COMSYN/FLEXCHX online Workshop Hot gas filtration

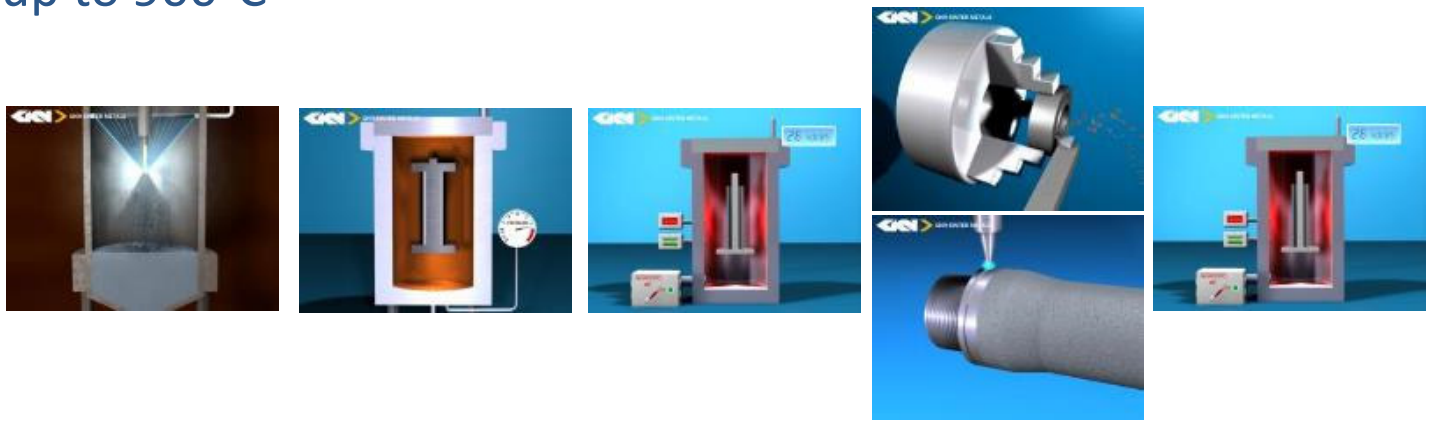
19.01.2021 Harald Balzer

content

- GKN manufacturing process overview
- Material and Process development
- Powder and filter specification
- Filter operation studies

Manufacturing process

- Aim: Material and Process development of a corrosion and heat resistant FeCrAlSi-Alloy as filter material for Sulfur containing gases up to 900°C



MCrAlY Powder Different sievings for different filter grades → **Cold Isostatic compaction** → **Heat Treatment 1: Sintering** → **Secondary Operations:** Turning, Welding → **Heat Treatment 2: Oxidation**

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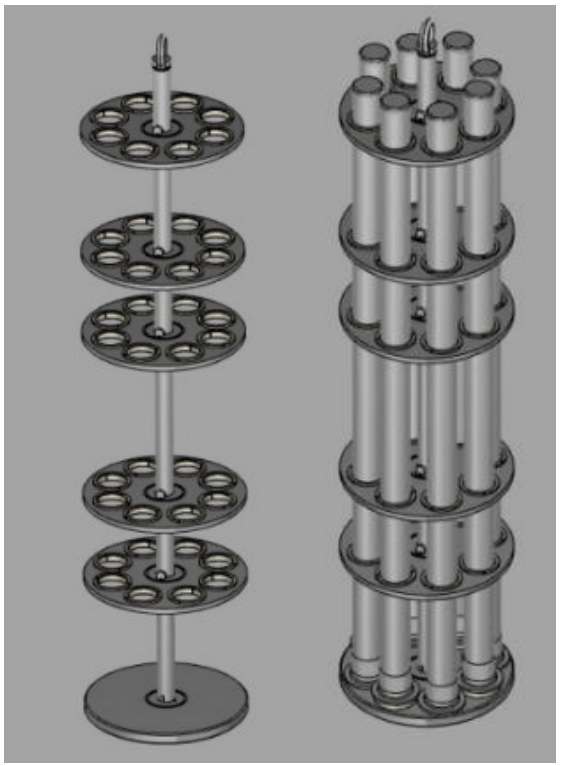
Heat treatment development

- New material critical for heat treatment process: liquid phase formation depending on temperature
- Roundness (important for welding operation and high burst pressure), straightness (important for max. pitch in the filter plate) often not sufficient
- Heat treatment frame and proper chosen heat treatment parameter stabilizes the filter during sintering
- Continuously enlarging the filter length from 1000 up to 1550 mm length



Heat treatment frame and delivered 1.2m filter elements

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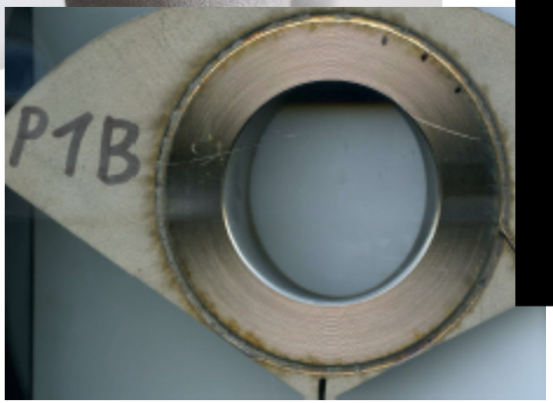
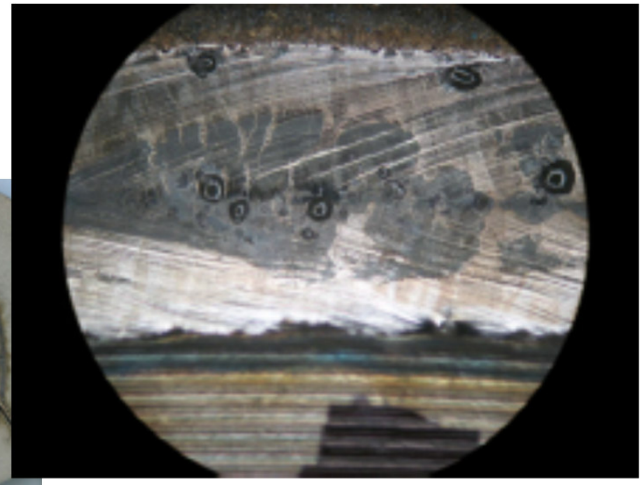
Secondary operation: laser welding

- Welding development: laser welding porous filter material and solid connectors or Filter plate
- Before positioning in filter plate the filter end is turned to achieve the needed roundness
- Results for laser welding on a pre heated device: much less micro cracks on the slope marked on the filter element





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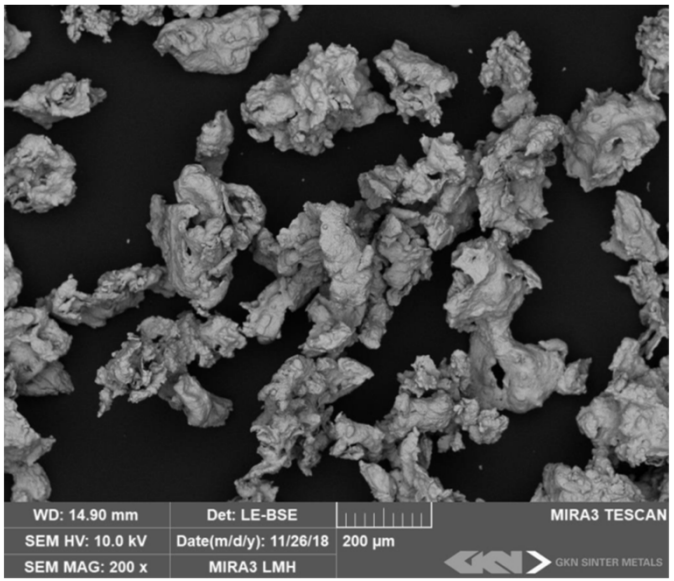
Typical values for fine and coarse filter quality

Material:	FeCrAlSi (1.4767 mod.)			
Chem. Composition [M-%]:	Fe	Cr	Al	Si
	Bal.	19~22	4~5	~2,5

Application Temperature [°C]: (in oxidising media)	max. 900°C

Filter Grade SIKA		**RHT 2IS**	**RHT 12IS**
Grade Efficiency [µm]*: x_T = 95% (0,1m/s)		0,25	0,5
Density [g/cm³]:		4,8	4,4
Porosity [%]:		30	40
Flow [m³/m²/h]:			25
Bubble Point [mbar]:		40	20
Pore size distribution: [µm]	d_{min}	1	2
	MFP	5	14
	d_{max}	18	37
Permeability coefficient	α [m²]	$4,1*10^{-12}$	$5,5*10^{-12}$
	β [m]	$0,9*10^{-6}$	$1,3*10^{-6}$



Typical water atomized powder shape

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COMSYN project: process flow chart

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Technology development

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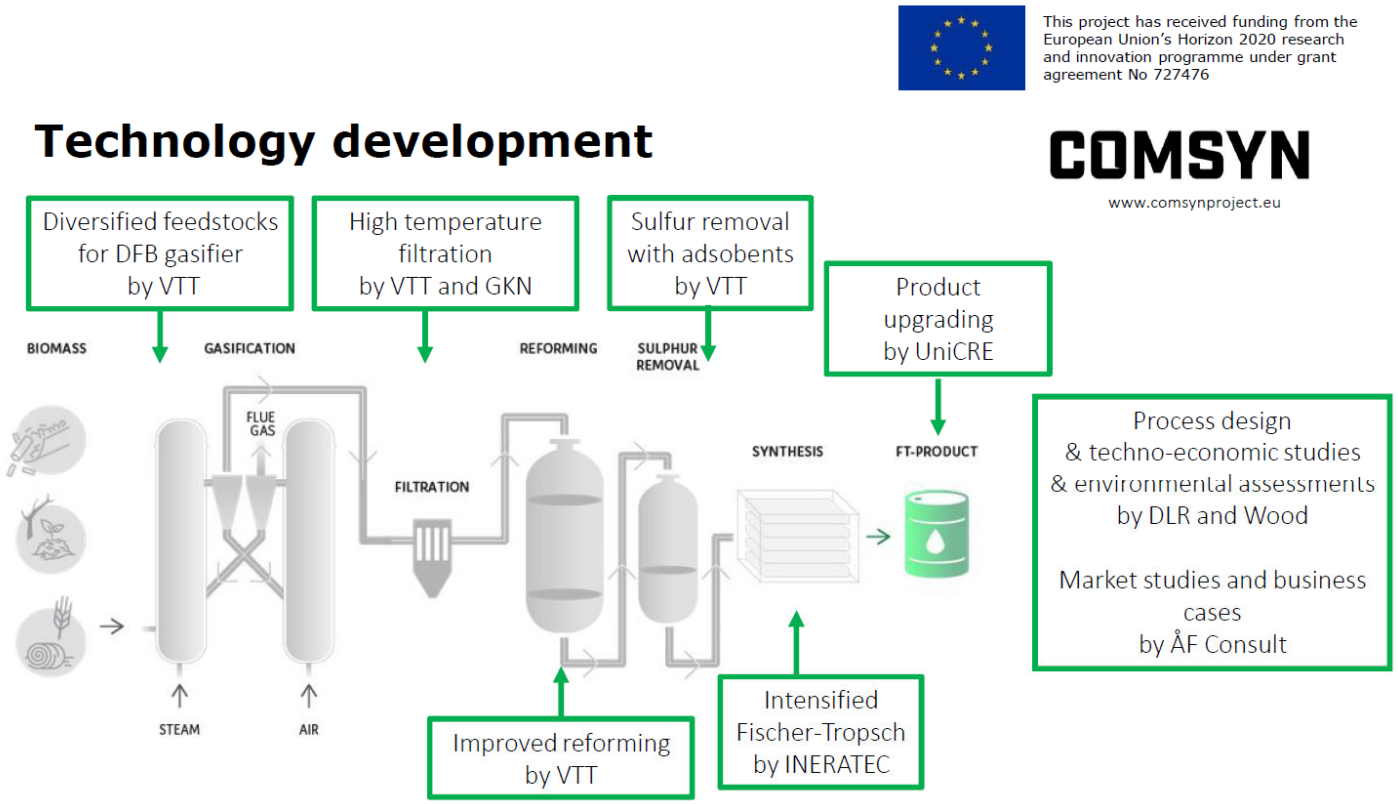
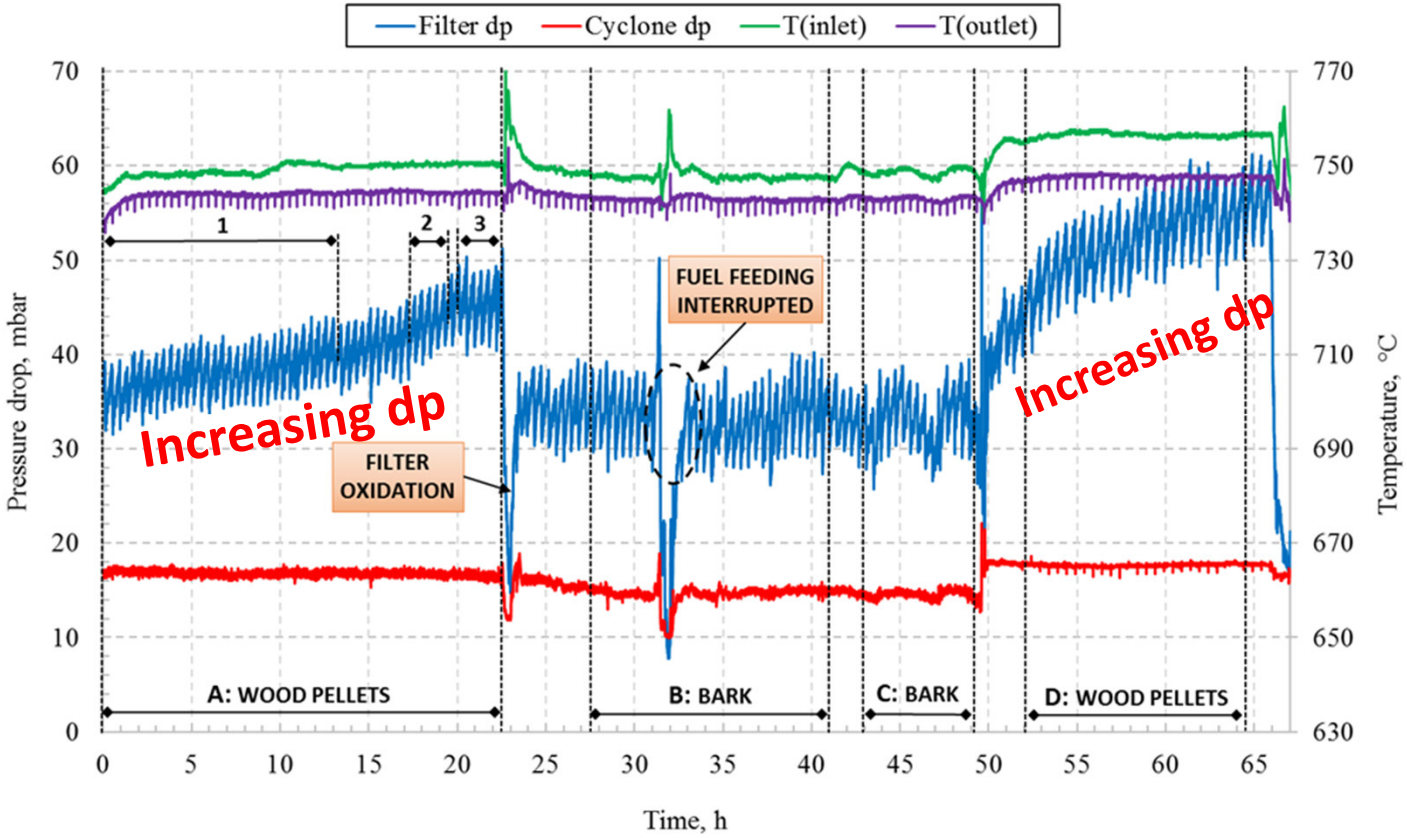
www.comsynproject.eu



Opened filter vessel at VTT site

Filter operation studies



- Filter blinding was encountered in some set points – particularly with wood pellet
- The combination of high tar load and low particulate concentration are particularly favorable conditions for filter blinding.

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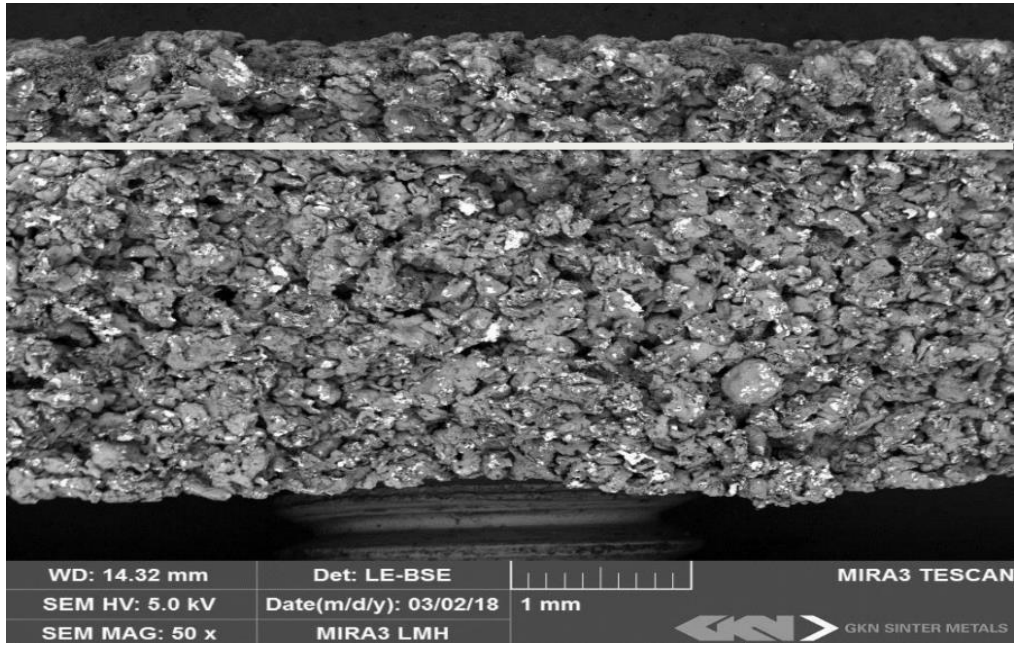
Metallographic examination of the used filter element

- After 300 hours of operation in biomass gasification conditions, one of the filter elements was removed from the filter unit and examined at GKN.
- Ashes were found only on top of the filter element
- No material inside the pores - proper filter grade was selected



BSE image of filter cross section

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Summary and outlook

- Main process steps in atomizing, compaction, heat treatment and laser welding were successfully developed during COMSYN project
- The actual max. length of the filter elements is 1550mm
- Stable filtration is possible if filter clogging with tar can be prevented (12µ filter grade in liquids)
- Metallographic investigations after long term tests show no corrosion during operation. No corrosive species (Chlorine, Alkaline and esp. Sulphur) were found inside the filter material
- Future development will focus on evaluation of new filter material in multifuel processes (e.g. municipal waste) and scale up the filter systems for small and medium sized gasification plants (1-50 MW)

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