

Modification of ash properties in fixed bed combustion systems / Beeinflussung der Ascheeigenschaften in Festbettverbrennungssystemen

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Dipl. Ing. Dr. Peter Sommersacher
Dipl. Ing. Dr. Stefan Retschitzegger



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Introduction - Ash related problems in fixed bed combustion systems

- Slagging



Sintered and molten ash in the furnace



Introduction - Ash related problems in fixed bed combustion systems

- Slagging
- Fouling



Protective evaporator after a system operation of only **9 weeks**



Introduction - Ash related problems in fixed bed combustion systems

- Slagging
- Fouling
- Corrosion



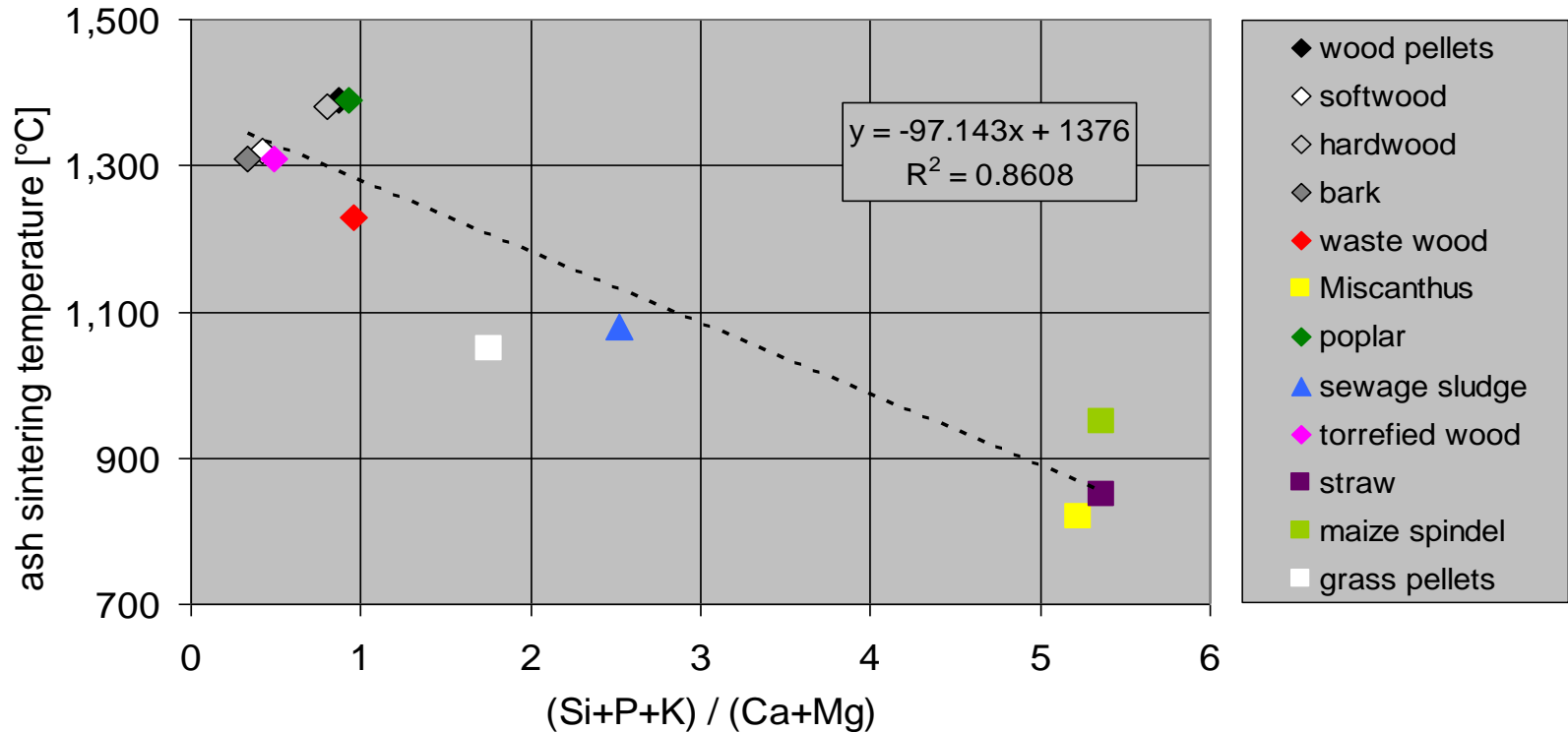
Superheater tube - High temperature corrosion

Economiser-tube - Low temperature corrosion



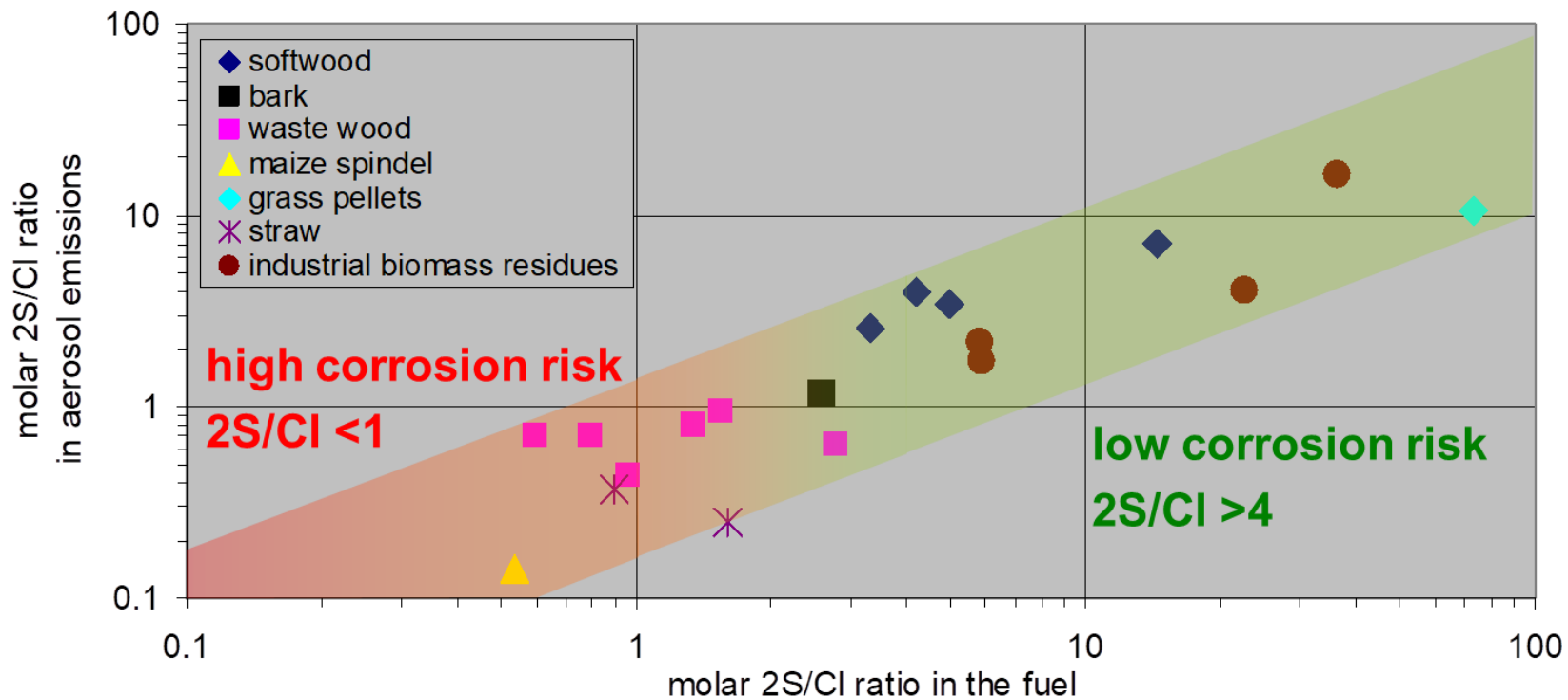


Ash chemistry – ash melting

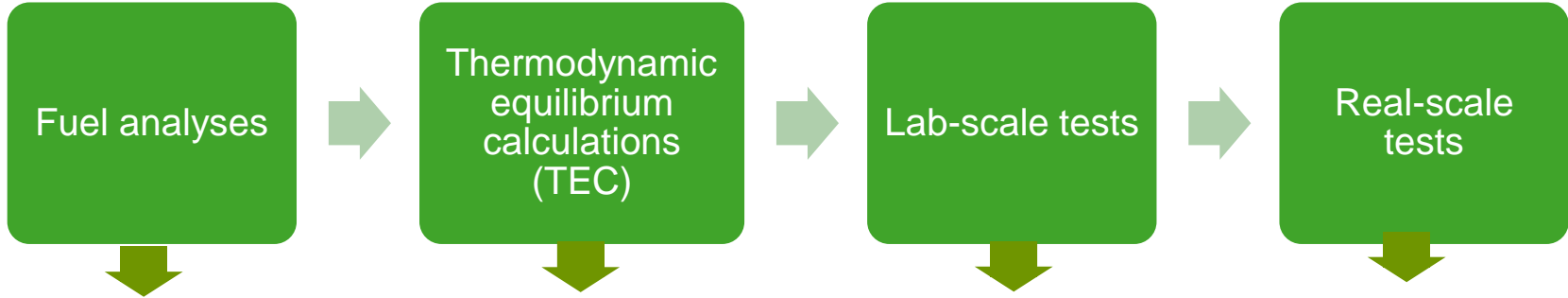




Ash chemistry – Corrosion



Methodology



- Wet chemical analyses
- Pre-evaluation of combustion properties based on fuel indices
 - Ash melting
 - Emissions
 - Corrosion
 - ...

Fuel + additive

- Ash composition
- Ash melting behaviour
- Suggestion for lab-scale tests

Fuel + additive

- Combustion behaviour
- Release of ash forming elements
- Ash melting tendency (optical evaluation)
- Suggestion for real-scale tests

Fuel + additive

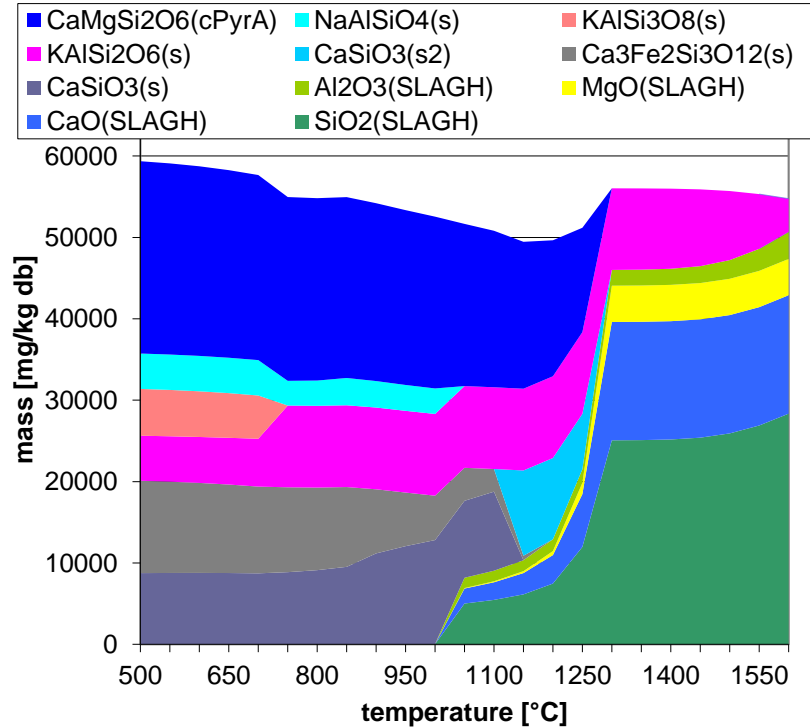
- Without additive
- With suggested additive ratios
- Effect on ashes, dust formation, corrosion



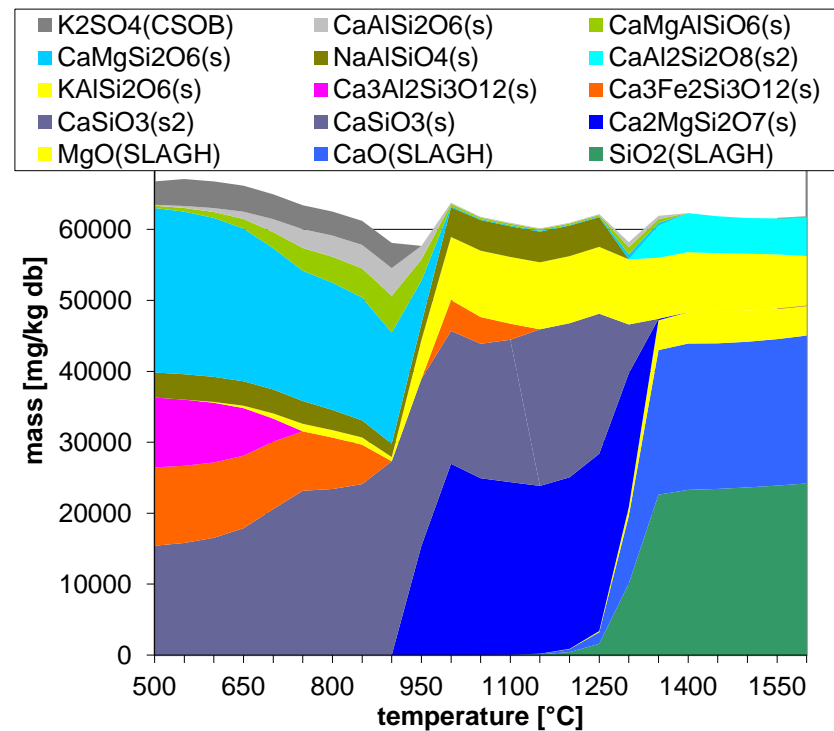
Results

- Waste wood combustion
- Additives
 - Gypsum
 - Reduction of risk for high-temperature corrosion
 - Increase of ash melting temperature
 - Coal fly ash
 - Increase of ash melting temperature

Results – Thermodynamic equilibrium calculations (TEC)



fuel pure



2 % gypsum



Results - TEC

- **Waste wood with gypsum addition**
 - 2% have a positive effect concerning the starting temperature of slag formation; 4.5% do not further increase the starting temperature
 - Higher SO₂ concentration in the flue gas for 2% gypsum; 4.5% further rise the SO₂ concentration → emission limits needs to be considered
 - Increased K release with gypsum addition → higher aerosol emissions
 - 2% of gypsum seems adequate additive ratio
- **Waste wood with coal fly ash addition**
 - Start of the slag formation at higher temperatures → improved ash melting behaviour
 - Reduced K release → reduction of aerosol emissions
 - Positive effect by coal fly ash addition can be expected; optimum additive rate cannot be identified



Results – Lab-scale tests

- Ashes after combustion tests



fuel pure



2% gypsum



4.5% gypsum



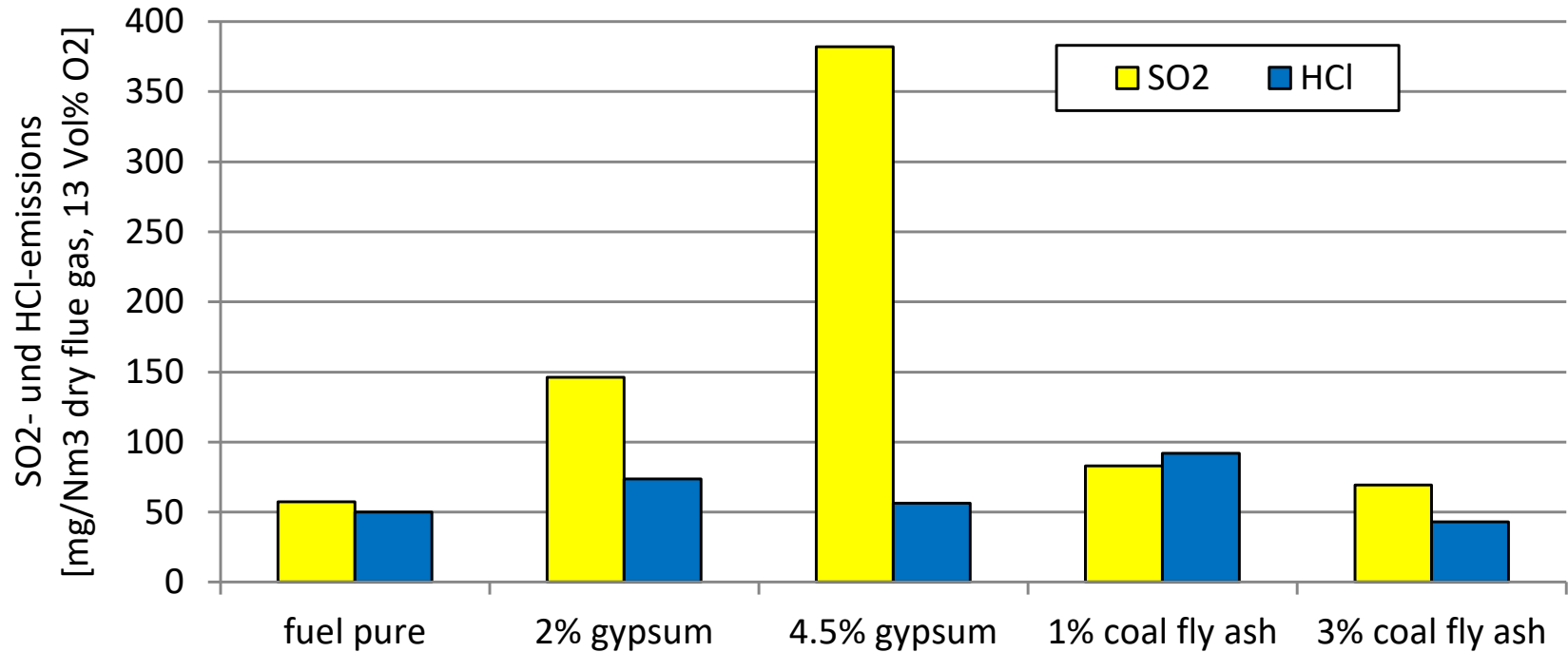
1% coal fly ash



3% coal fly ash

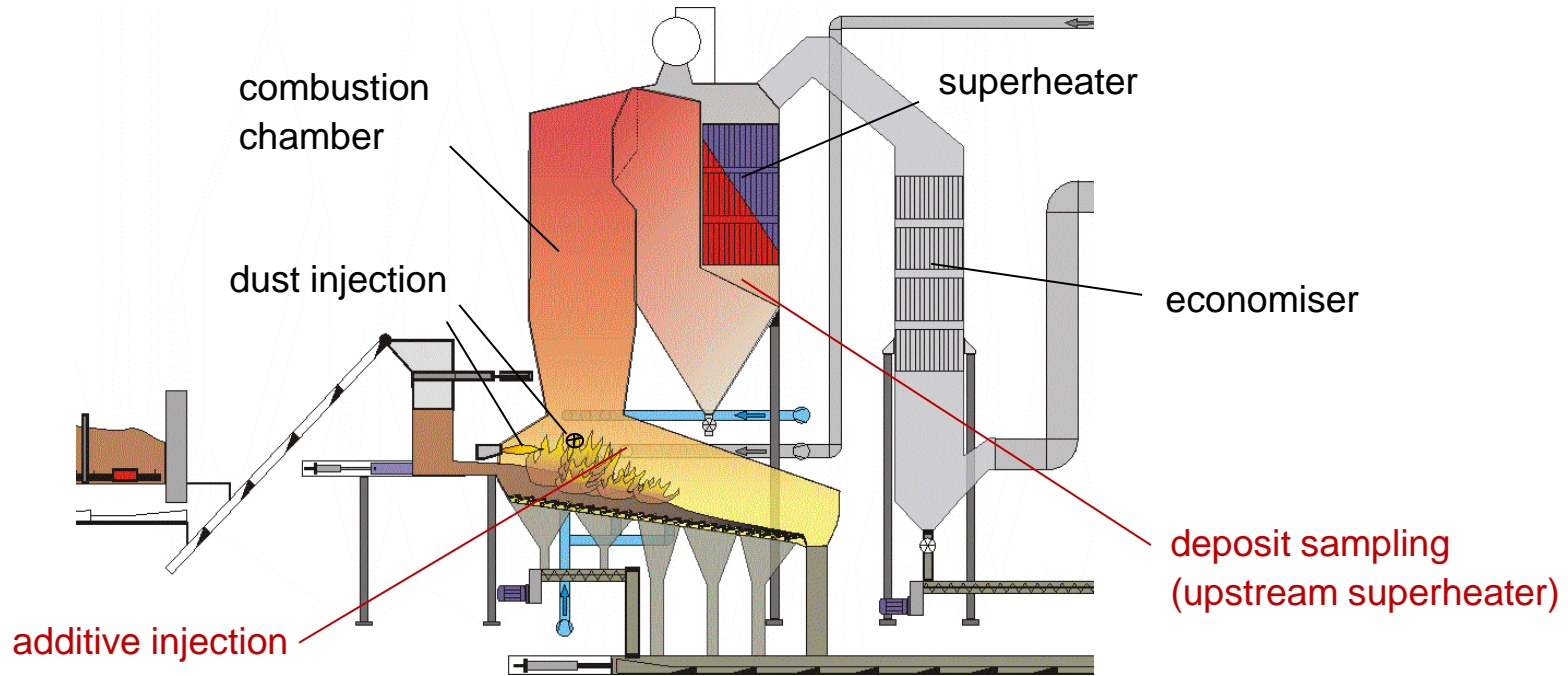


Results – Lab-scale tests





Results – Real scale tests



- 40 MW_{th} grate furnace equipped with 3 dust injectors
- Fuel: forest wood chips, bark and waste wood



Results – Real scale tests

■ Reference

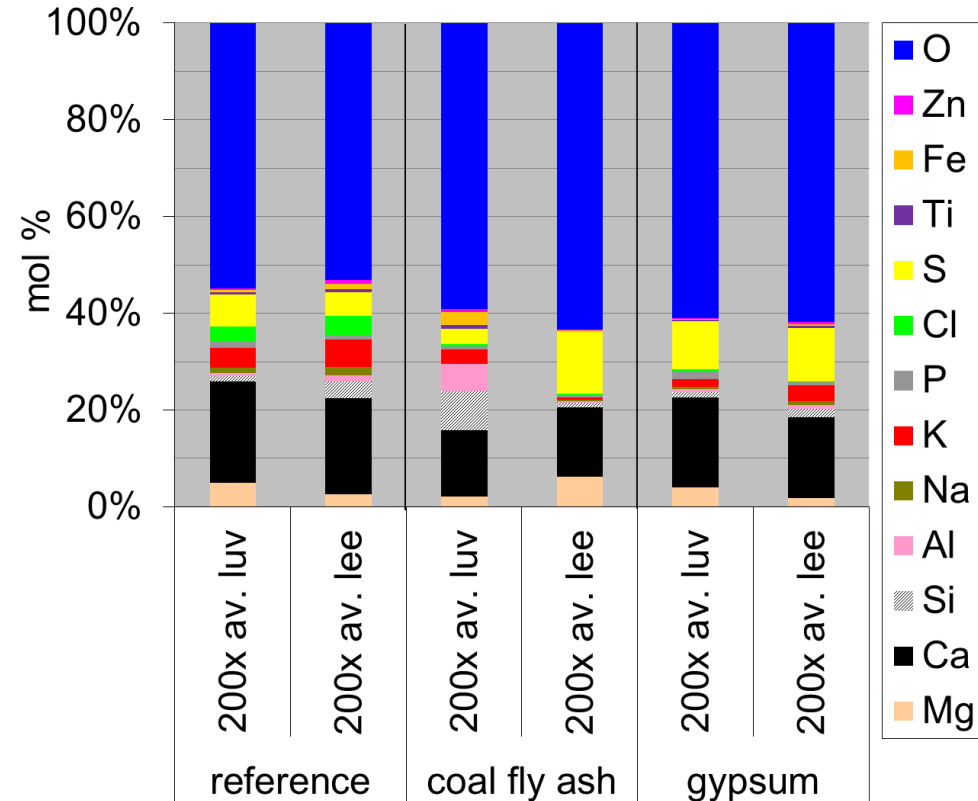
- Up to 4.1% Cl in deposits

■ Coal fly ash

- Increased Si and Al concentrations
- Reduced Cl content

■ Gypsum

- Increased S concentrations
- Almost no Cl (< 0.5%)





Summary

- Modification of ash properties in fixed bed combustion systems is possible via fuel additives
- Additives can reduce risk for slagging, fouling and corrosion
- Multi-step approach Analyses – TEC – Lab-Scale – Large-Scale is a suitable procedure



Thank you for your attention!

Peter Sommersacher

peter.sommersacher@best-research.eu

Stefan Retschitzegger

stefan.retschitzegger@best-research.eu

www.best-research.eu