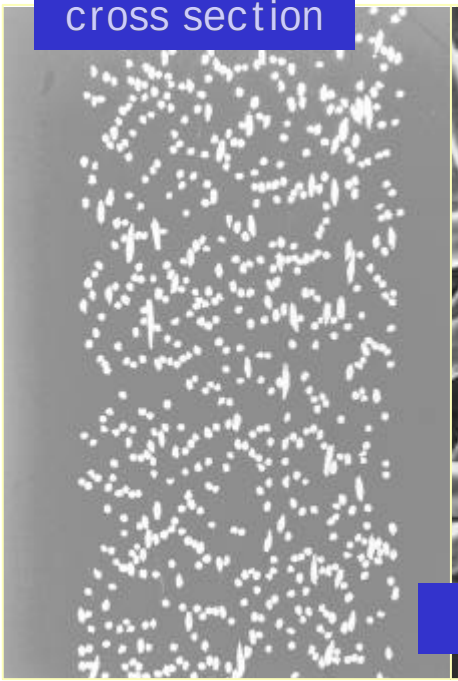
- Technical profile of Bekipor®
- Flexibility of Bekipor® in DPF applications
- Developing and Optimizing by Modeling
- Field testing
- Conclusion

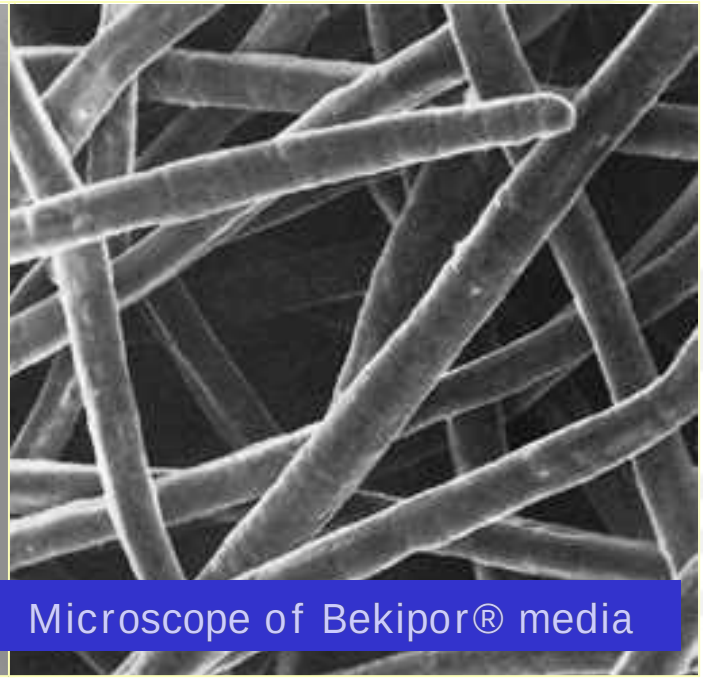
Technical Profile - *Material Structure*

- Composite of FECRALLOY® fibers with various size and porosity fully subject to design
- Porosity: up to 93%

Mono-layer cross section

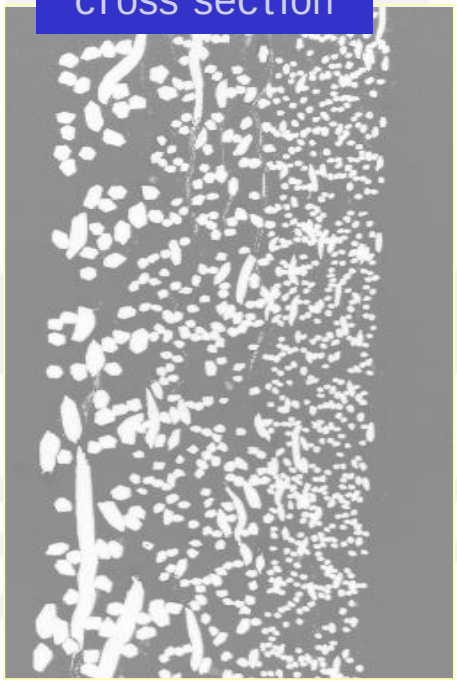


A non-woven sintered labyrinth



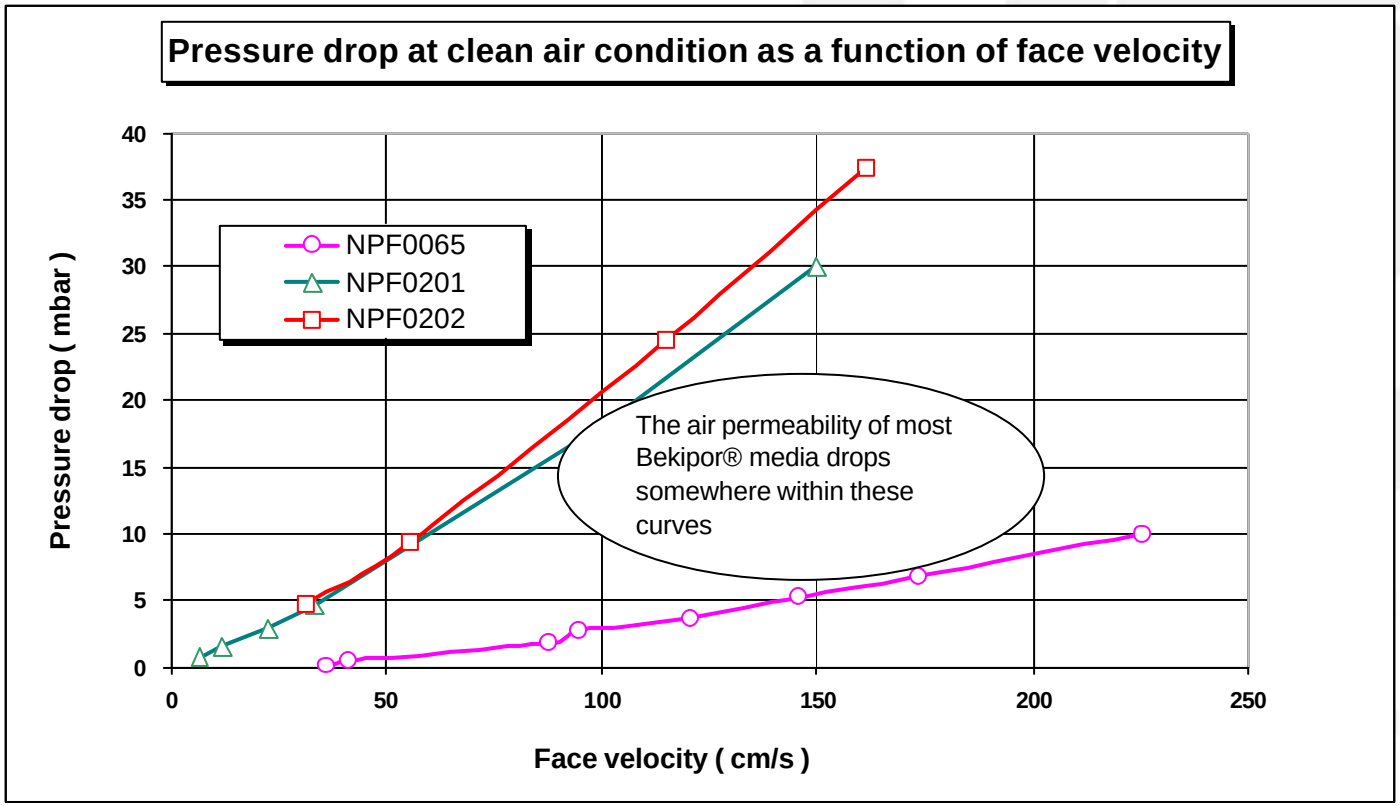
Microscope of Bekipor® media

Three-layer cross section



Technical Profile - *Fluid-dynamic Property*

- Air permeability of Bekipor® media heavily depends on the specific structure. A typical value ranges from 1.4×10^{-11} m^2 to 2.0×10^{-10} m^2 under clean air condition



Technical Profile - *Thermophysical Properties*

Density: 700 - 2800 kg/m^3

Specific heat capacity: about 460 J/kg

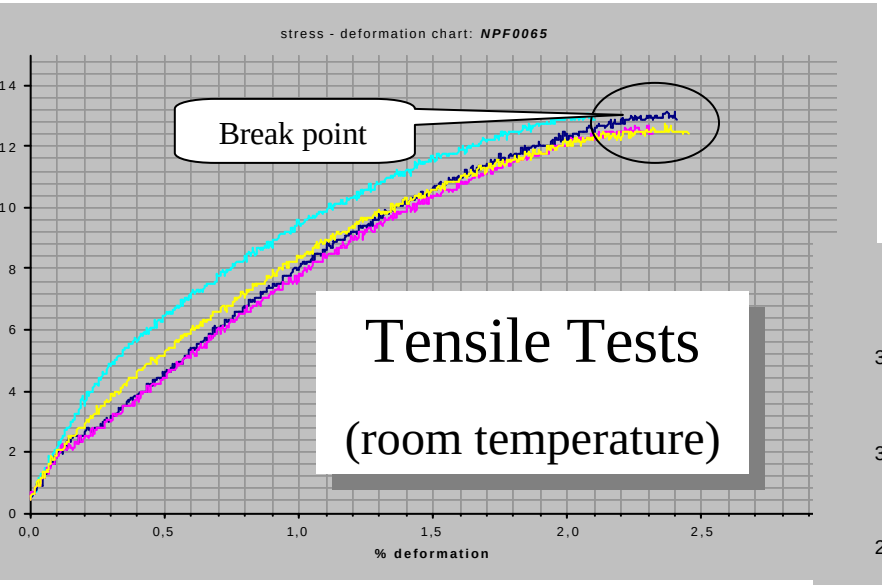
Emissivity: >= 0.7

Working temperature: up to 1000 °C

Electrical resistivity* : 1.39 ohms.mm^2/m

* FECRALLOY® at 20°C

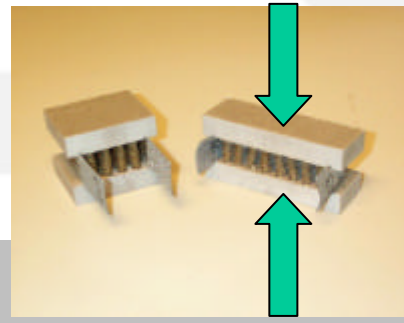
Technical Profile - *Ductility*

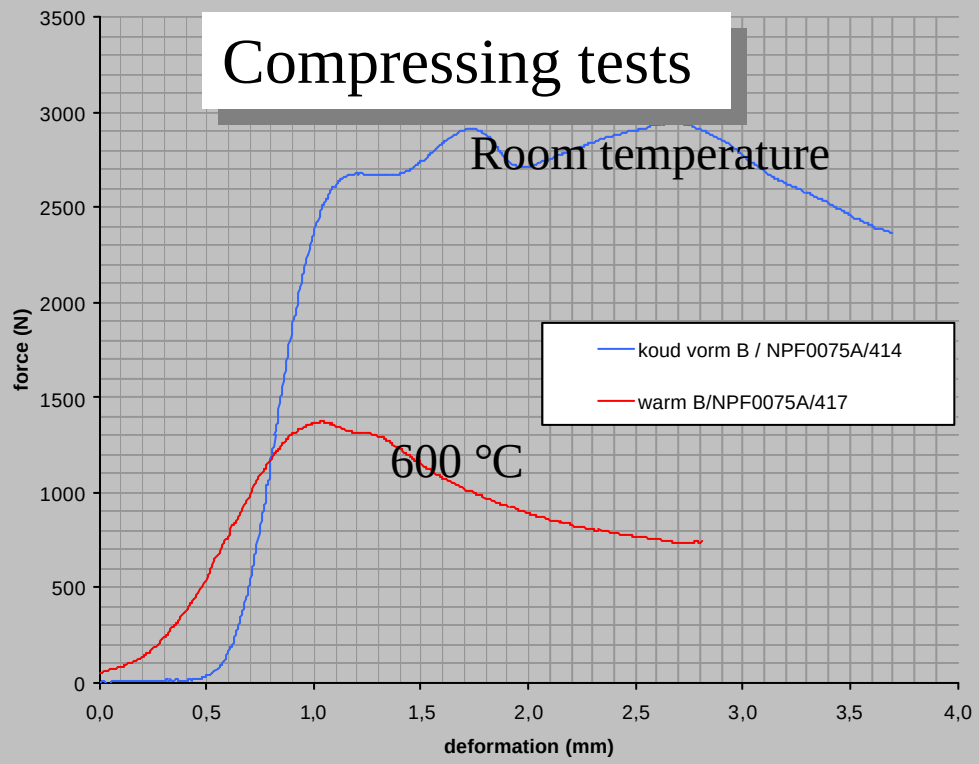


material : NPF0065, Testing results: deformation at room temperature > 2%

Bekipor® can survive substantial deformation without being demaged

Test Force





Destroying Testing in Vehicle Research Inst., Univ. of Applied Sciences Dresden under the following condition:

- 48 hours continuous operation
- Loading to 900 mbar
- Regenerating by adding additives

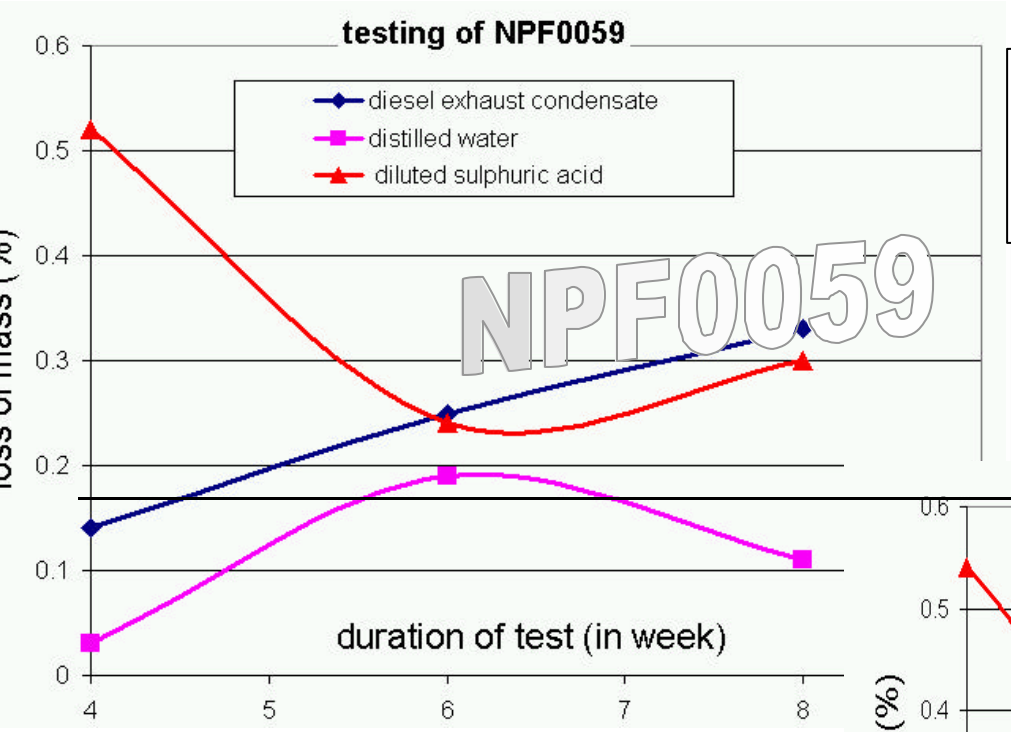
No damage identified on Bekipor® DPF

Technical Profile - *Corrosion resistance*

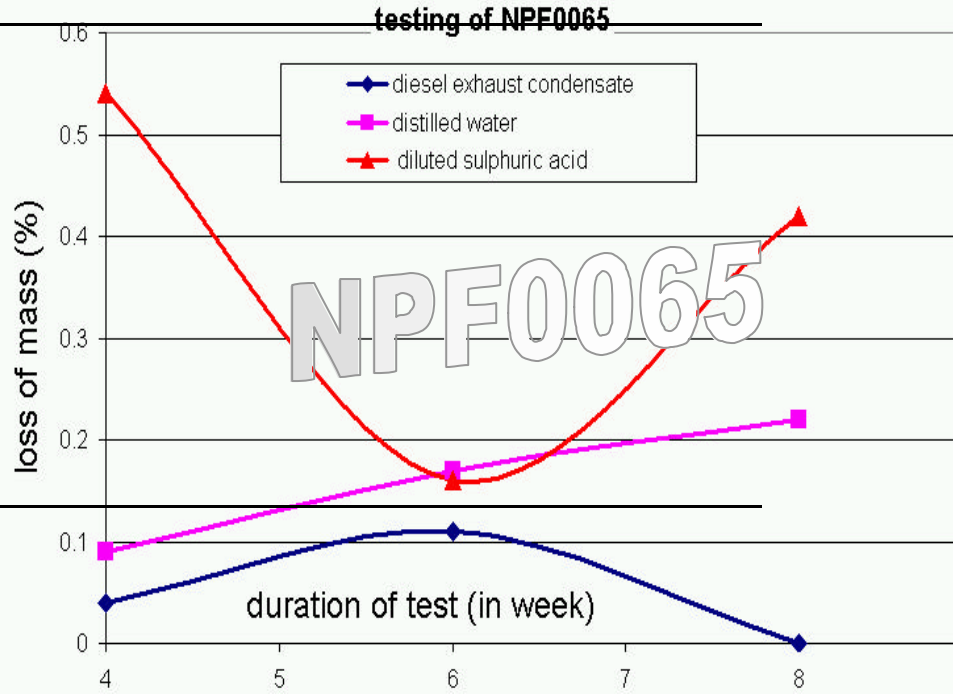
Intensive corrosion investigations have been done both internally (Bekaert Technology Center) and externally (Vehicle Research Inst. Univ. of Applied Sciences Dresden), which come up with the same conclusion:

The corrosion resistance of Bekipor®
is high enough to be applied for
diesel exhaust aftertreatment

Data & Facts:



Corrosion experiments conducted by Univ. of Applied Sciences Dresden:



No substantial mass loss has been found under the specified corrosive environment

Flexibility in DPF applications

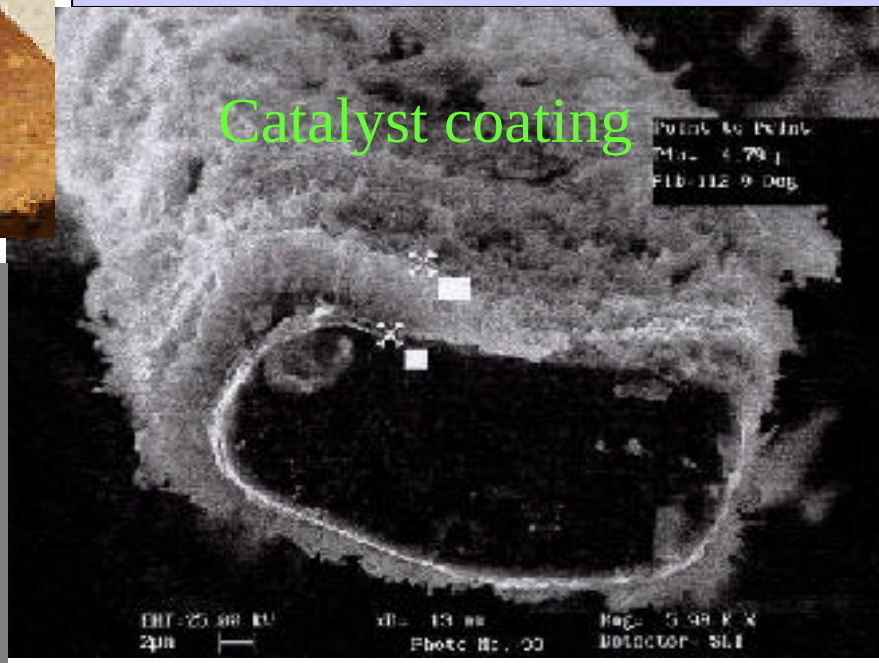
The material properties enable high flexibility of Bekipor® in DPM aftertreatment applications

- Flexible to apply various regeneration strategies
- Flexible to be shaped into various geometries
- Flexible to customize filtration performance by application
- Flexible to the positioning of filter

Flexibility in DPF applications - *Regeneration*

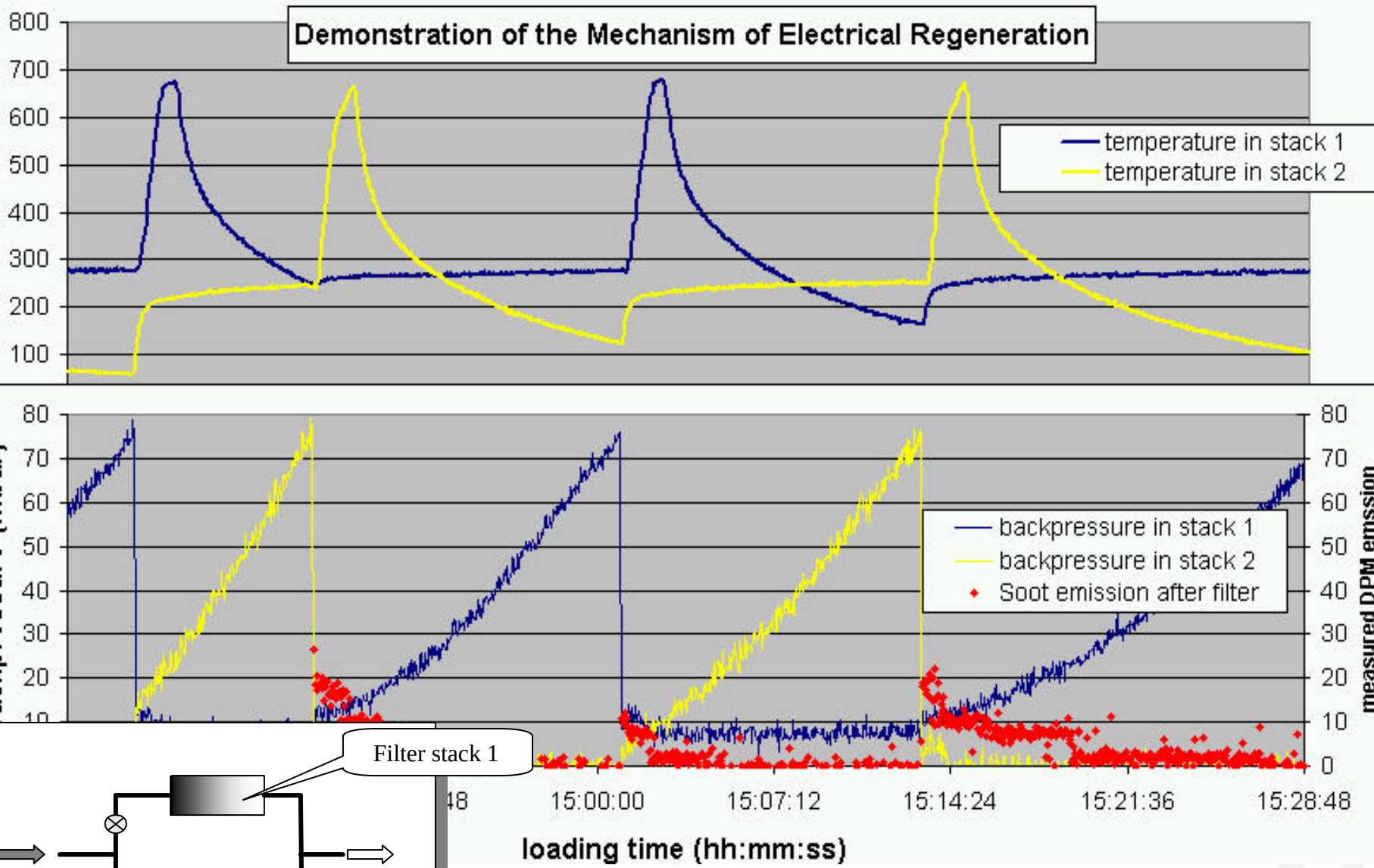
Electrical heating: high sulfur fuel or low exhaust temperature applications

Hybrid strategy: Combining two or more techniques in one filtration system



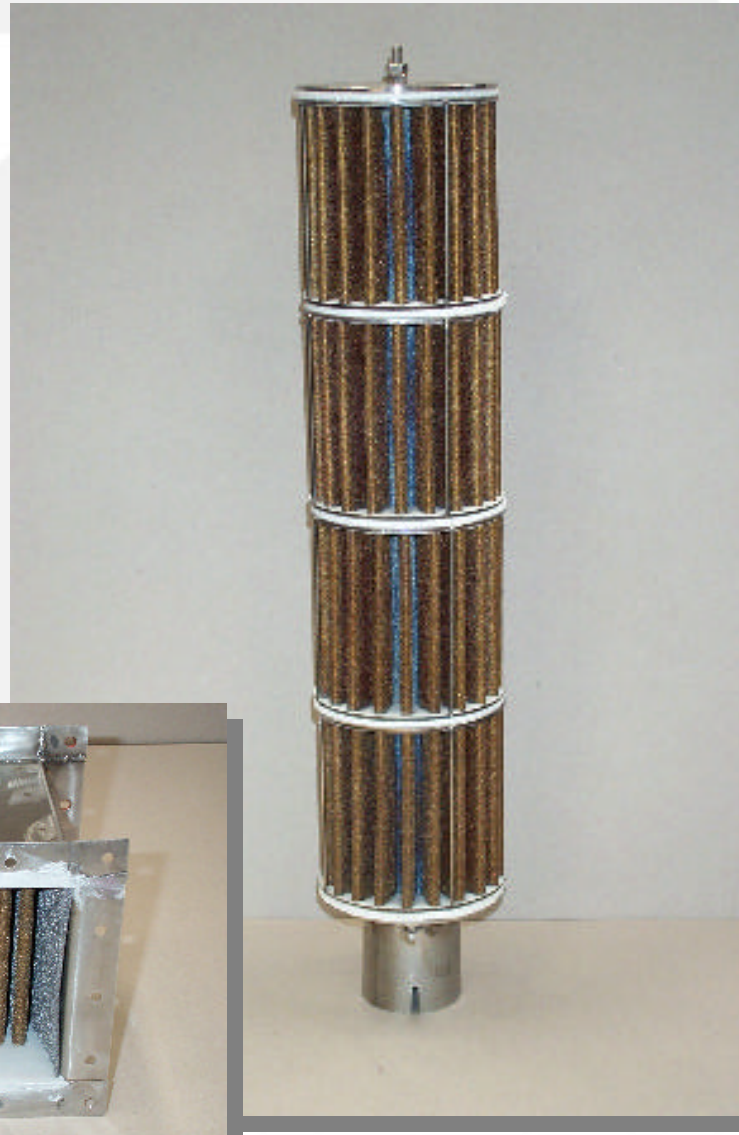
Heating by External Combustion

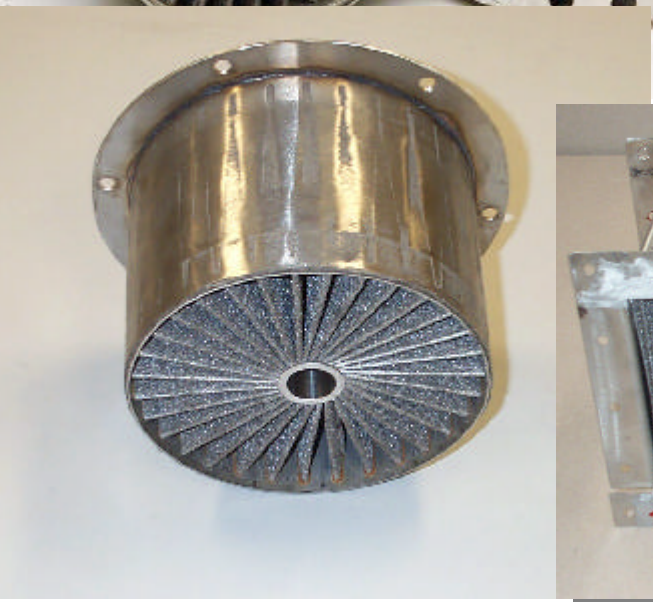
Adding additives

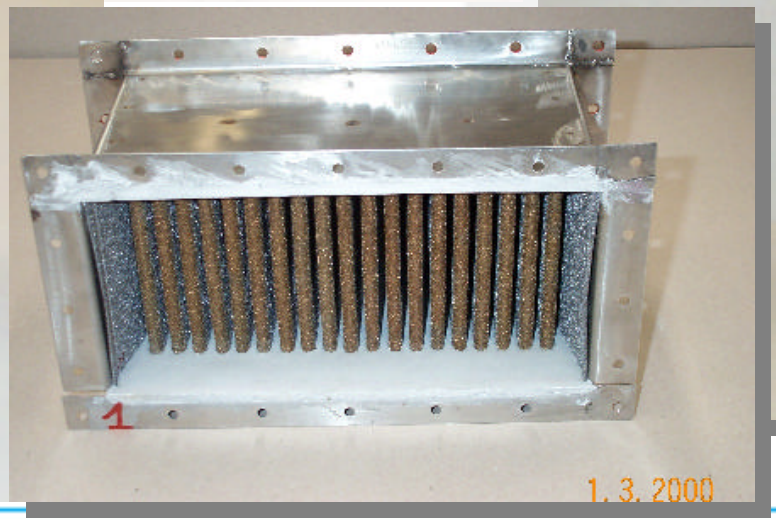


The stack to be regenerated is partially shut off when pressure reaches threshold

Flexibility in DPF applications - *shaping*

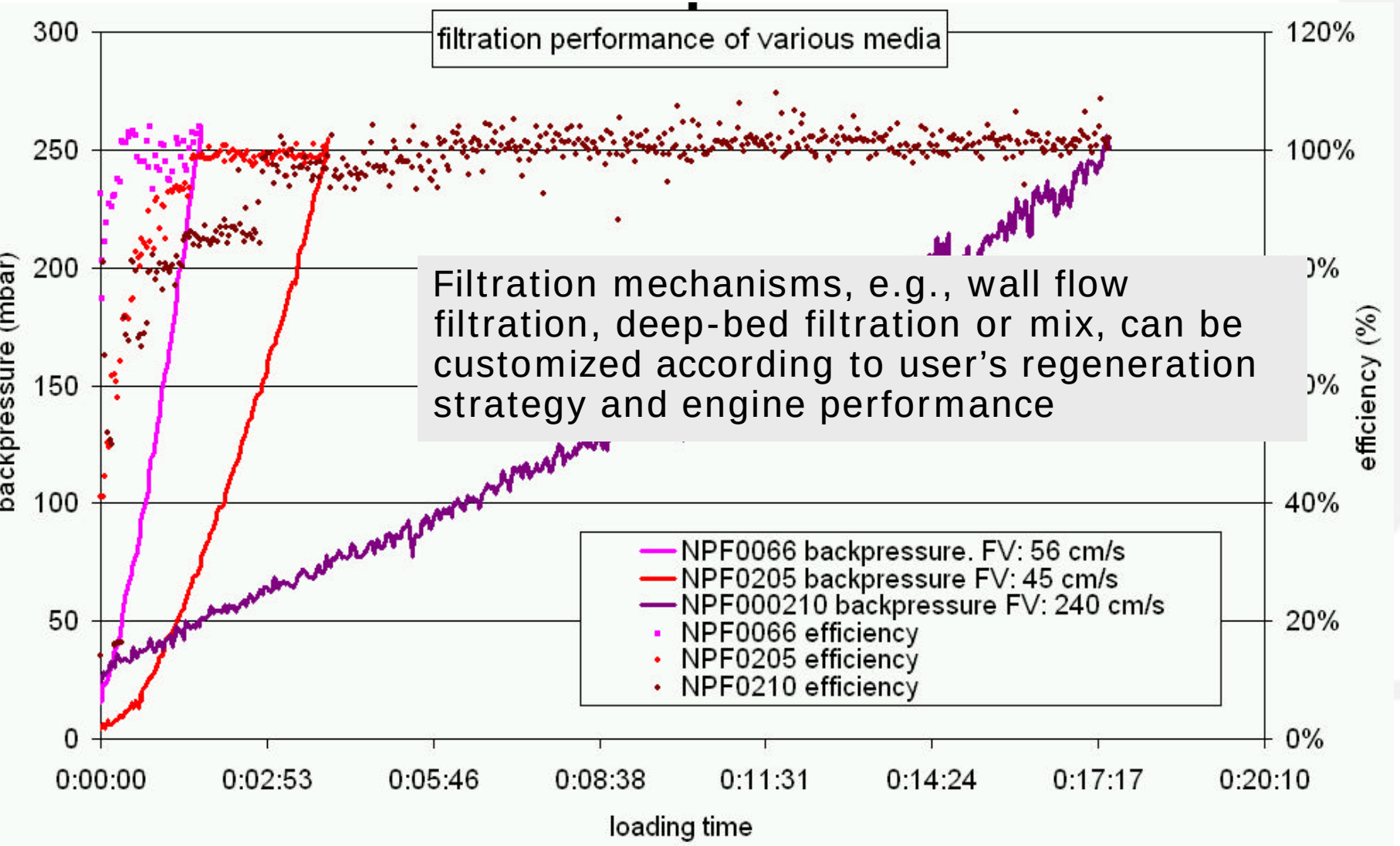




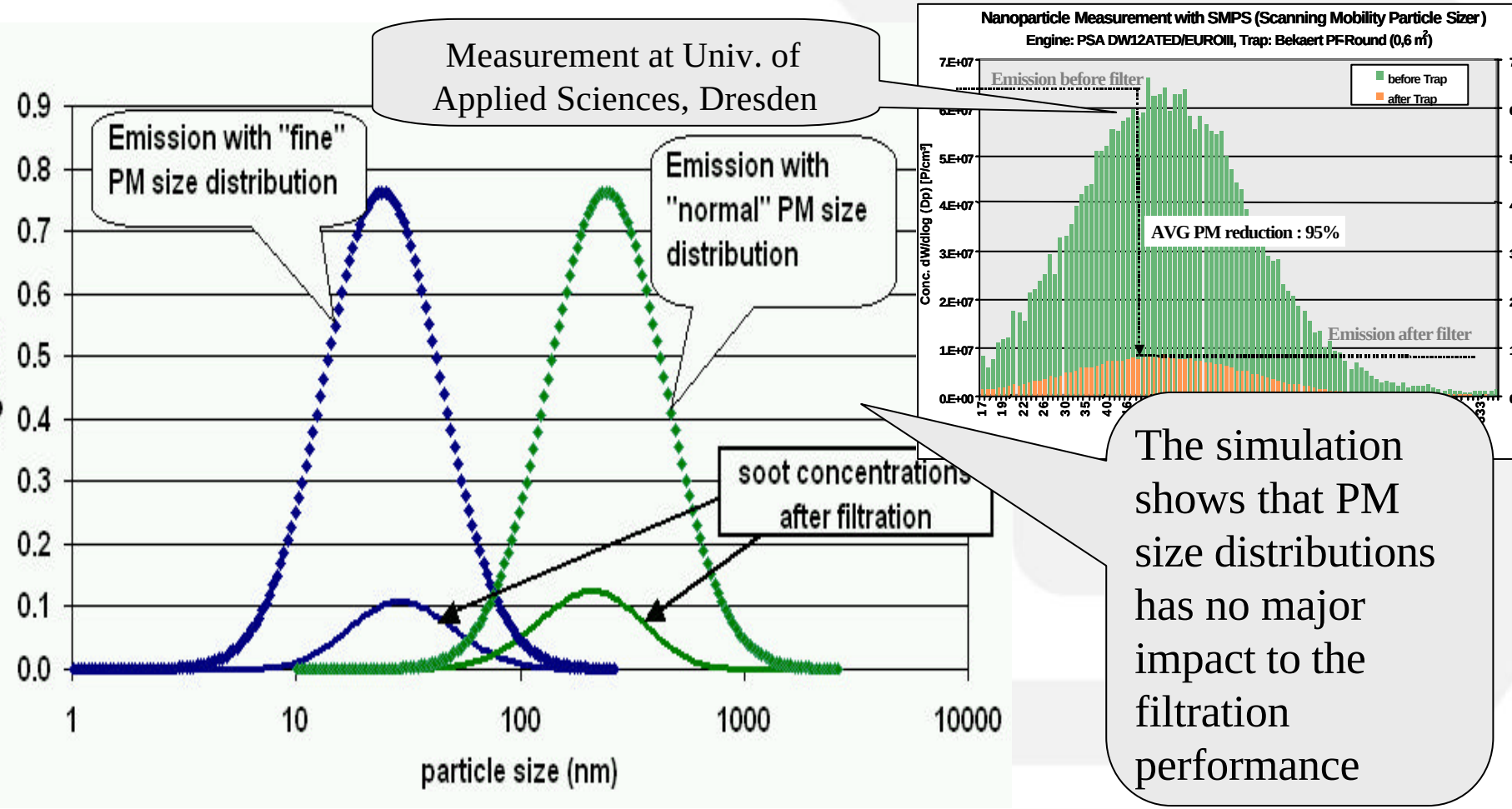


Flexibility in DPF applications –

customizing filtration perfomance by applications



Flexibility in DPF applications - *filter positioning*

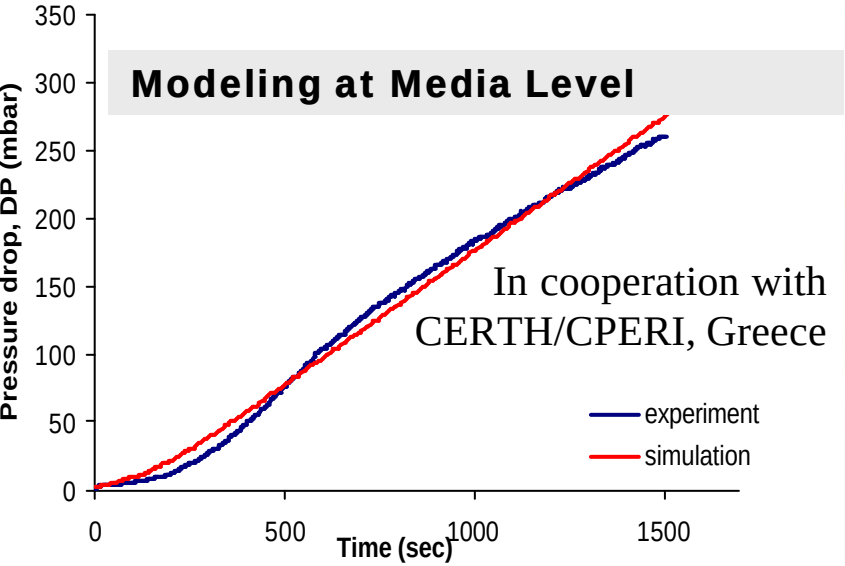


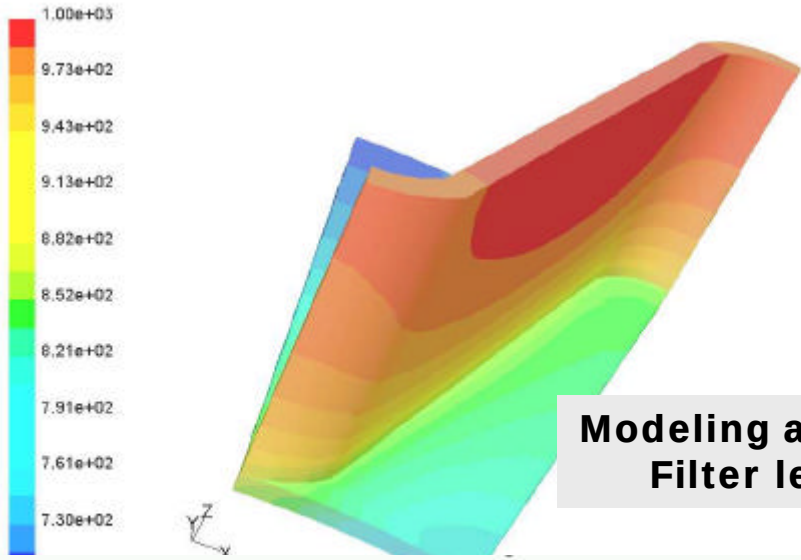
The simulation shows that PM size distributions has no major impact to the filtration performance

This indicates that despite its very porous structure, Bekipor® would also perform well when positioning very close to the engine, where PM sizes are generally smaller but temperature are quite higher.

Developing & Optimizing by Modeling

Modeling at Media Level

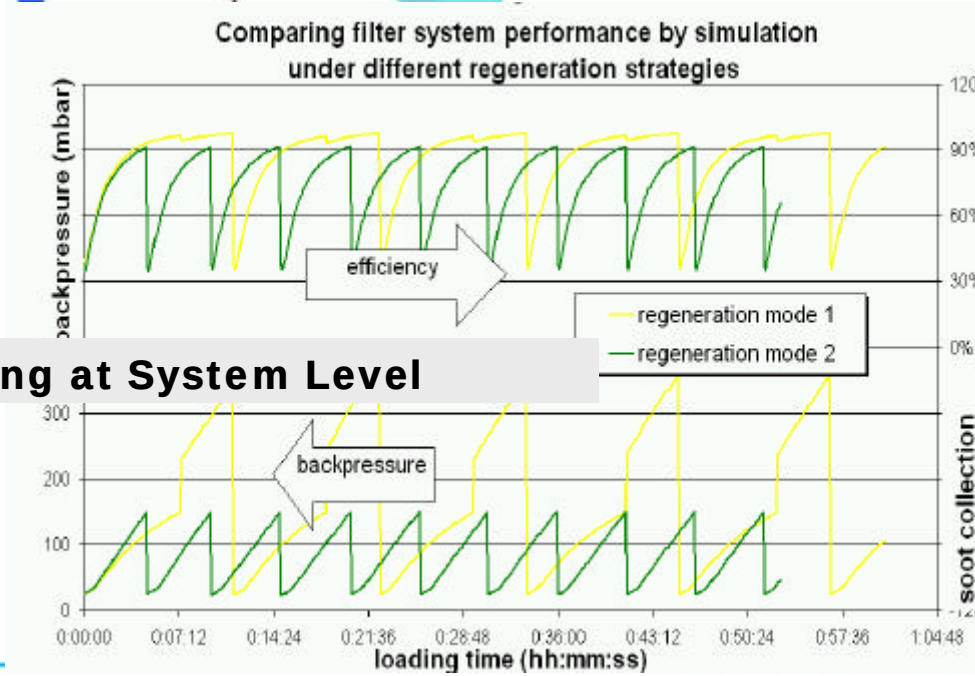




Modeling at Filter level

CFD and other modeling techniques are extensively applied at all levels to optimize and upgrade performances

Modeling at System Level



Field Testing

Road grader (John Deere) :

Stationary Gensets :

Lombardini

Cummins

Forklifts : Hyster with Perkins engine

Conclusion

Investigations find Bekipor® filters robust and flexible

- Material robustness: no damage found under
  - Working temperature up to 1000°C;
  - Heating/cooling rate ~100 °C/s
  - 2-3 % deformation by tensile/compressive stress
- Filtration performance flexibility: subject to needs of customers
  - 90% mean efficiency achievable at up to 240 cm/s face velocity and 27 mbar initial backpressure
  - Bearable backpressure ≥900mbar
- Regeneration strategy flexibility: subject to needs of customers
  - Active mode (electricity, external combustion)
  - Passive mode (catalyst, additives)
  - Mix (active + passive)

Conclusion (cont'd)

The robustness and flexibility make Bekipor® possible to be applied in wide range of DPF activities which are:

- from very low to very high exhaust temperature;
- from very low to very high backpressure constraints;
- involved with severe mechanical vibration and/or thermal instability
- using high sulfur fuel
- of special needs in filter geometry
- demanding in easy reshaping or resizing