Hans-Joerg Rembor

Hot gas filtration of fine and ultra fine particles with Liquid Phase Sintered SiC ceramic DPF

Agenda

Filter media and their structure

Particel collection mechanisms

Back pressure

Soot loading

Liquid Phase Sintered SiC and ist performance

Filter media and their structure

Ceramic media: SiC, Cordierit, etc.
Fibre media: Sintered metal, Glas fibres, Paper

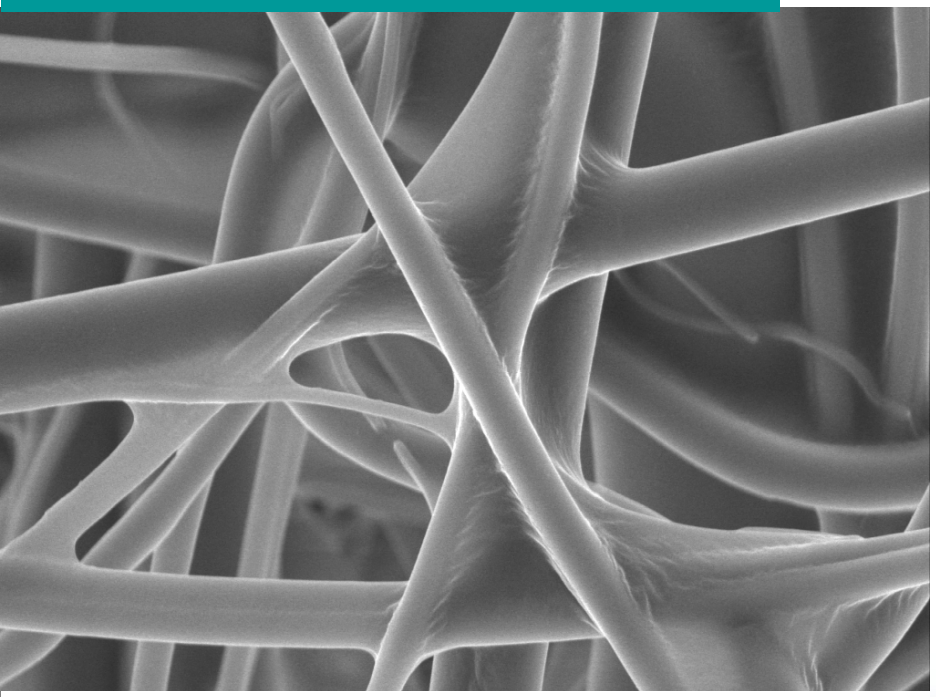
Diameter of the structures: 1 μm bis 50 μm

Pore diameters: 3-10 times bigger than structues

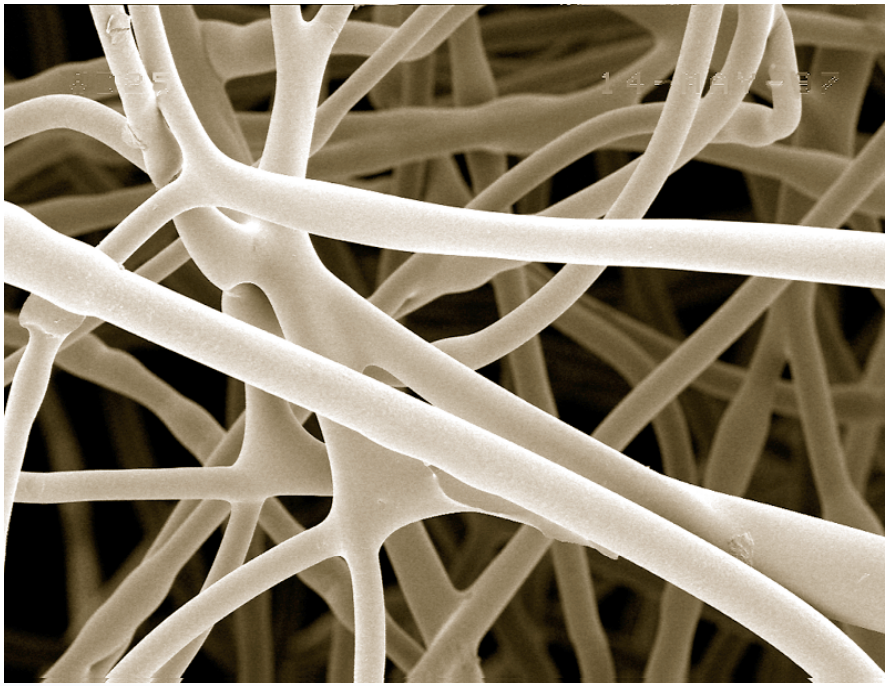
Porosities: 45 % bis 99 %

Comparison: particle diameter of soot 0,001-1 mm

Filter media and their structure

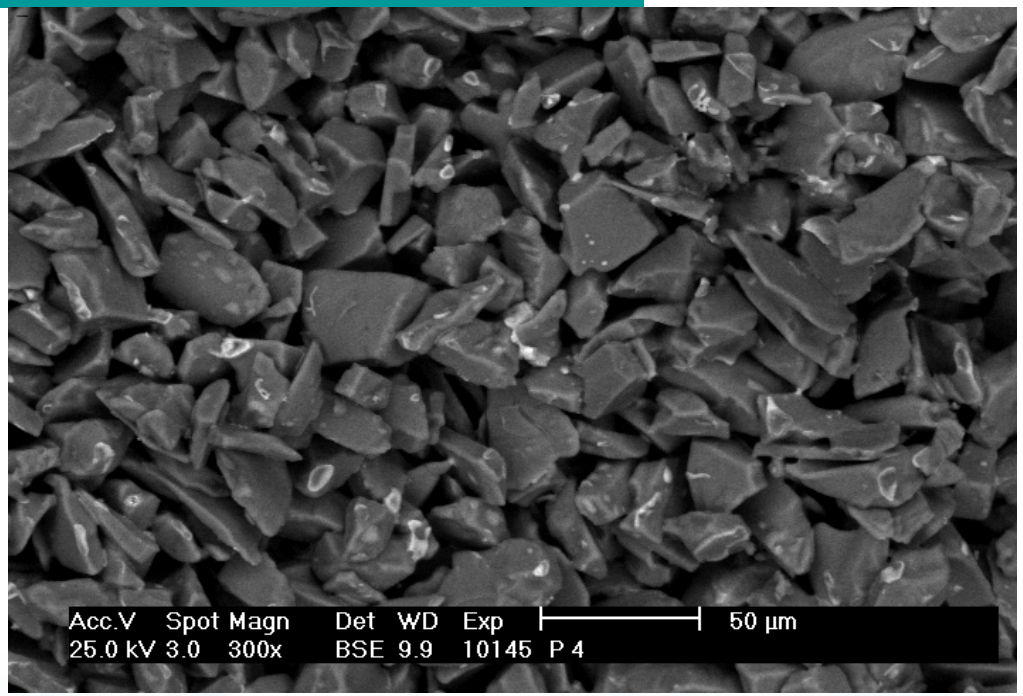


Glas fibre medium



Paper

Filter media and their structure

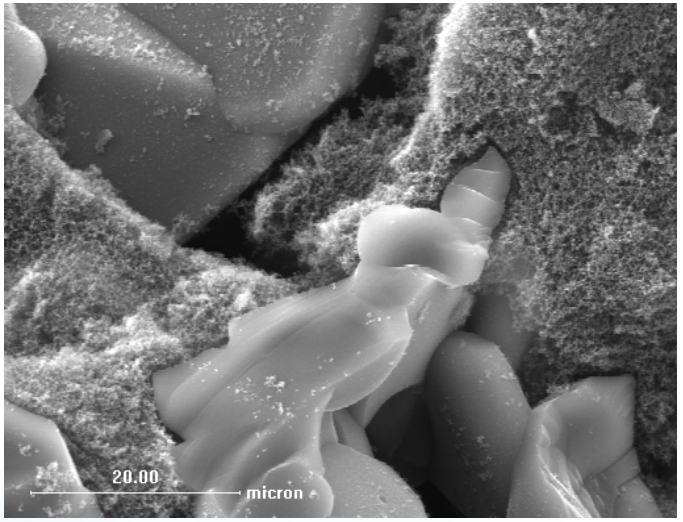


LPS SiC with an average pore diameter of 12 µm

Filter media and their structure

Porosities: up to 99,8%

A filter is not a sieve: pore diameters > particle diameters

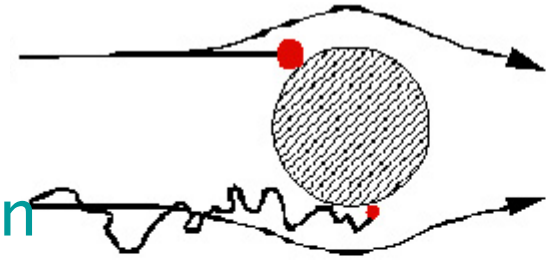


D_F=45µm, d_P=5µm (no soot) D_F=20µm, d_P=0.1µm (soot)

Particle collection mechanisms

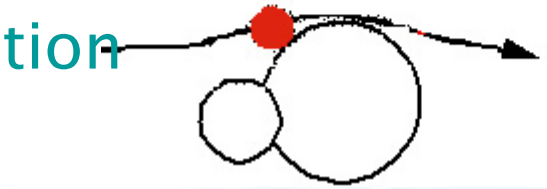
Transport mechanisms to the filter structure

- Inertia

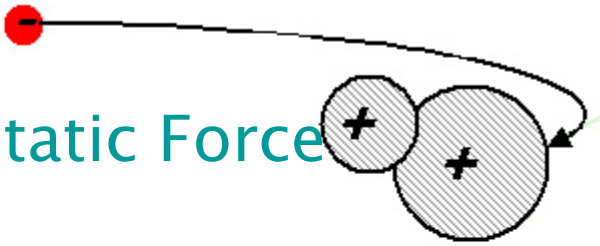


- Diffusion

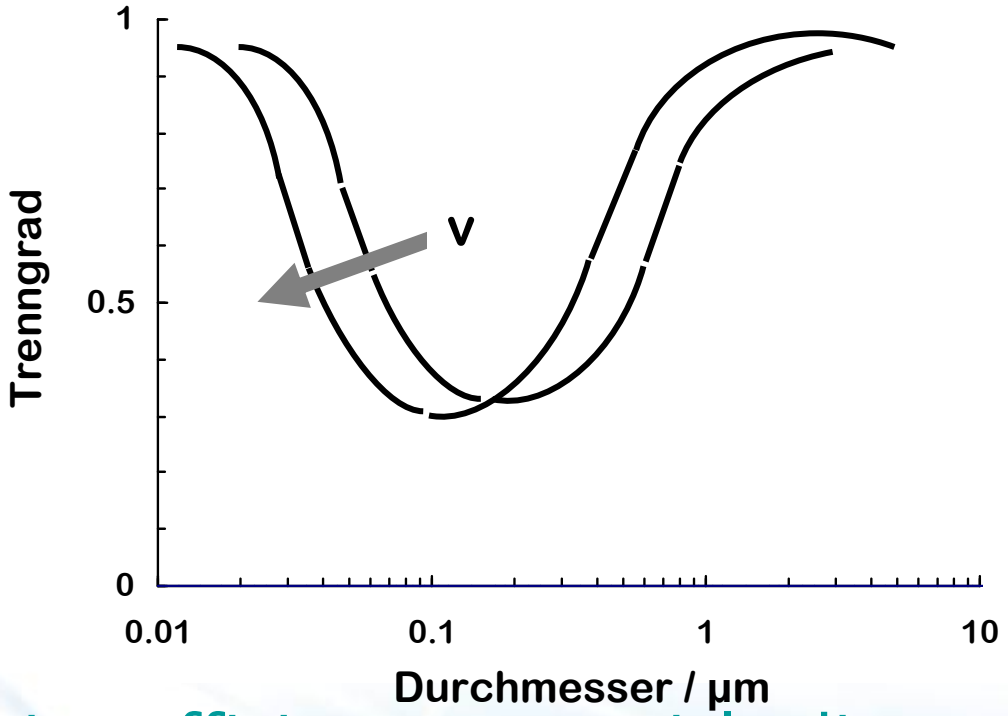
- Interception



- Electrostatic Force



Particle collection mechanisms



Collection efficiency vs particle diameter and velocity

Back pressure

- High porosity: Drag force model
- Drag Force on whole filter material → Δp
- Drag force model for a single object

$$W = \frac{\rho}{2} u^2 c_D A_F$$

$$\frac{\Delta p}{z} = \frac{W}{Az} = \frac{2}{\pi} c_D u^2 \frac{\rho}{D_F} \alpha$$

ρ = *fluiddensity, u = velocity*

c_D = *drag force coefficient,*

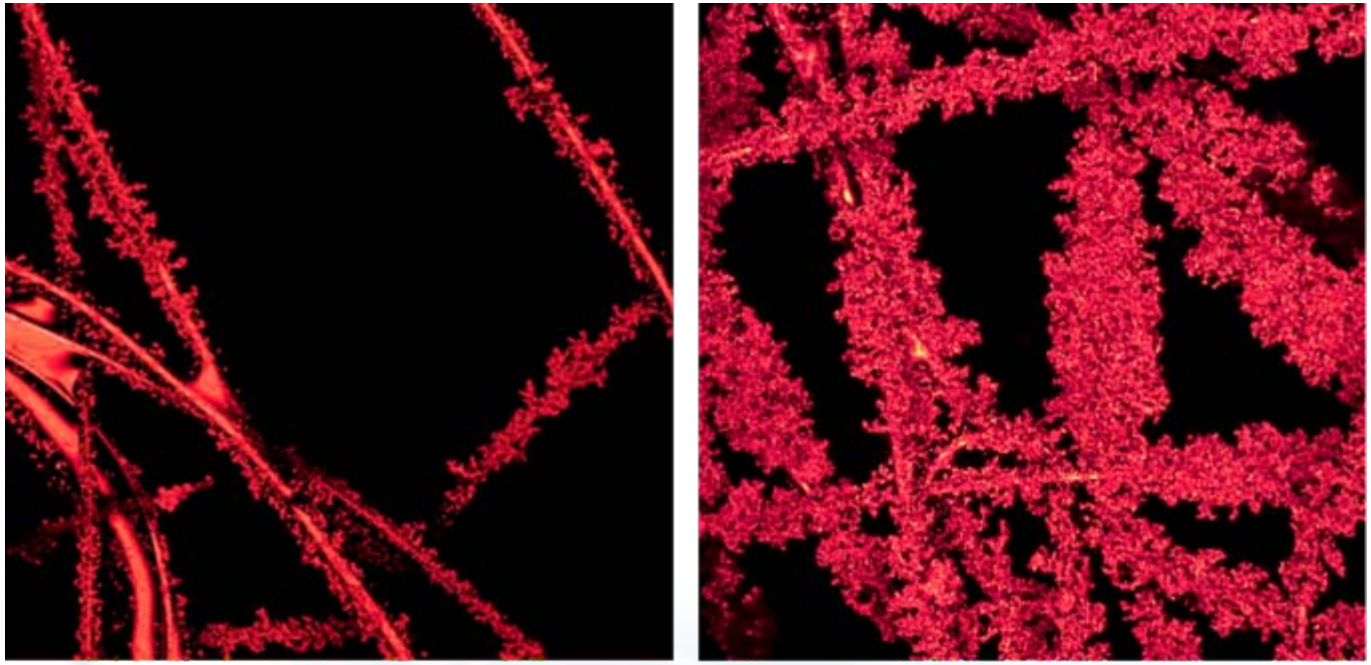
z = thickness

Az = filtration area

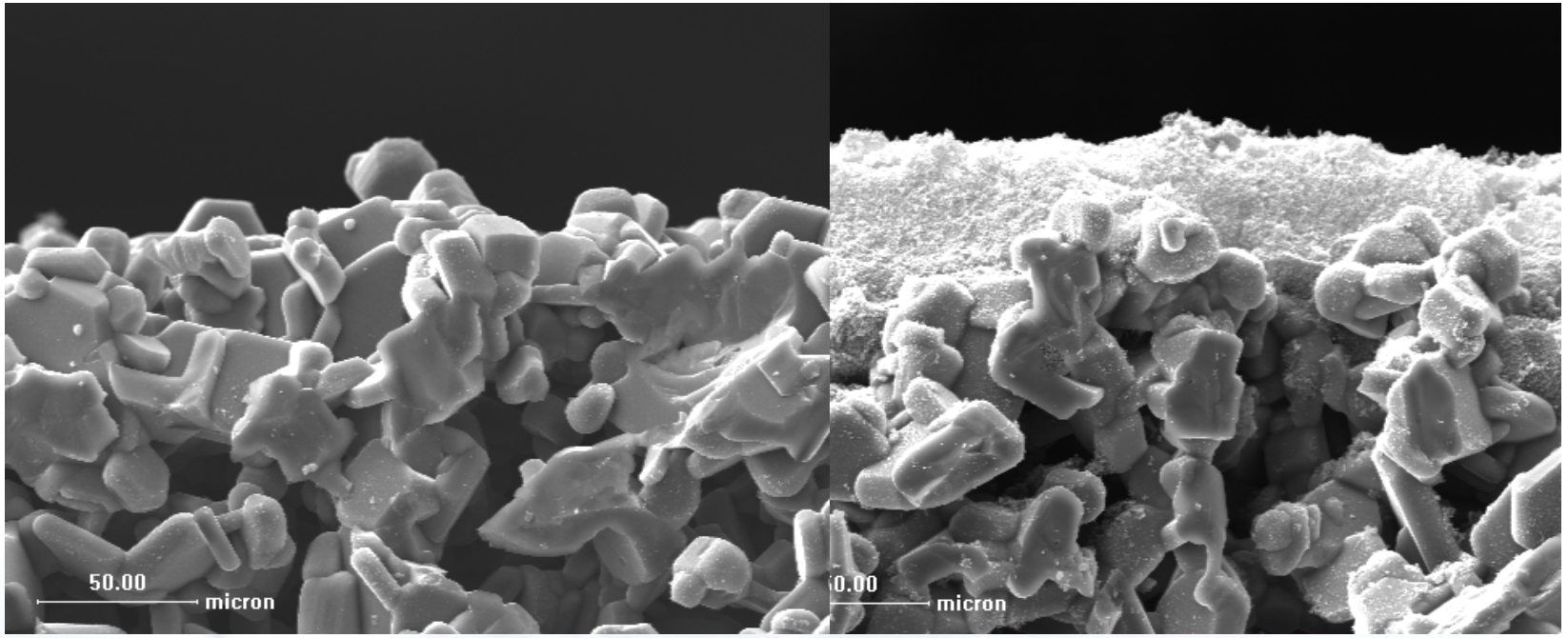
A_F = *projected area of all filter structure*

α = *packing density,* ε = *porosity,* $\varepsilon = 1 - \alpha$

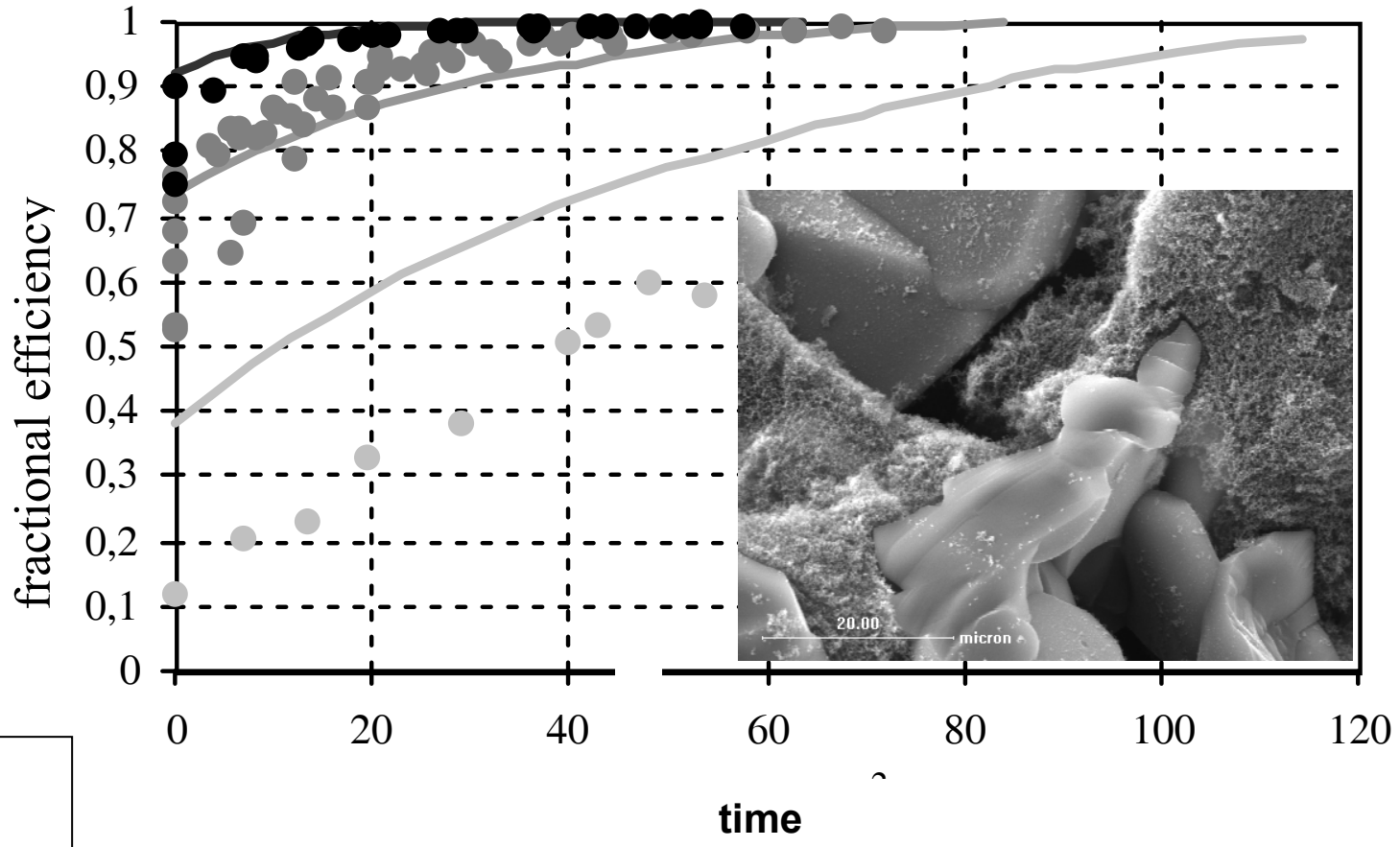
Soot loading



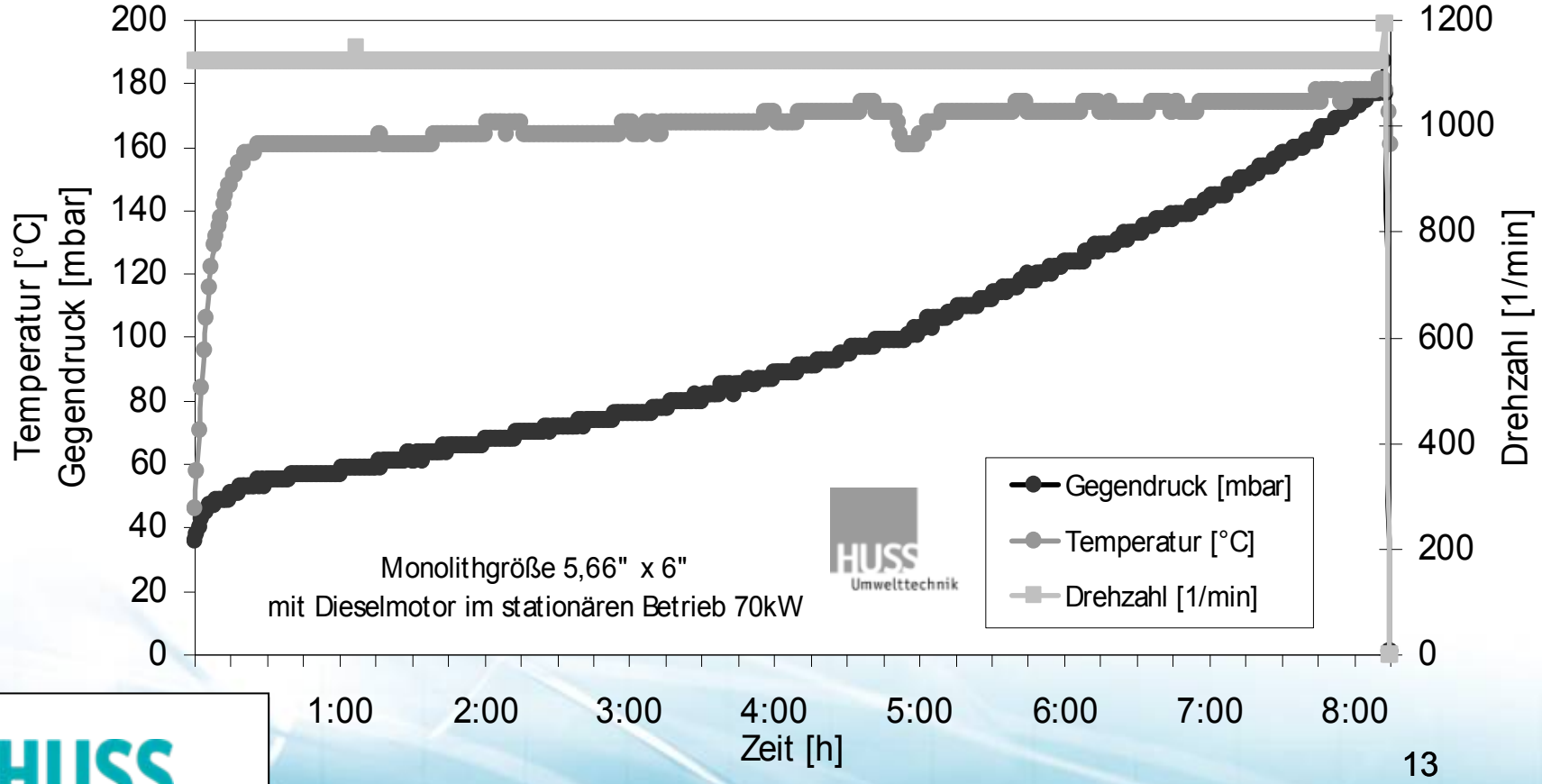
Soot loading
Deep bed/surface filtration



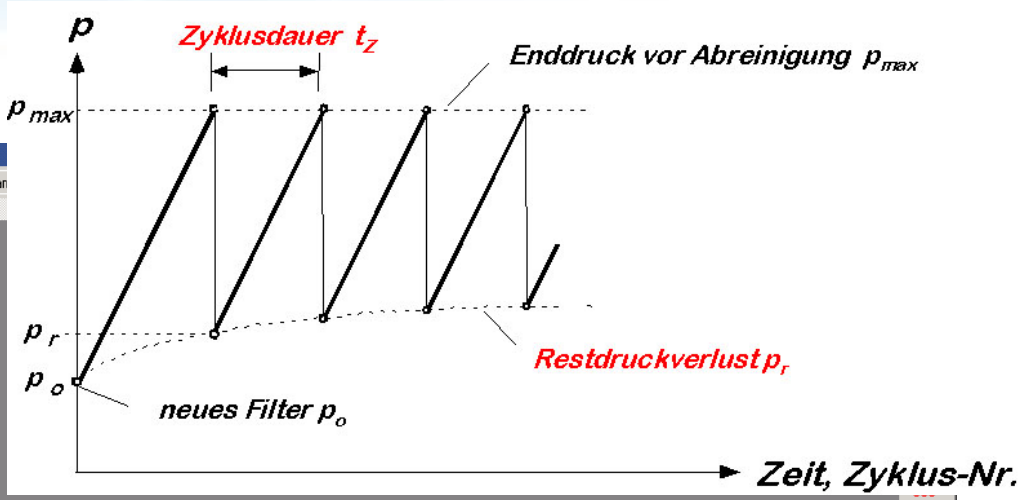
Soot loading
Collection efficiency



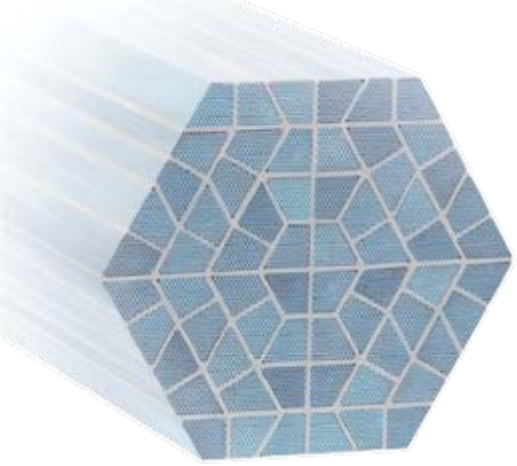
Soot loading
Back pressure



Soot loading
Back pressure



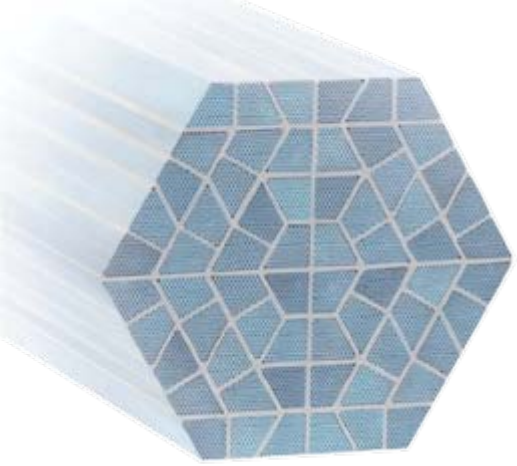
LPS-SiC – the characteristics



Material characteristics

- High thermal resistance
- High chemical
- High mechanical resistance
- High filtration efficiency
- Low back pressure

LPS-SiC –
the characteristics



Geometry

„Wall flow“-Filter

High flexibility through segmented design

14 % higher filtration area than square channels

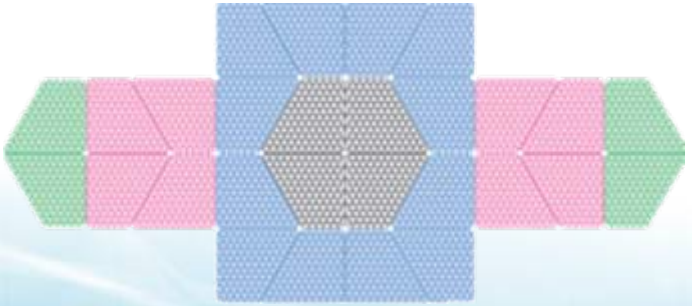
200 cpsi cell density

Performance

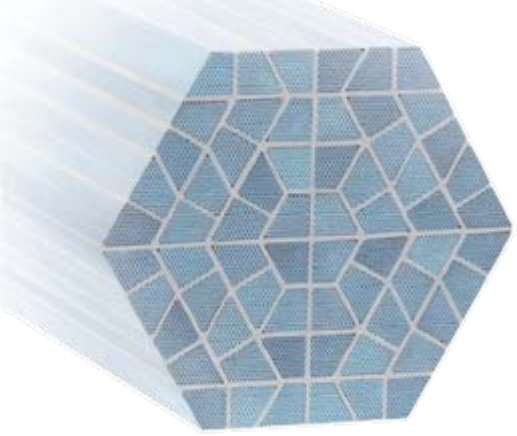
99,9 % collection efficiency (by number)

Low back pressure

Soot loading capacity 8-10 g/l

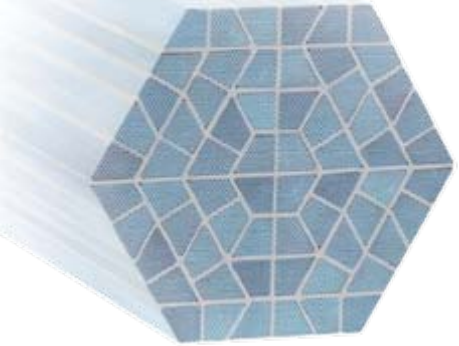


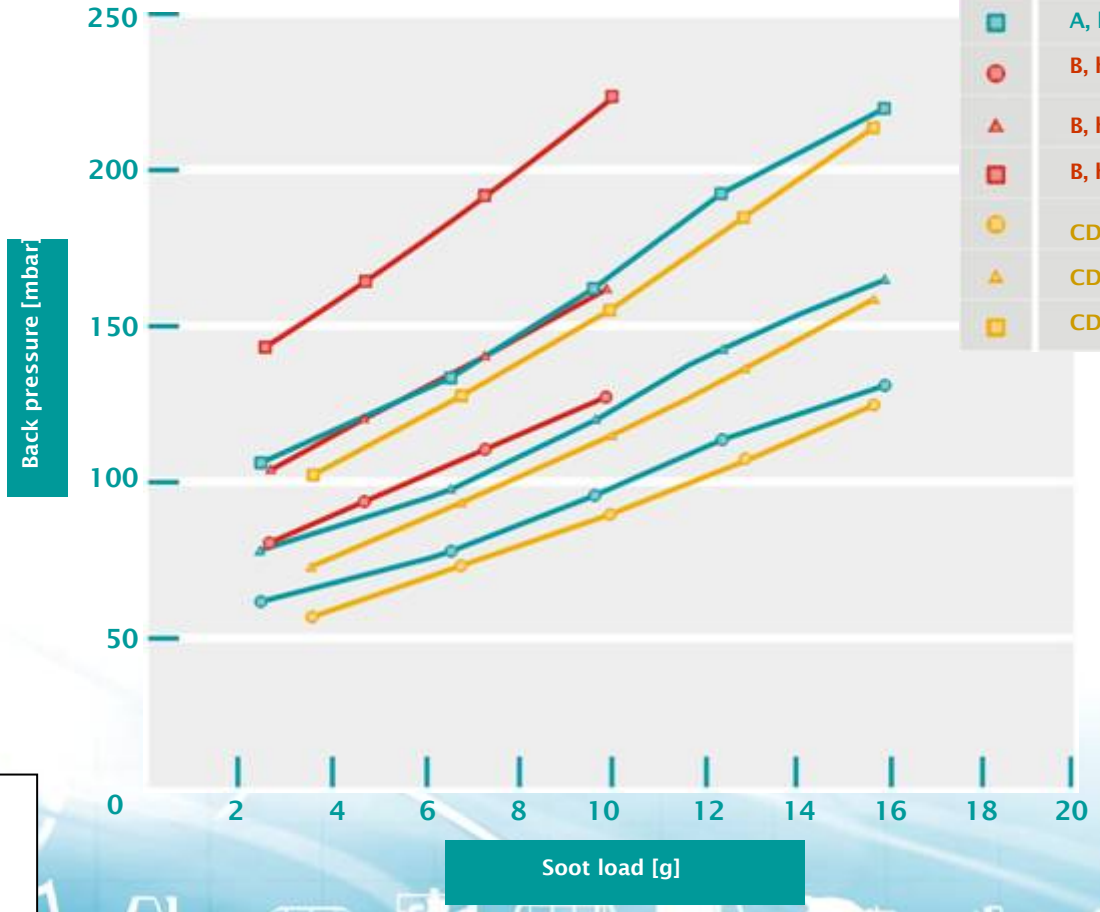
LPS-SiC –
the characteristics



Parameter	CDC -F360
Filtration efficiency (by number)	99,0 % (d = 2 nm – 2 mm)
Porosity	54,1 %
Av. Pore diameter	9,9 mm
Wall thickness	0,35 mm
E-Module	30,3 GPa
Therm. expansion CTE	$4{,}5 \cdot 10^{-6}$ 1/K (bei 30 bis 1000°C)
Therm. conductivity	15,8 W/mK
Tolerance diameter	≤ 1 mm
Tolerance lenght	

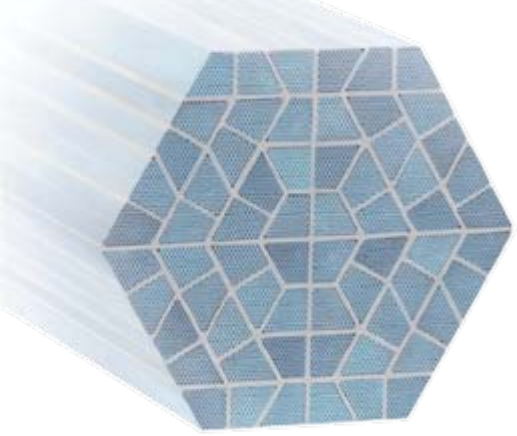
LPS-SiC –
the characteristics

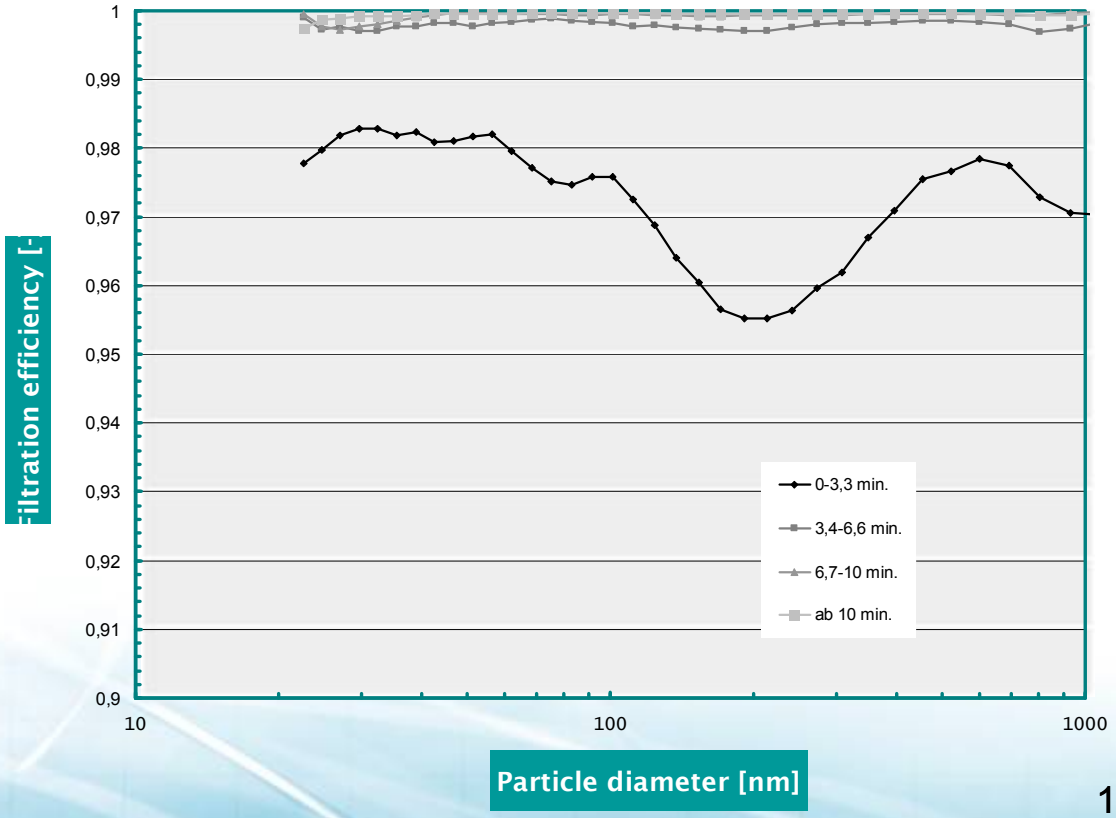




Back pressure vs soot load for hexagonal Filters with same sizes (diameter heagon s=140mm x lenght 6")
(average out of 5 measurements)

LPS-SiC –
the characteristics





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