

Co-firing of rapeseed-cake pellets with wood in a CFB boiler, the benefits of adding limestone on preventing bed agglomerations

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CHALMERS

FOSTER  WHEELER

Combustion of clean stem wood in the Chalmers Boiler



Combustion of “Dirty” Biomass:

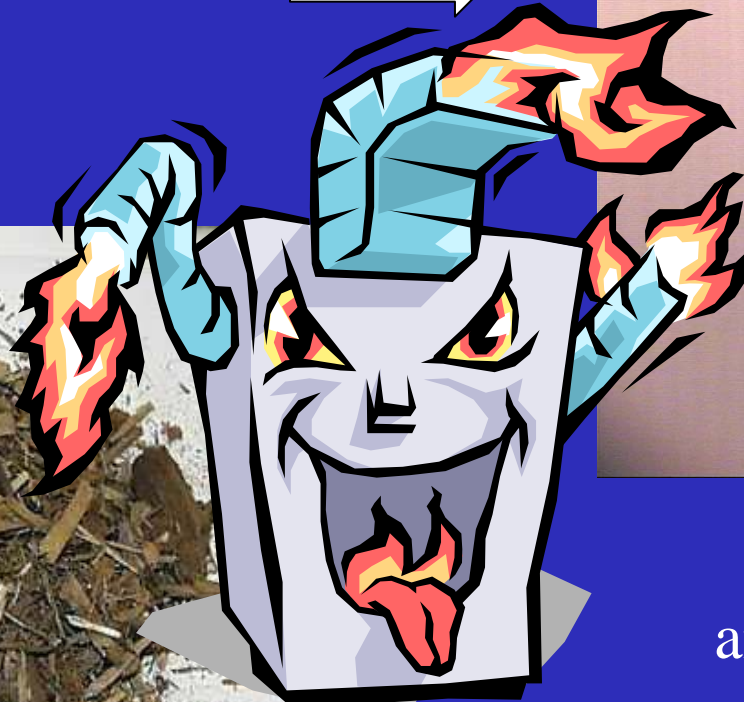
- Forest residues
- Straw
- Salix
- Residues from bio-ethanol plants?
- Residues from biodiesel plants
- Refuse derived waste (RDF)

Leads to:

contains reactive alkali (K and Na) and chlorides

Deposits on tube panel in convection section

Leads to



and corrosion....

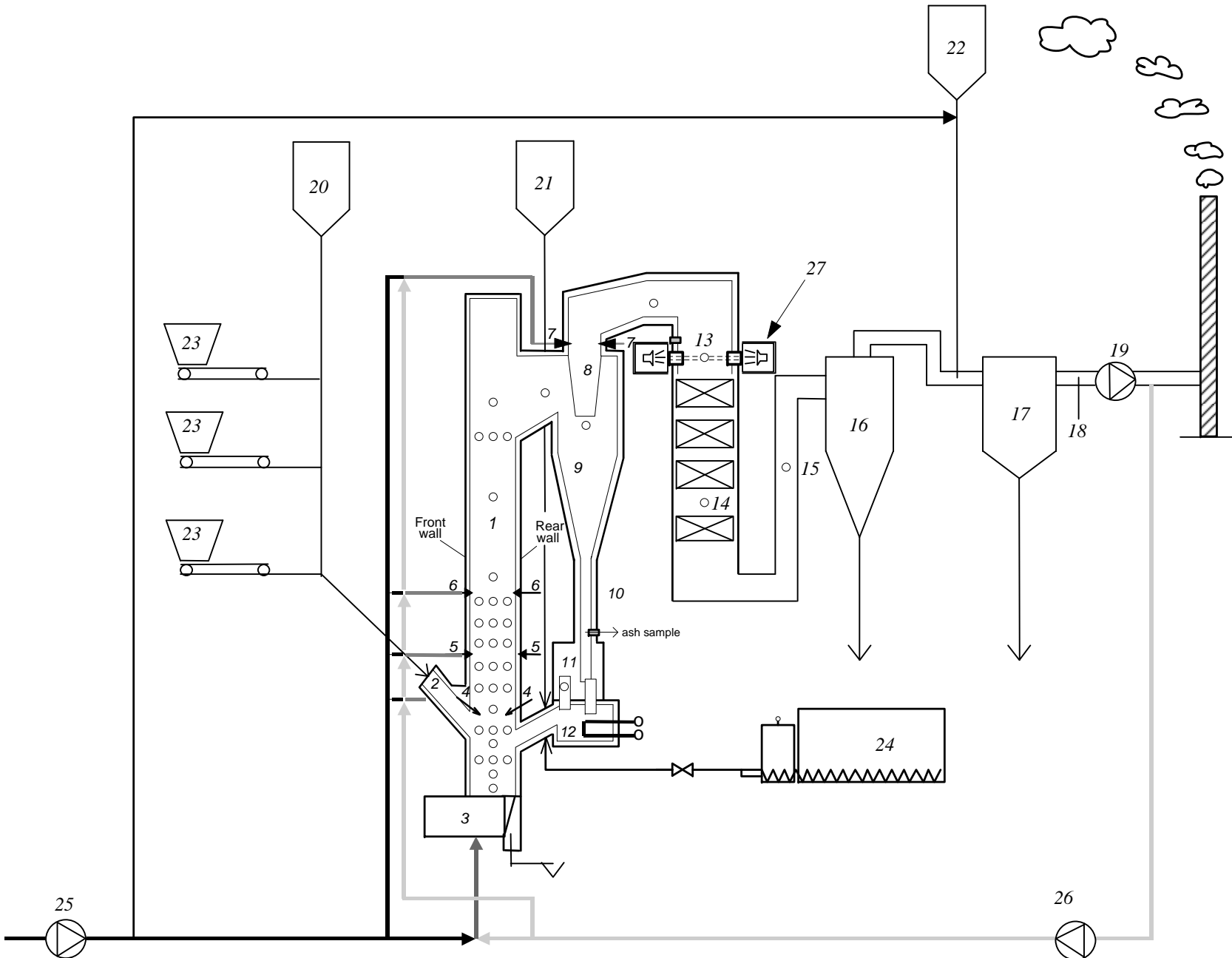


Forest residues as fuel

...and agglomerates in the
particle seal of the boiler



The Research Boiler



Fuel analysis

Analysis	Rapeseed Cake Pellets*	Wood Pellets	Wood Chips
Ash at 550°C [wt%_{d.s.}]	7.5	0.6	0.7
Ultimate analysis [wt%_{d.s.}]			
Carbon	49.9	50.2	49.5
Hydrogen	6.9	6.0	6.2
Nitrogen	5.10	0.06	0.15
Sulfur	0.72	0.01	0.02
Chlorine	0.26	0.02	0.01
Oxygen, calculated	29.6	43.4	43.8
LHV, as received [MJ/kg]	18.88	17.21	8.76
Ash forming elements [mg/kg_{d.s.}]			
Sodium	4660	45	32
Potassium	12300	828	757
Calcium	7040	912	1521
Magnesium	4500	178.8	233
Silicon	43.4	40.2	24
Aluminum	152	52.8	13
Iron	261	696	120
Titanium	3.6	2.4	1
Phosphorus	11500	78	113

Operating conditions:

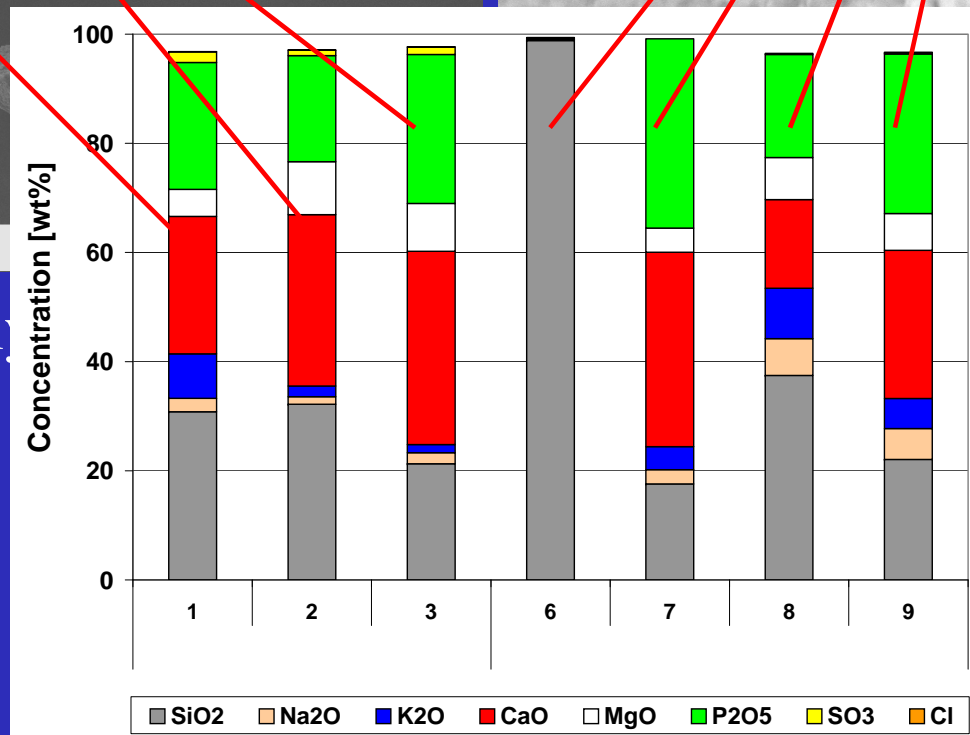
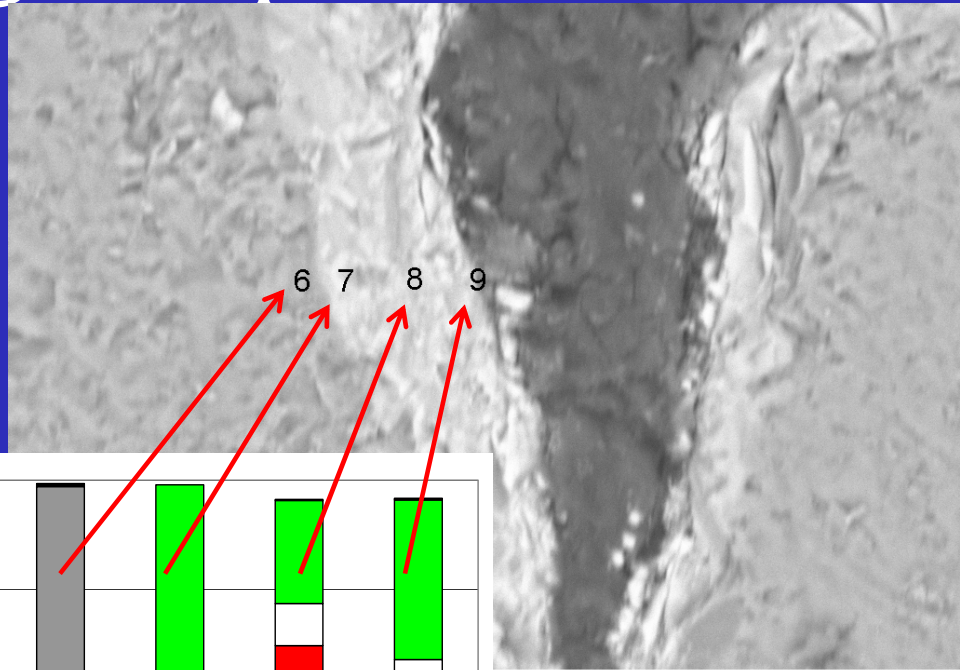
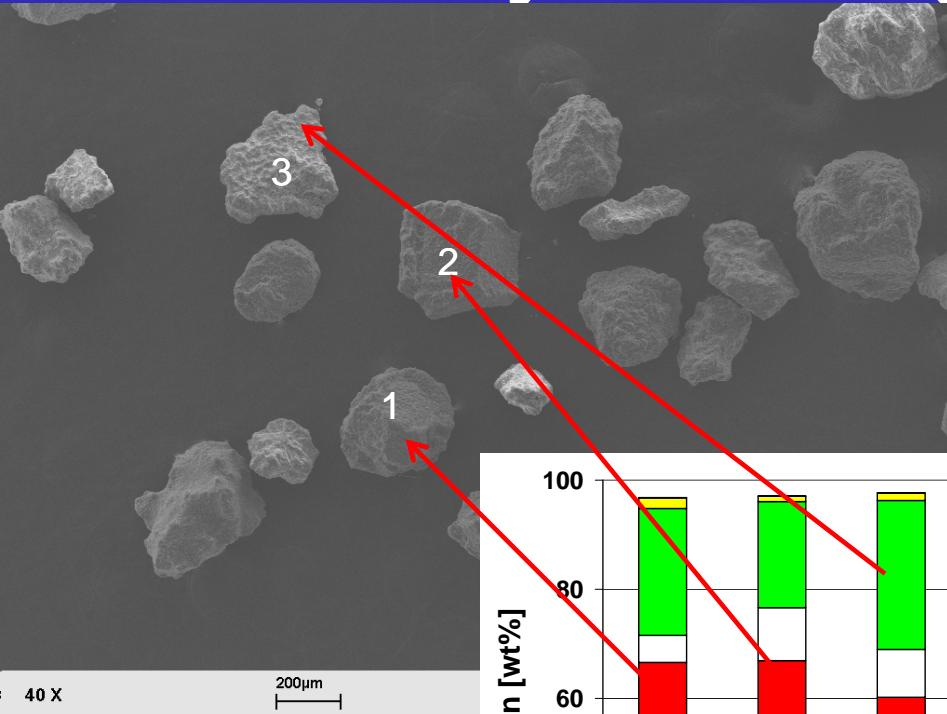
Test	Fuel ¹	Fuel ratio, % on energy basis	Test duration [hour]
1	RCP + WOP + WOC	12 + 24 + 64	4
		21 + 22 + 57	4
		45 + 16 + 39	4
2	RCP + WOP + WOC + limestone	12 + 38 + 50	12

¹RCP – rapeseed cake pellets, WOP – wood pellets, WOC – wood chips

Agglomerate from the particle seal
produced after one day of
operation of the test 1



No limestone addition Cyclone leg samples

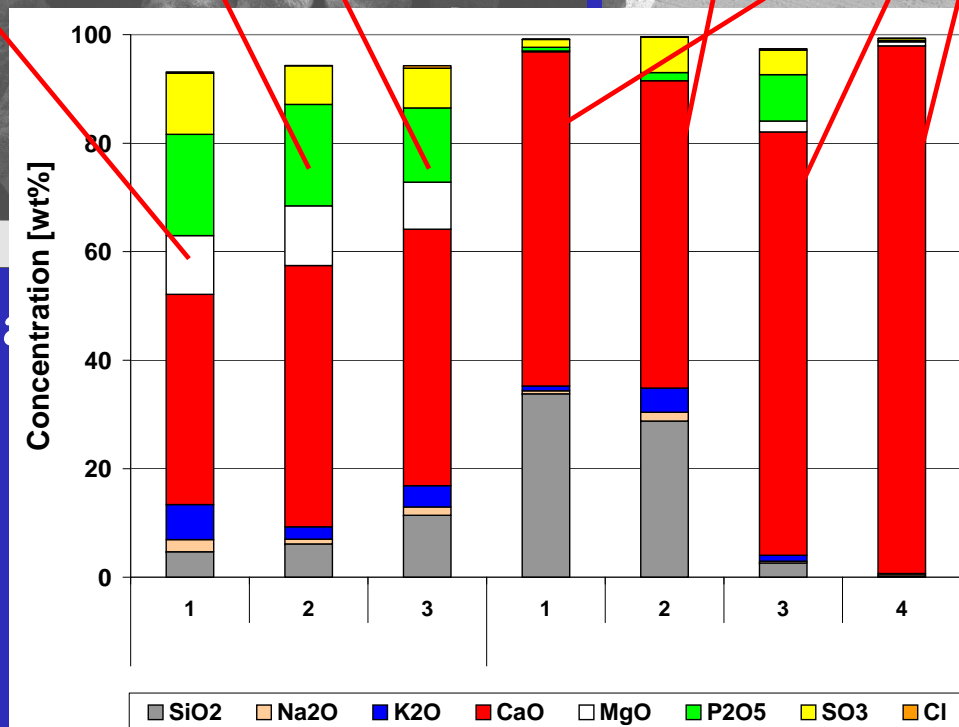
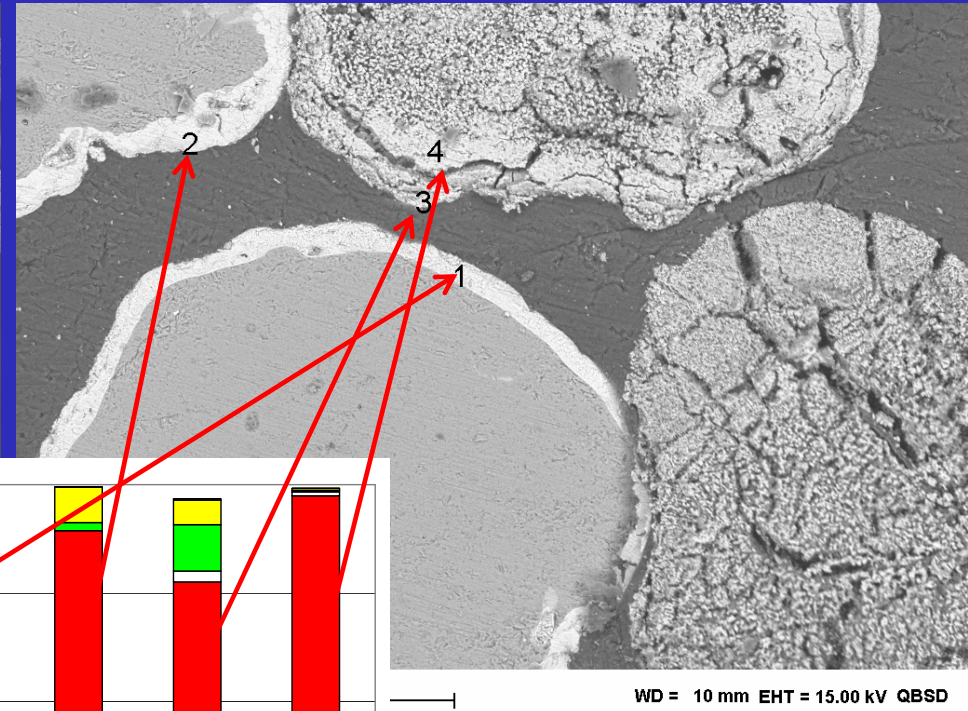
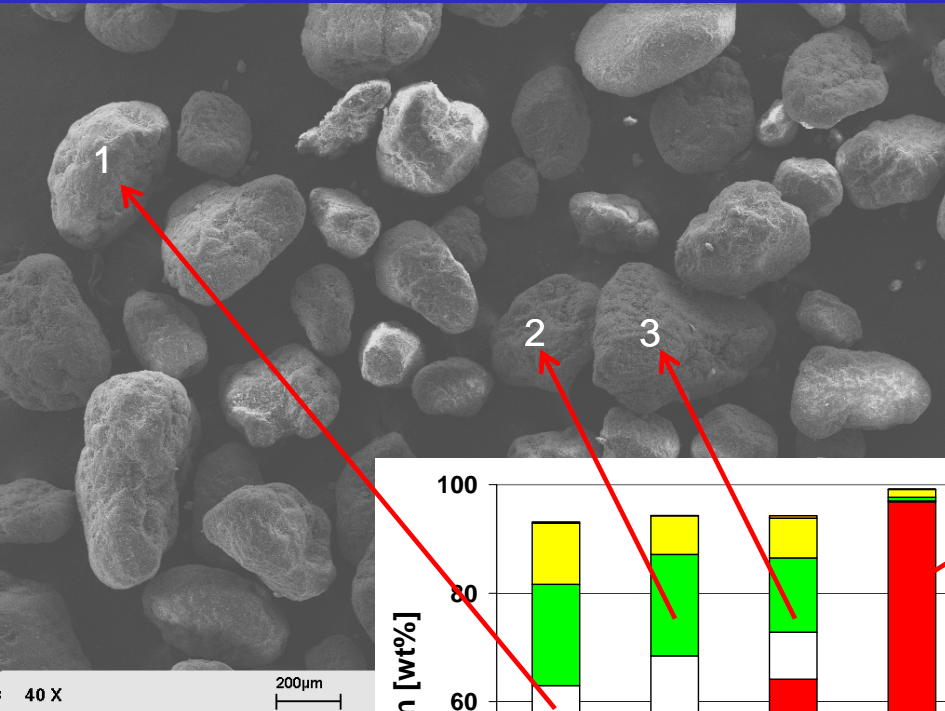


WD = 10 mm EHT = 15.00 kV QBSD

SEM surface anal

s-section analysis

Limestone addition

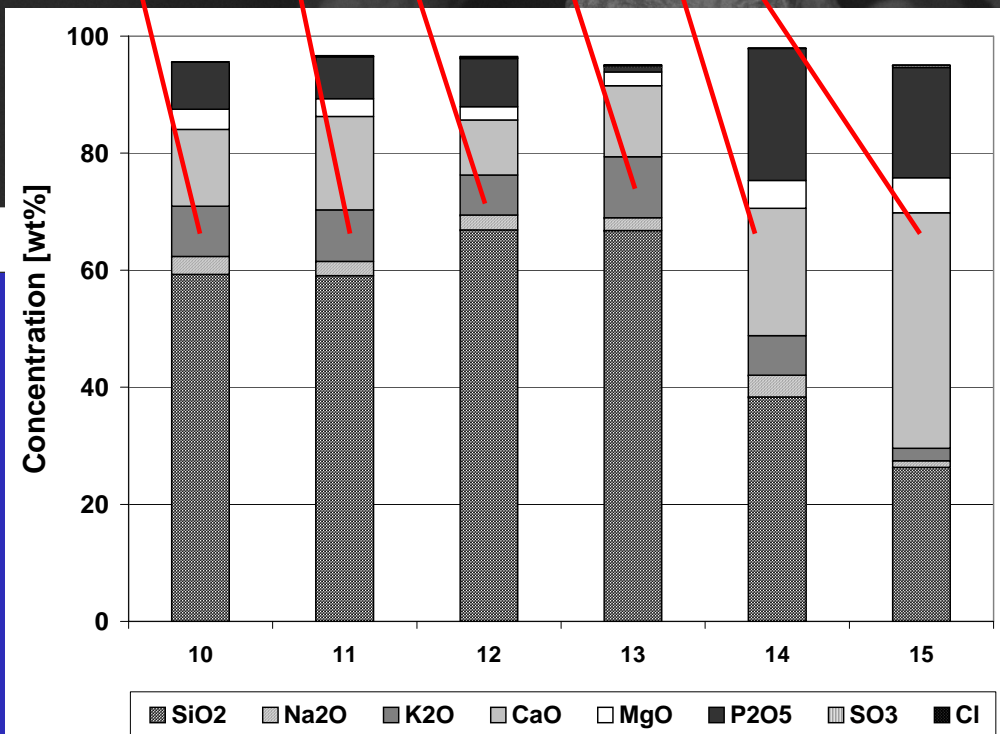
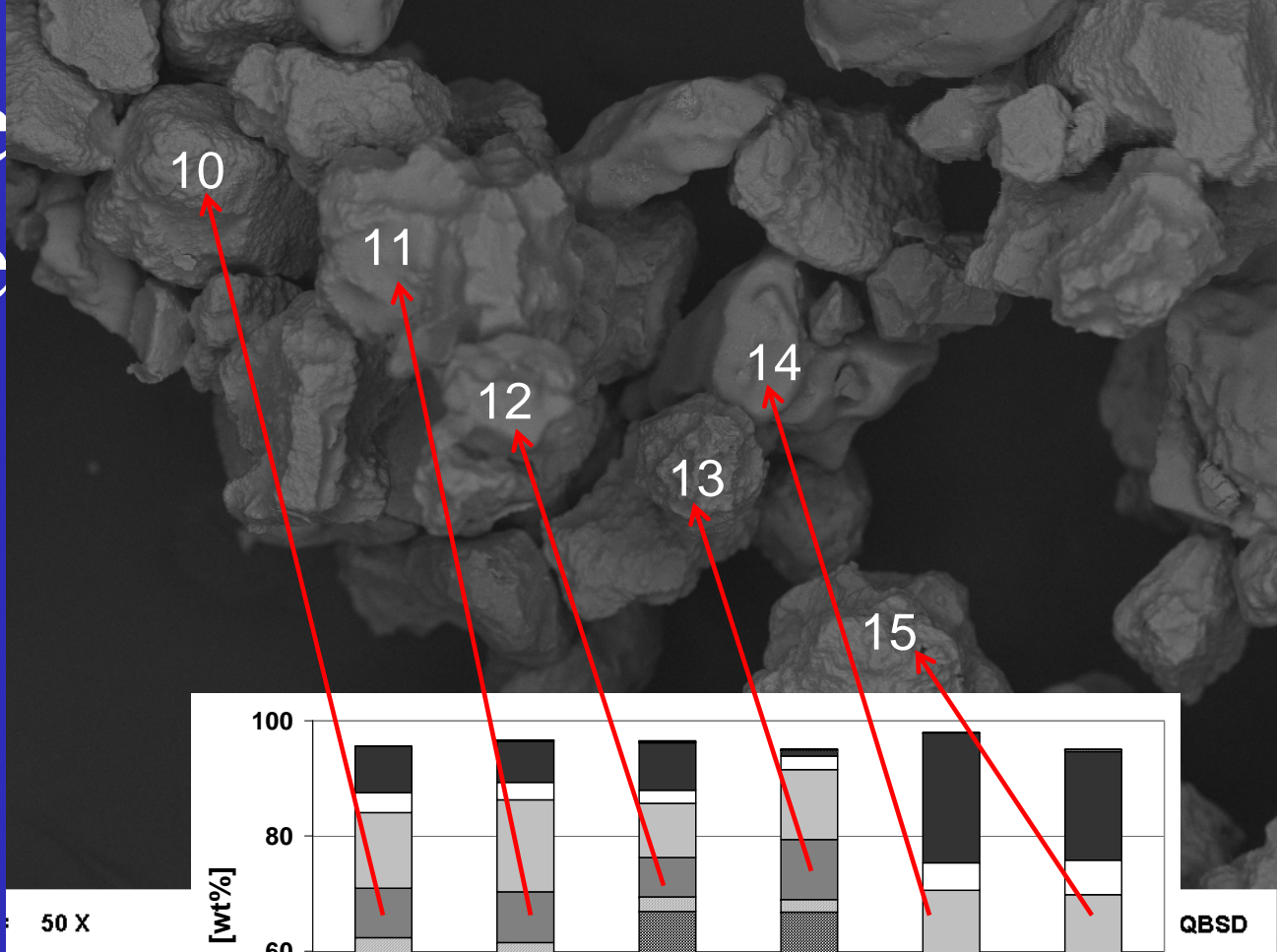


SEM surface

cross-section analysis

WD = 10 mm EHT = 15.00 kV QBSD

Agglomerate from particle seal



Conclusions:

- Addition of limestone causes increase in calcium concentration in the system, which leads to the formation of high-temperature melting calcium-potassium-phosphate and sulphate phases

Conclusions:

- Addition of limestone prevents reaction of potassium phosphate and silica by coating the silica particles, and as a result taking out silica from the reacting system

Acknowledgements

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