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Debottlenecking HCGO Filtration

Niels van der Horst, Düsseldorf, Germany, October 2011

Agenda

- Company Profile
- HCGO Filtration
  - the problem
  - design principles
  - operations
- Testing facilities
- Reference project
- Questions

Dahlman world wide I

- Head offices in Maassluis, The Netherlands

  - Management
  - Sales
  - Engineering
  - Production

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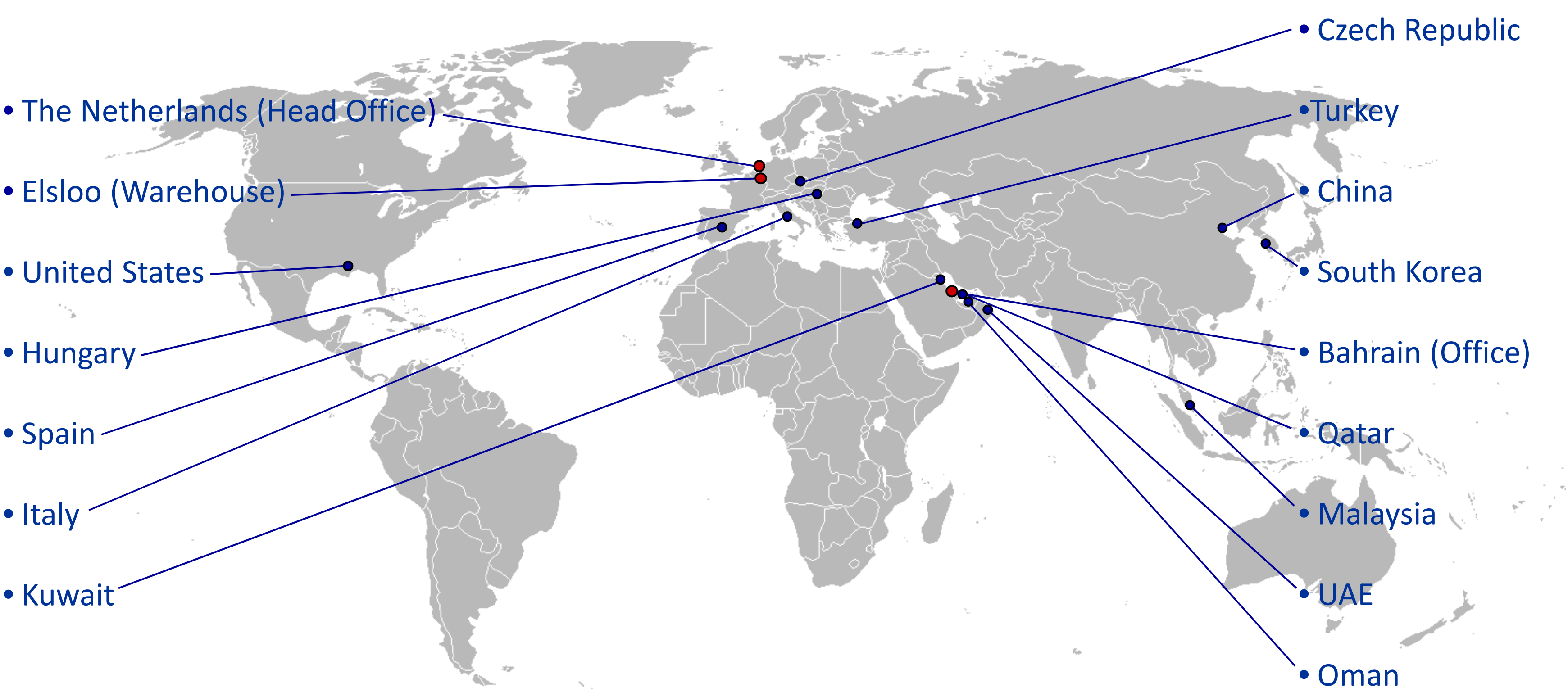
Dahlman world wide II

- Riffa (Bahrain)
  - Sales ME, Gulf Area
  - Consultancy

- Elsloo (The Netherlands)
  - Spare Parts & Consumables
  - Total Supply Frame Agreements
  - Maintenance
  - After Sales Services

Dahlman world wide III



The problem with filtration

- Penetration of contaminants in filter medium
  - > Short cycle times

- Element cleaning not powerful and effective
  - > Backwashing with filtered product shows bad results

Result:

- *High backwash frequency -> excessive product loss*
- *Ex situ cleaning required -> downtime causing production losses*

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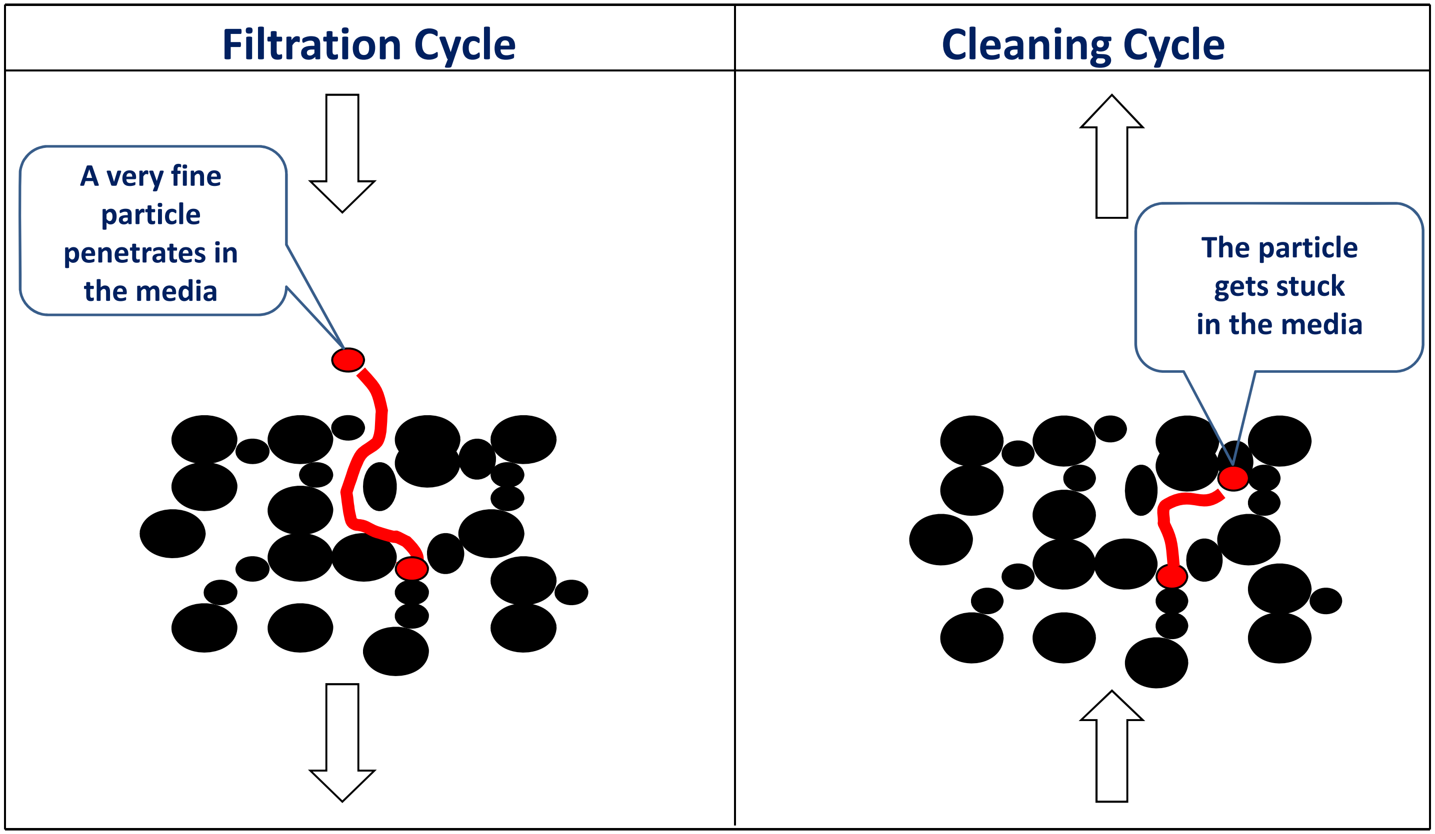
HCGO Filtration Design Principles

- Minimize penetration of contaminants in filter medium
  - > ***S*urface filtration**
- Optimal use of filter area at high solids content
  - > **Filtration from inside-to-outside**
- Element cleaning needs to be powerful and effective
  - > **Gas-assisted backwash (steam, nitrogen or (sweet) fuel gas)**
- Effective way of sludge disposal
  - > **Sludge removal gas-driven or by pump(s)**

Minimize penetration of contaminants in filter medium

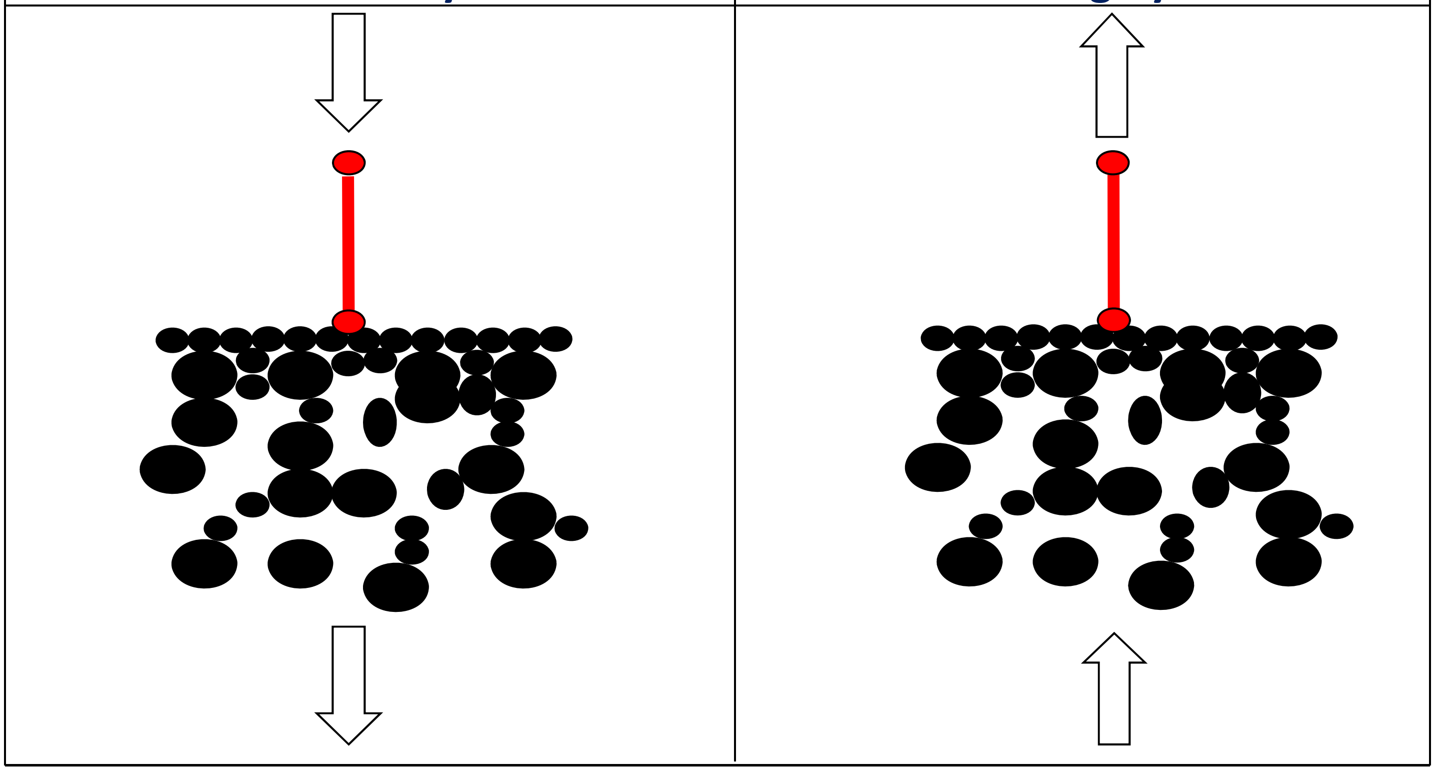
Not depth filtration …



Minimize penetration of contaminants in filter medium

But surface filtration!

Filtration Cycle	Cleaning Cycle



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Filter media used for pilot testing

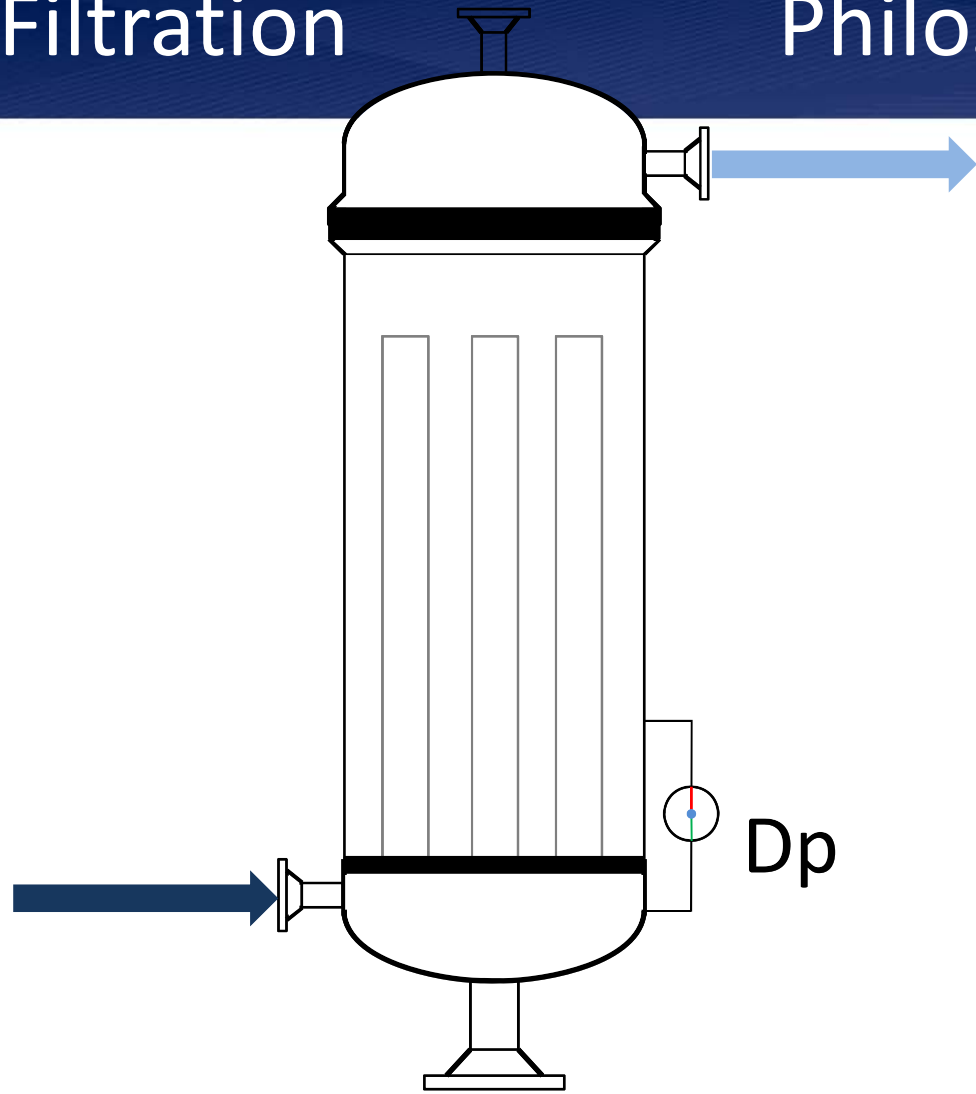
DAHLMAN CLASSIC SINTERED POWDER, WIRE MESH & DAHLMAN (NEW DEVELOPED) WEDGED WIRE ELEMENTS

- Surface filtration
- Shape stability
- Suitable for high differential pressure
- Easily cleanable using gas assisted back flush technology
- Wide variety of sizes and materials
- High permeability with low pressure drop
- Chemical and heat stability, also for ex situ cleaning

<u>Demonstrated technology for HCGO filtration</u>

Dahlman Filtration Philosophy I

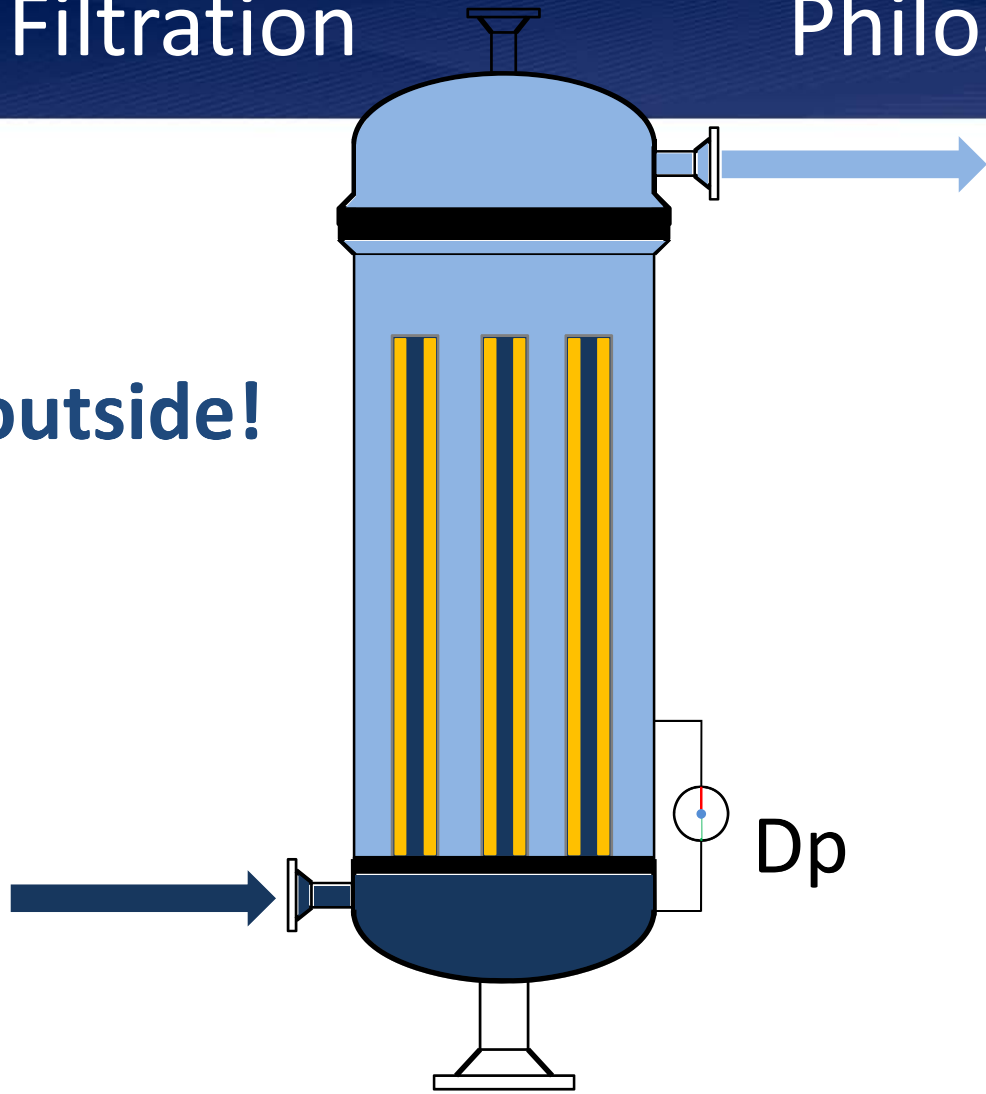
- Filling



Dahlman Filtration Philosophy II

- Filtering

Inside to outside!

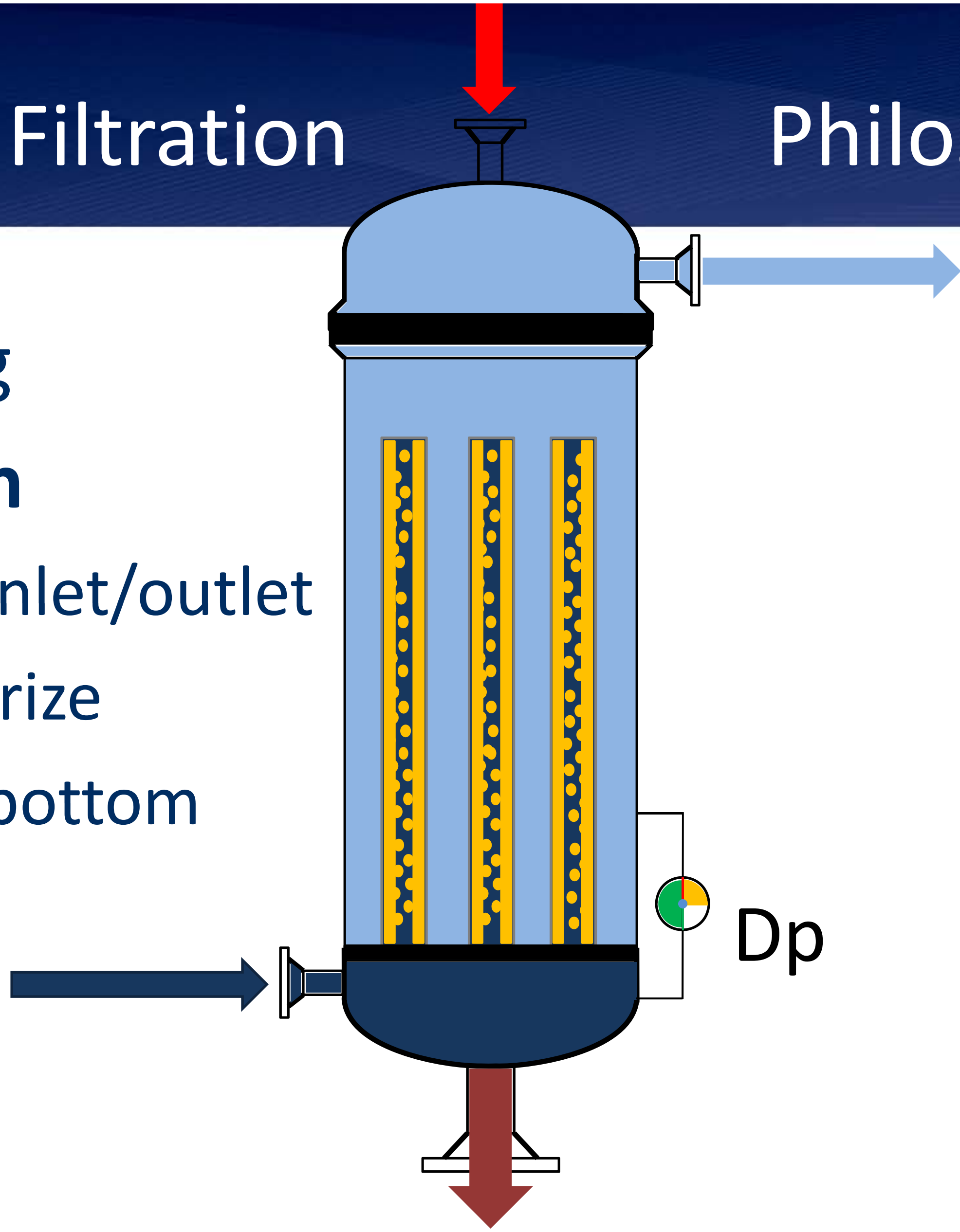


Dahlman Filtration Philosophy III

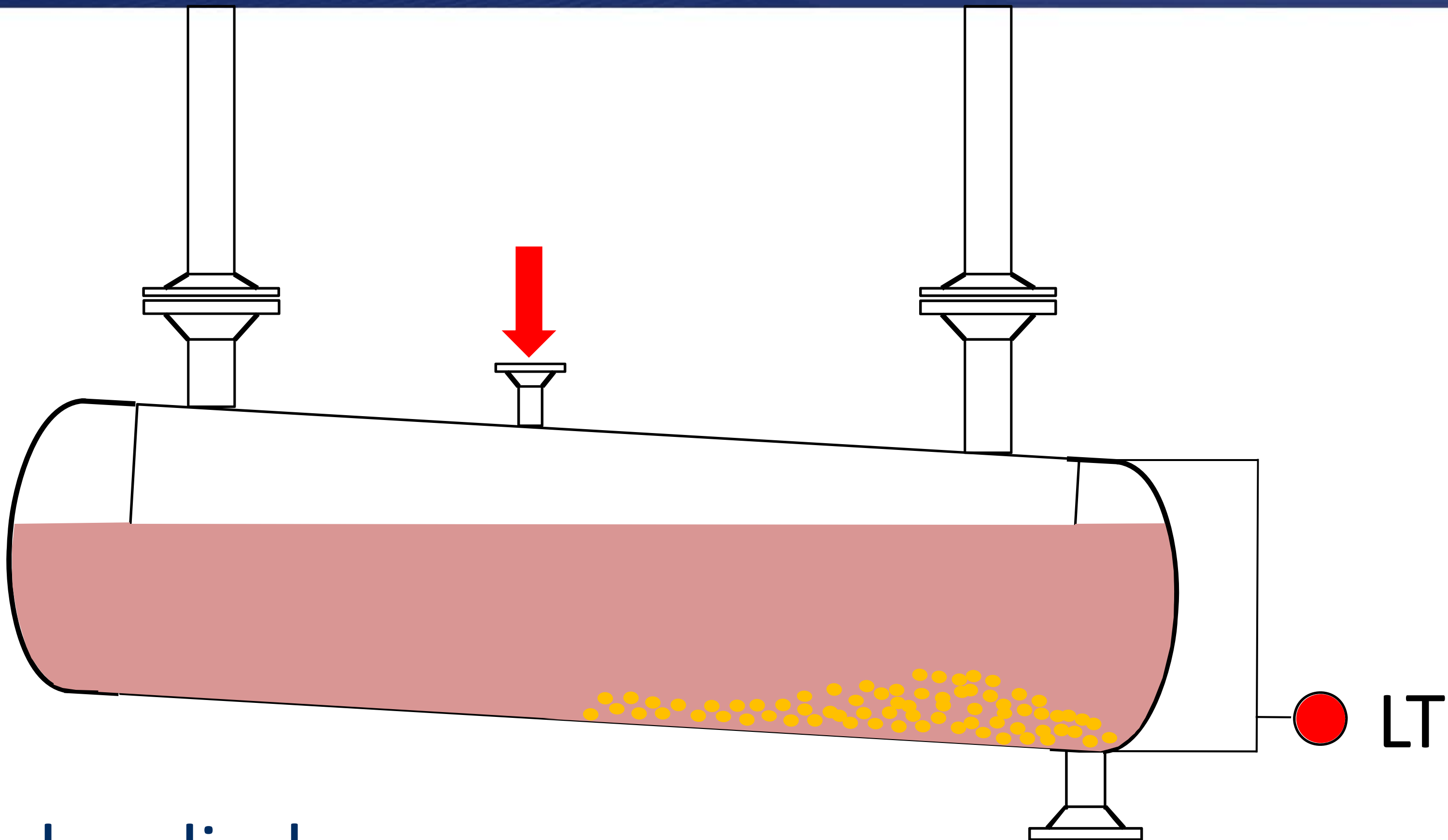
- Cleaning

Gas-driven

- Close inlet/outlet
- Pressurize
- Open bottom valve



Dahlman Filtration Philosophy IV



- Sludge discharge

Testing Facility

Semi Automatic Backflush Test Filter with FCV

Test unit in place

Different elements are tested

Convincing results

Process Specifications

• Fluid	:	HCGO
• Particles	:	Coke fines
• Flow rate		
- Normal	:	70 m^3/hr
- Maximum (design)	:	76,6 m^3/hr
• Temperature		
- Operating	:	240 °C
- Design (mechanical)	:	310 °C
• Density	:	801,5 kg/m^3
• Viscosity @ operating temperature	:	0,22 cP
• Pressure		
- Operating	:	8,5 bar
- Design	:	35 bar
• Maximum allowable pressure drop	:	3 bar

Testing

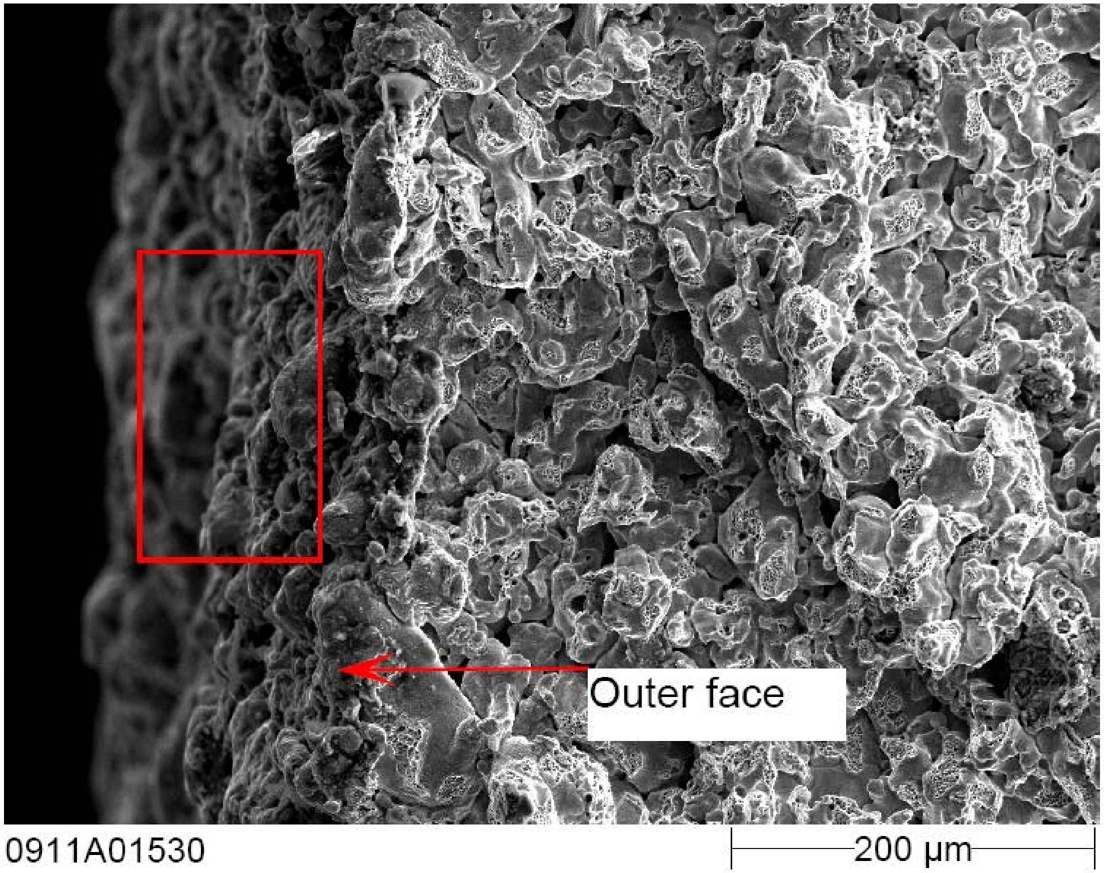
Questions:

- Which filter media is best able to filter HCGO?
- Will these filter elements be cleaned effectively?
- What are the expected cycle times?
- What is the effect of gas assisted backwashing, can we reach initial clean delta P?

Dahlman Test Rig

Problem Analyses Sintered Powder

Fracture surface
SEM-imaging: Device Tescan TS5130MM



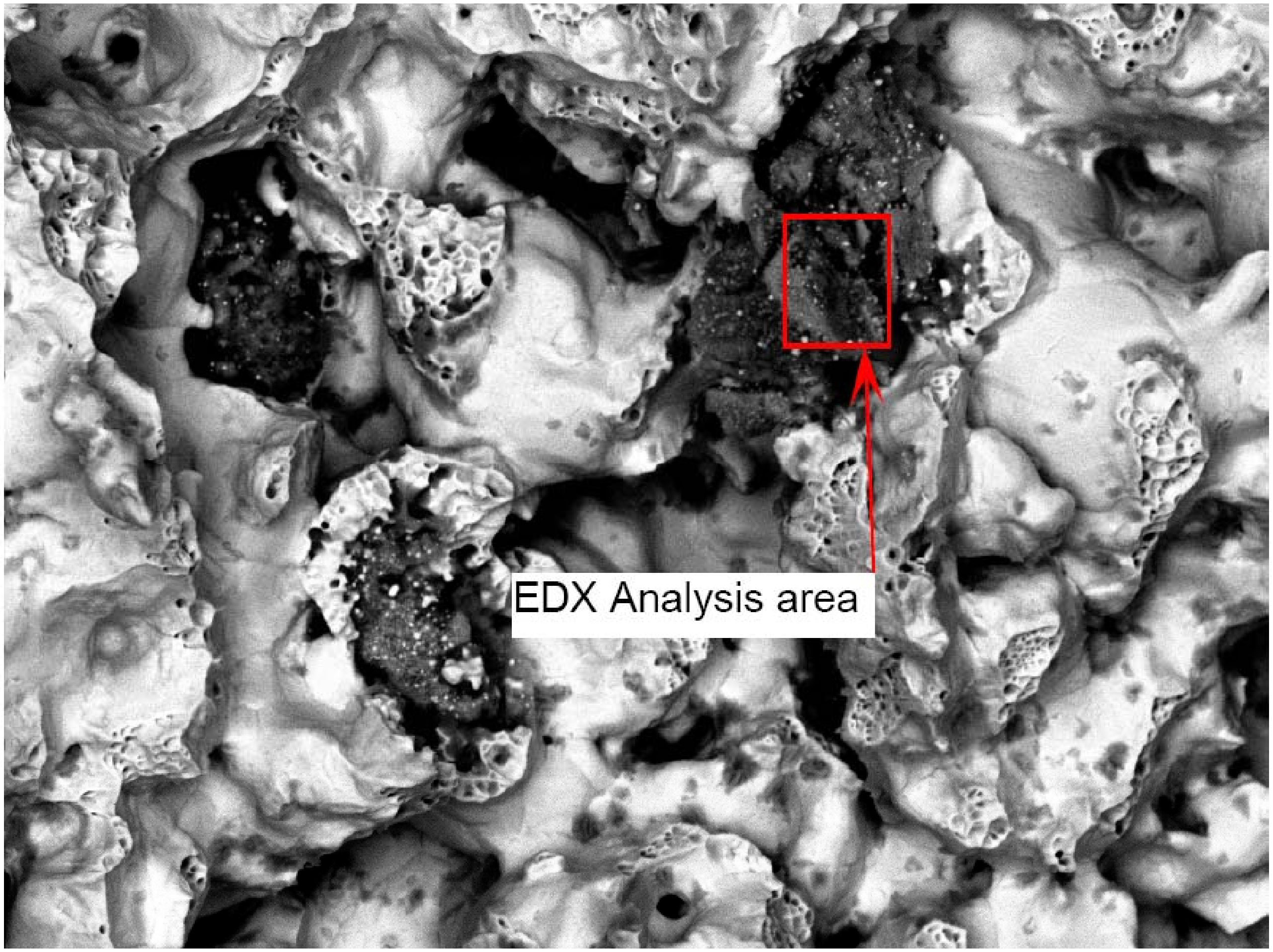
Work-Nr.: 2009110040

Magnification: 215 : 1

EDX Analysis results

Element	Massen%	Atom%
O K	38.11	55.26
Na K	0.62	0.63
Mg K	24.68	23.55
Al K	1.28	1.10
Si K	4.24	3.50
S K	1.36	0.98
Cl K	9.25	6.05
K K	0.78	0.46
Ca K	1.40	0.81
Cr K	3.45	1.54
Fe K	12.84	5.33
Ni K	1.98	0.78
Insgesamt	100.00	

Problem Analyses Sintered Powder



0911A01522 50 µm

Work-Nr.: 2009110040

Magnification: 1000 : 1

Image comment:
Foreign material in pores

EDX Analysis:

Element	Massen%	Atom%
C K	15.90	33.68
O K	18.56	29.52
Si K	10.81	9.80
S K	3.61	2.87
Cr K	25.05	12.26
Mn K	7.53	3.49
Fe K	16.32	7.43
Ni K	2.23	0.97
Insgesamt	100.00	

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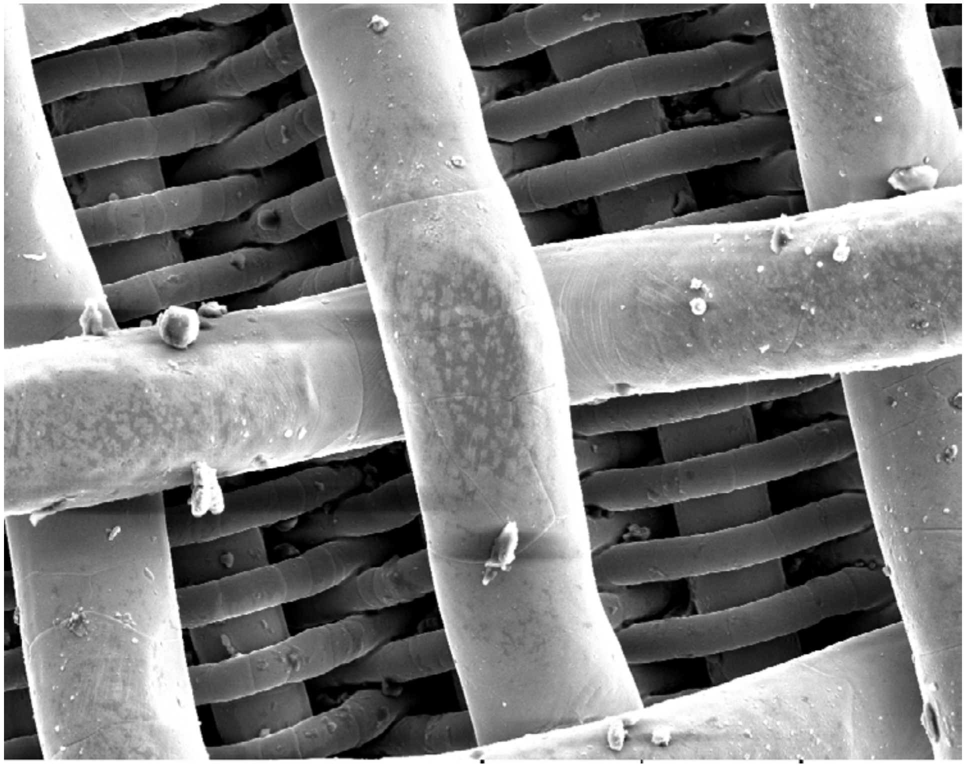
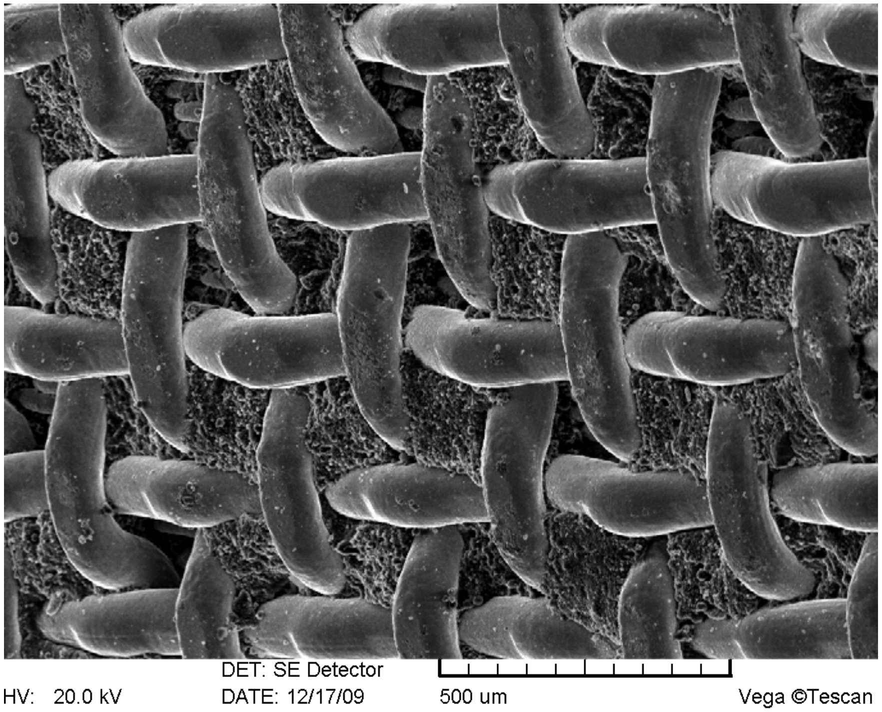
Analyses of Sintered Wire Mesh

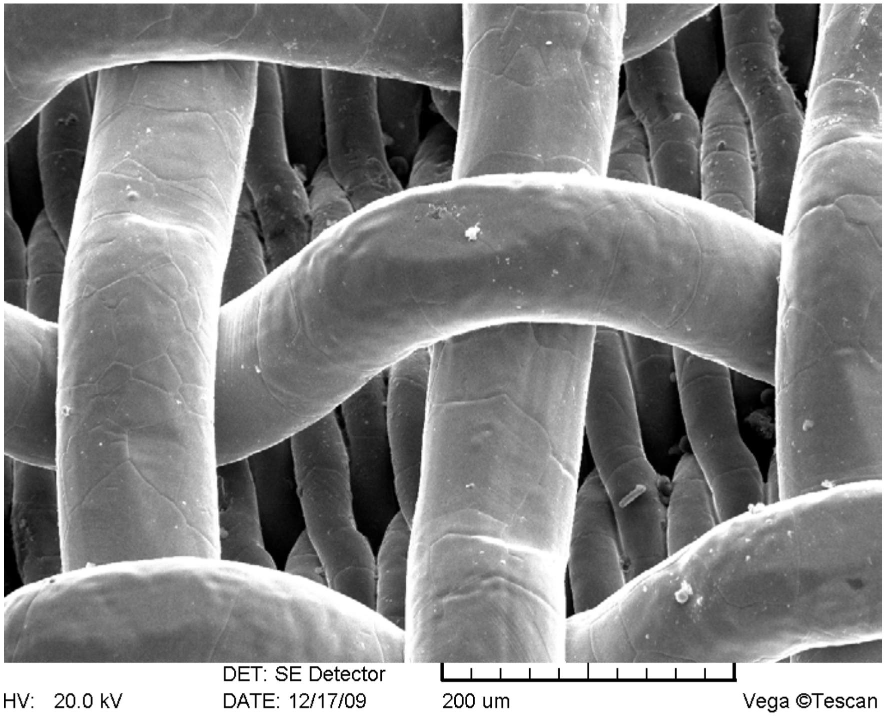
Cut section



Microscopic detail

Analyses of Sintered Wire Mesh

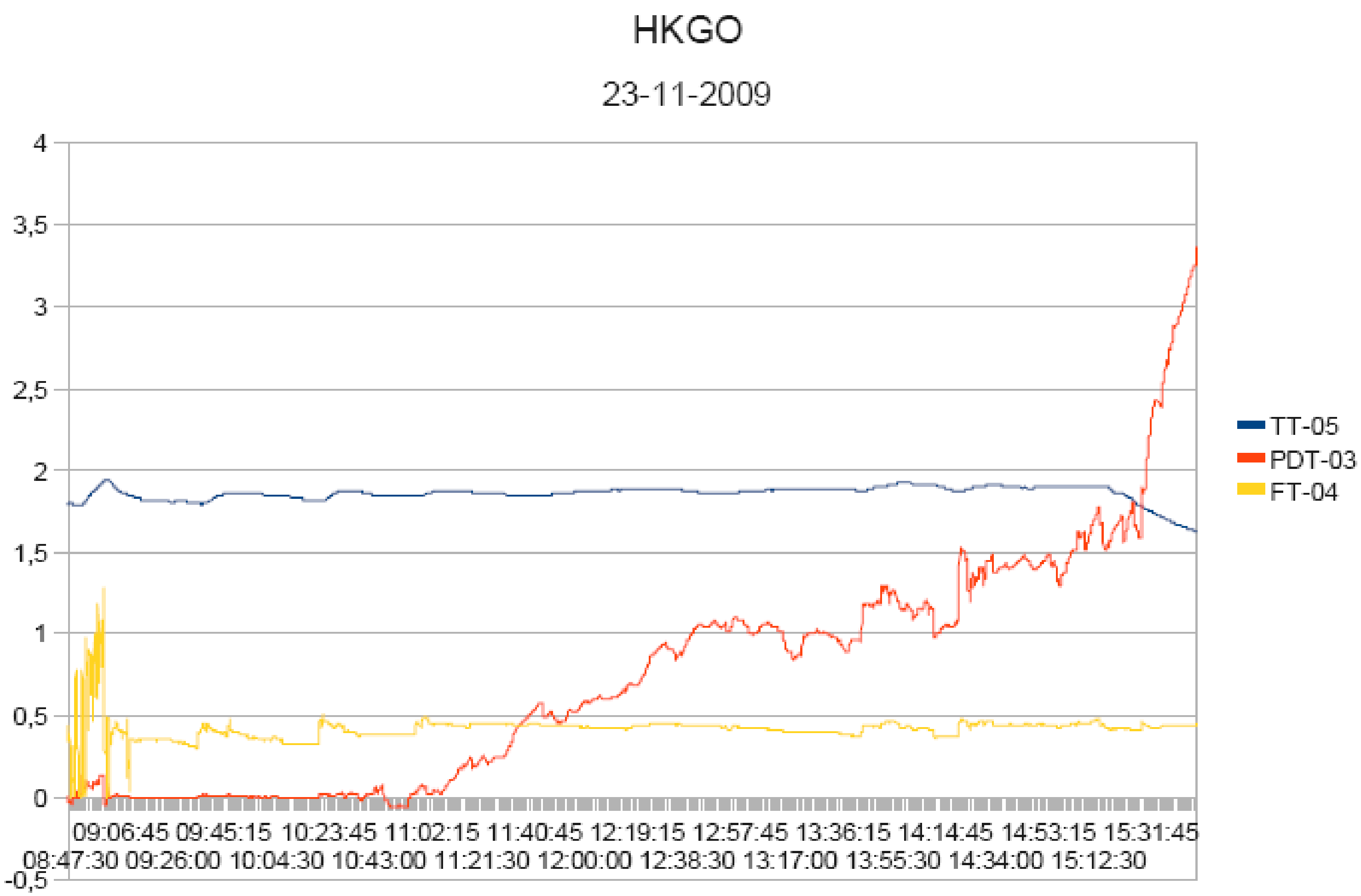




Before cleaning

After cleaning

Filtration Test Results



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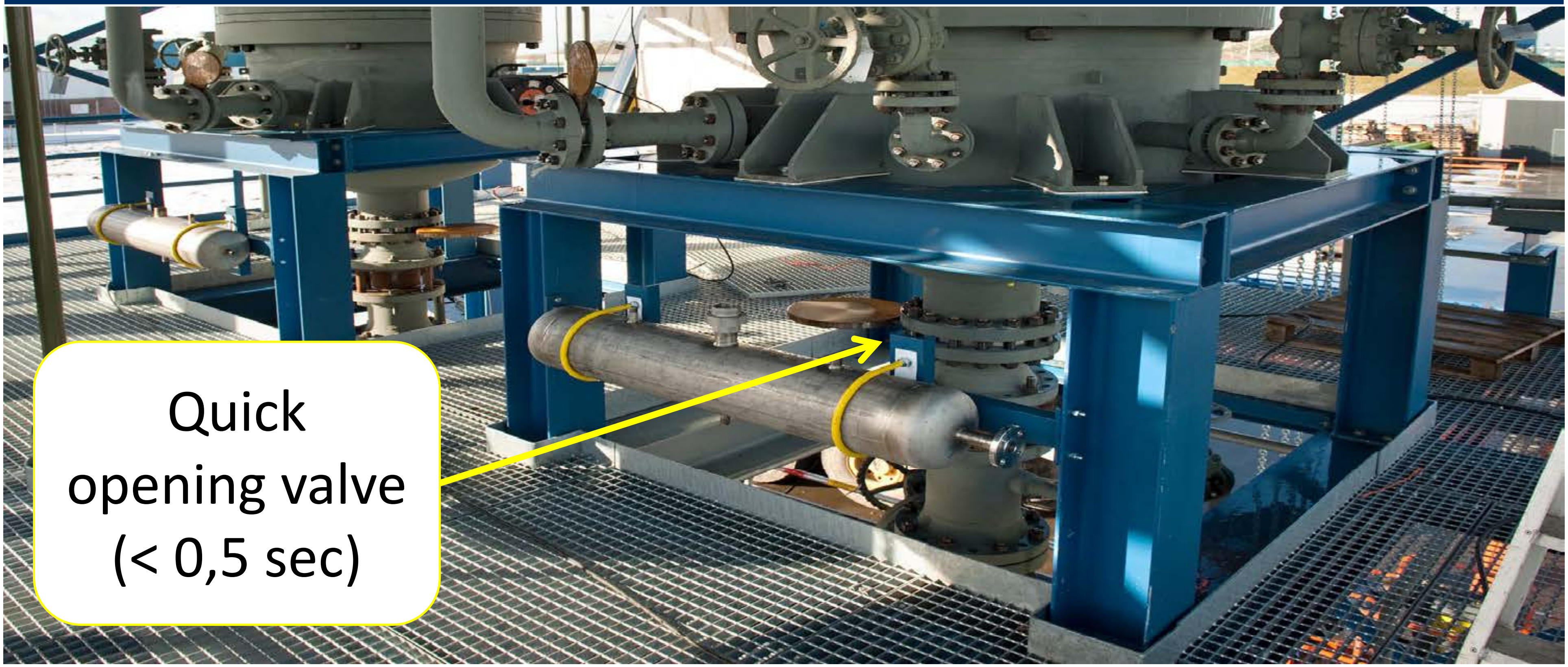
Conclusion of the testing

- A significant amount of very small coke particles is present
- Lower operational temperatures than indicated; temperature drops during drum switch (8h-16h operation)
- Improved back flush results using LCGO
- Some filter media is not useful for HCGO filtration

Dahlman HCGO Reference Project

Detailed picture of the special discharge valve



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Dahlman HCGO Reference Project

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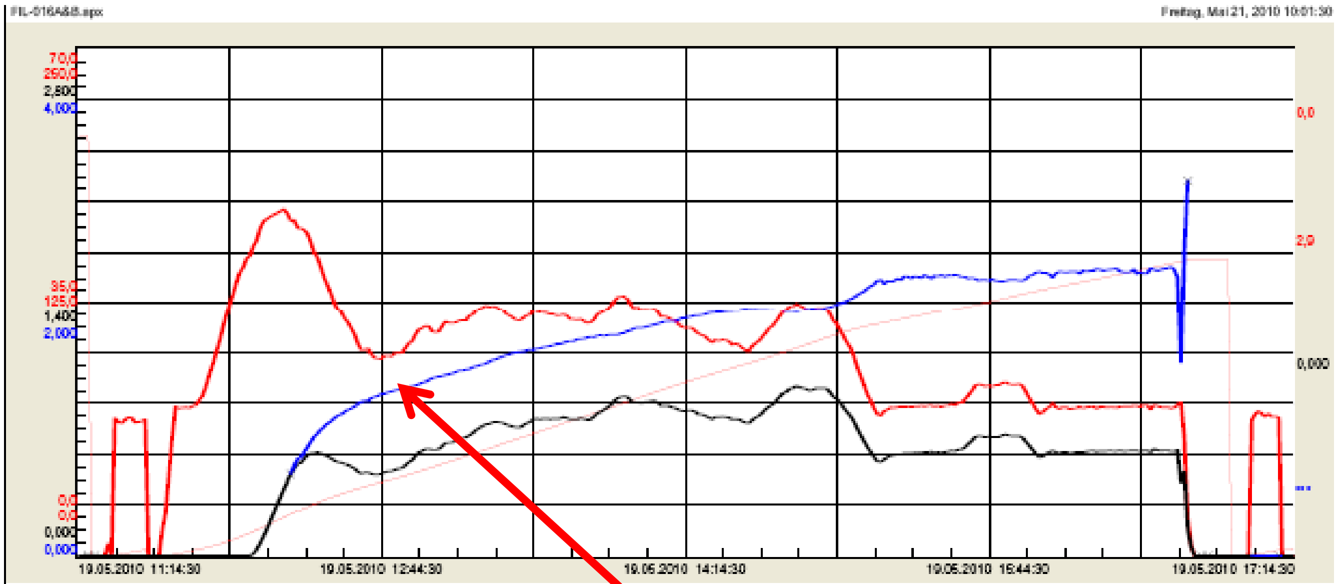
Today's performance



Corrected delta P curve for flow fluctuations

Conclusion

- Gas assisted backwash cleaning is today a demonstrated and **proven** technology for HCGO filtration
- Wear resistant, use of the best components
- Easy operation, no operator intervention required
- Lower use of utilities compared to other technologies resulting in lower operational costs
- Demonstrated in the field, up and running today

Thank you!

Questions?

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