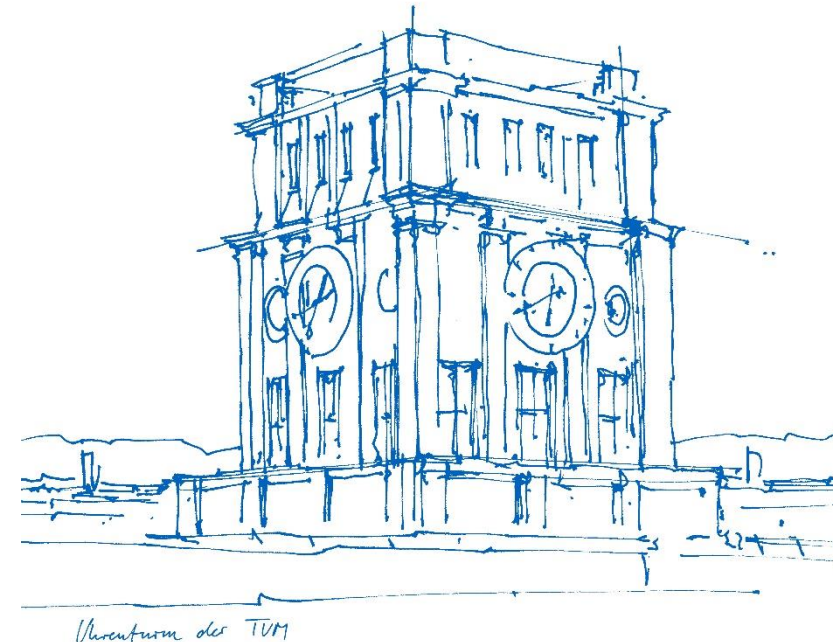# Alkali Removal by Mineral Sorbents in a Novel Two-staged Thermogravimetric Analysis System

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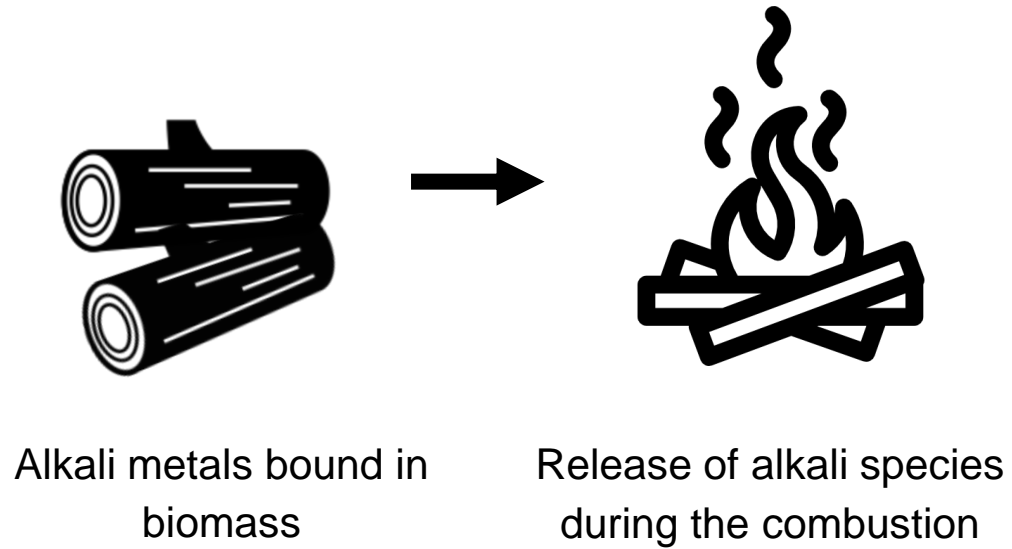Chair of Energy Systems

Bologna, 07.06.2023

Agenda

- Motivation

- Thermodynamic Equilibrium
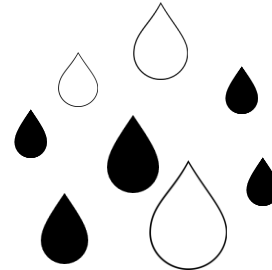
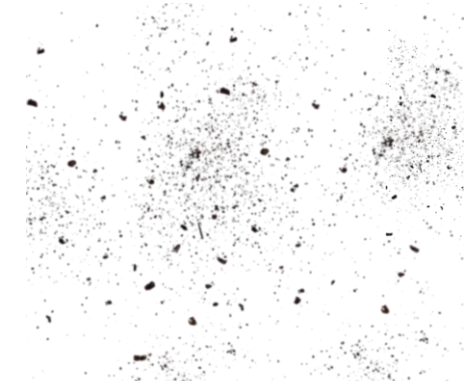- Experimental Setup

- Results

- Outlook

Motivation

Alkali metals bound in biomass
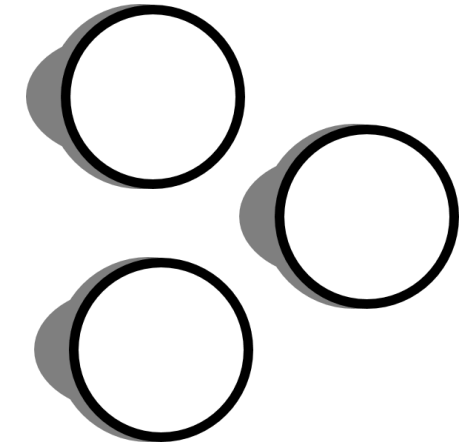
Release of alkali species during the combustion

Motivation

Fine particle emissions

Alkali metals bound in biomass

Release of alkali species during the combustion

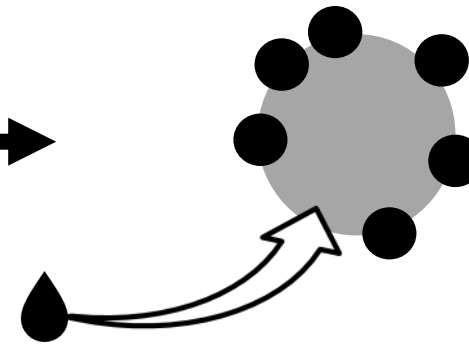Condensation in the flue gas

Deposition build-up

Motivation

Alkali metals bound in biomass
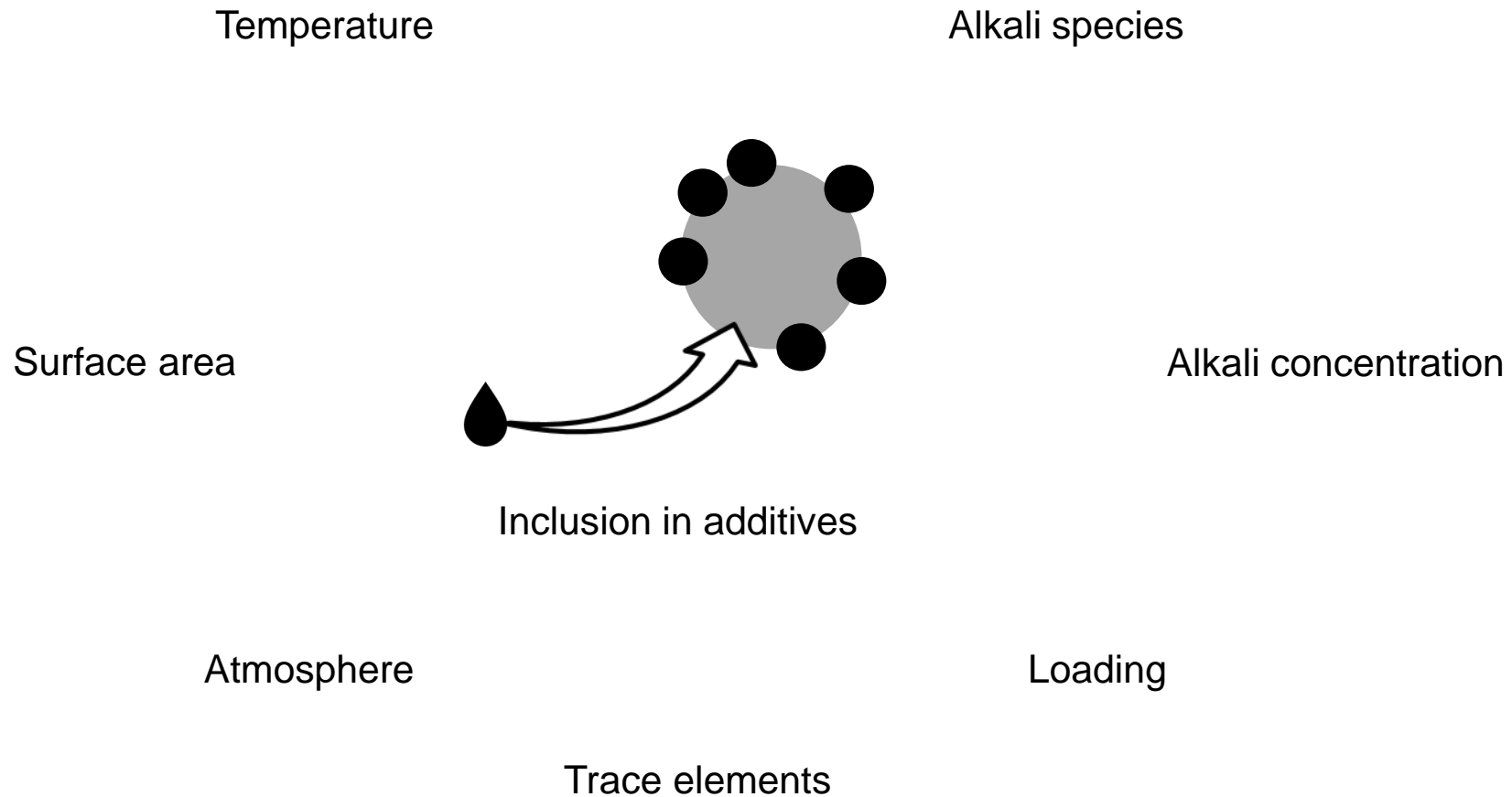
Release of alkali species during the combustion

Inclusion in additives
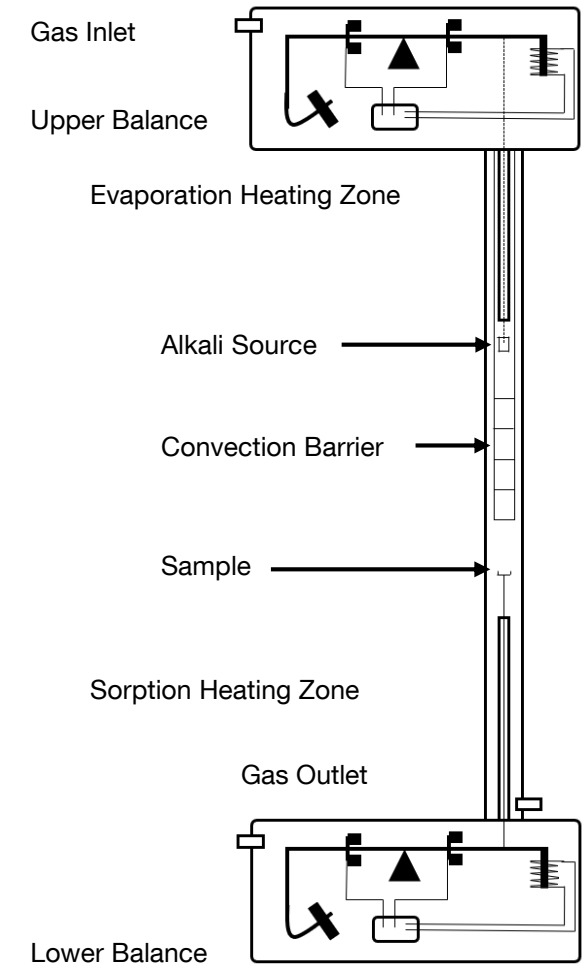
Influencing Factors on Rate and Capacity

Temperature

Alkali species

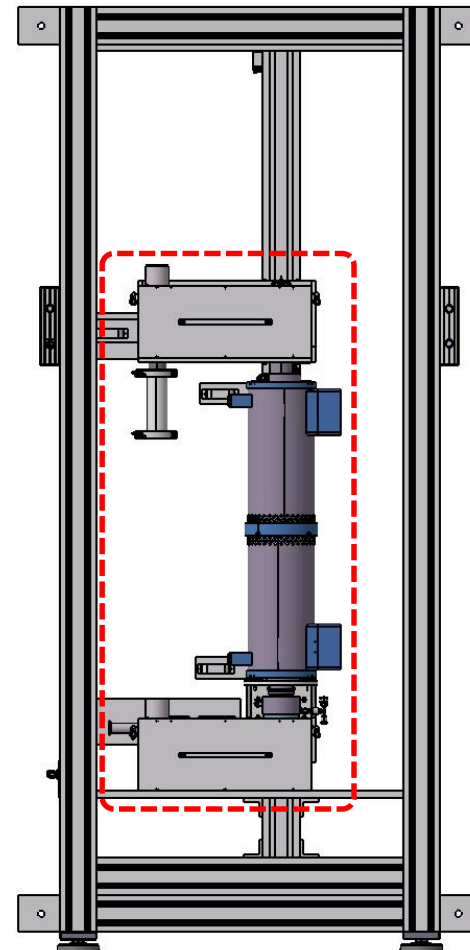Surface area

Alkali concentration

Inclusion in additives

Atmosphere

Loading

Trace elements

Thermodynamic Equilibrium

- Theoretic potassium uptake of metakaolinite

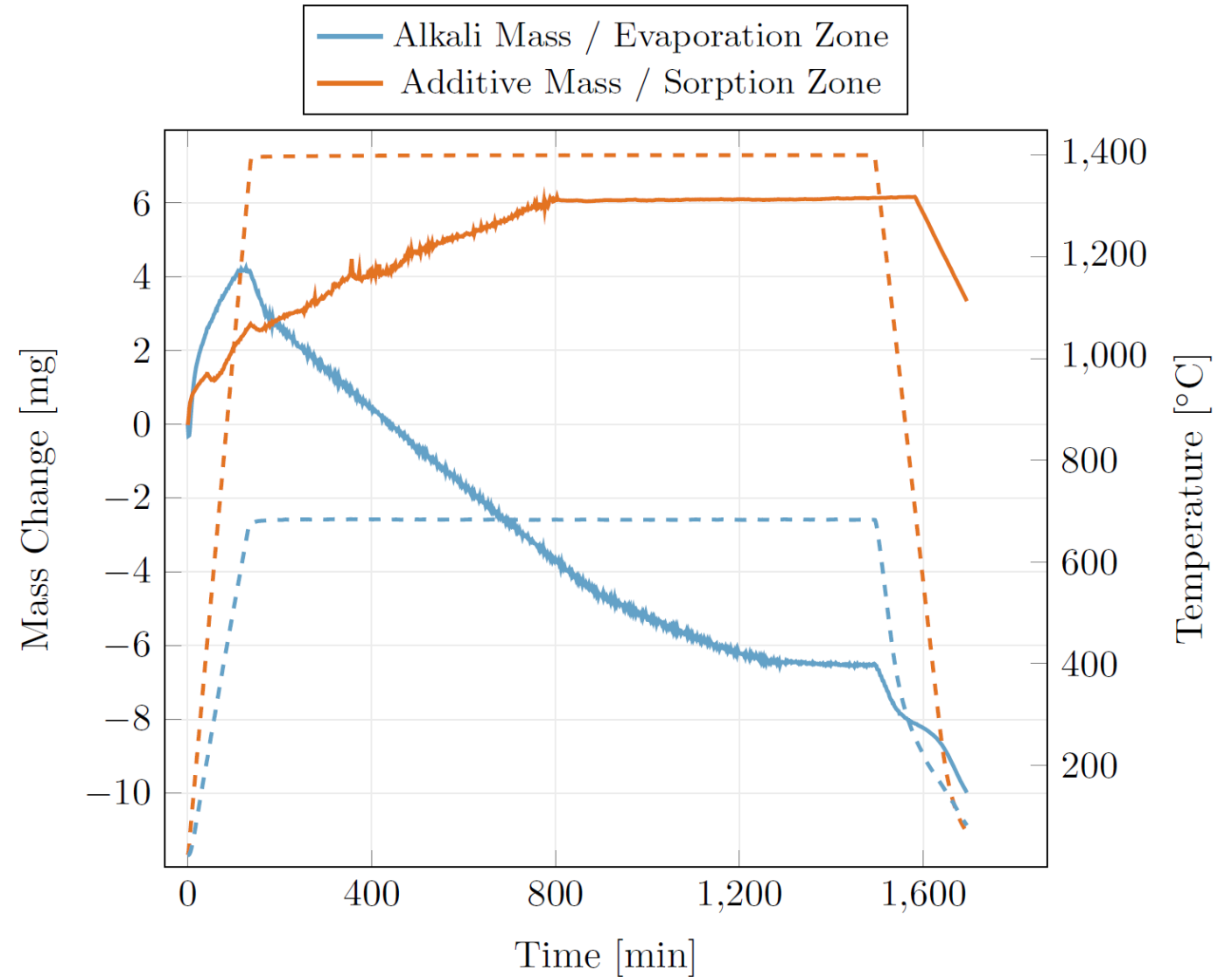Calculations are only as good as the Database!

K₂O - Al₂Si₂O₇

1 bar
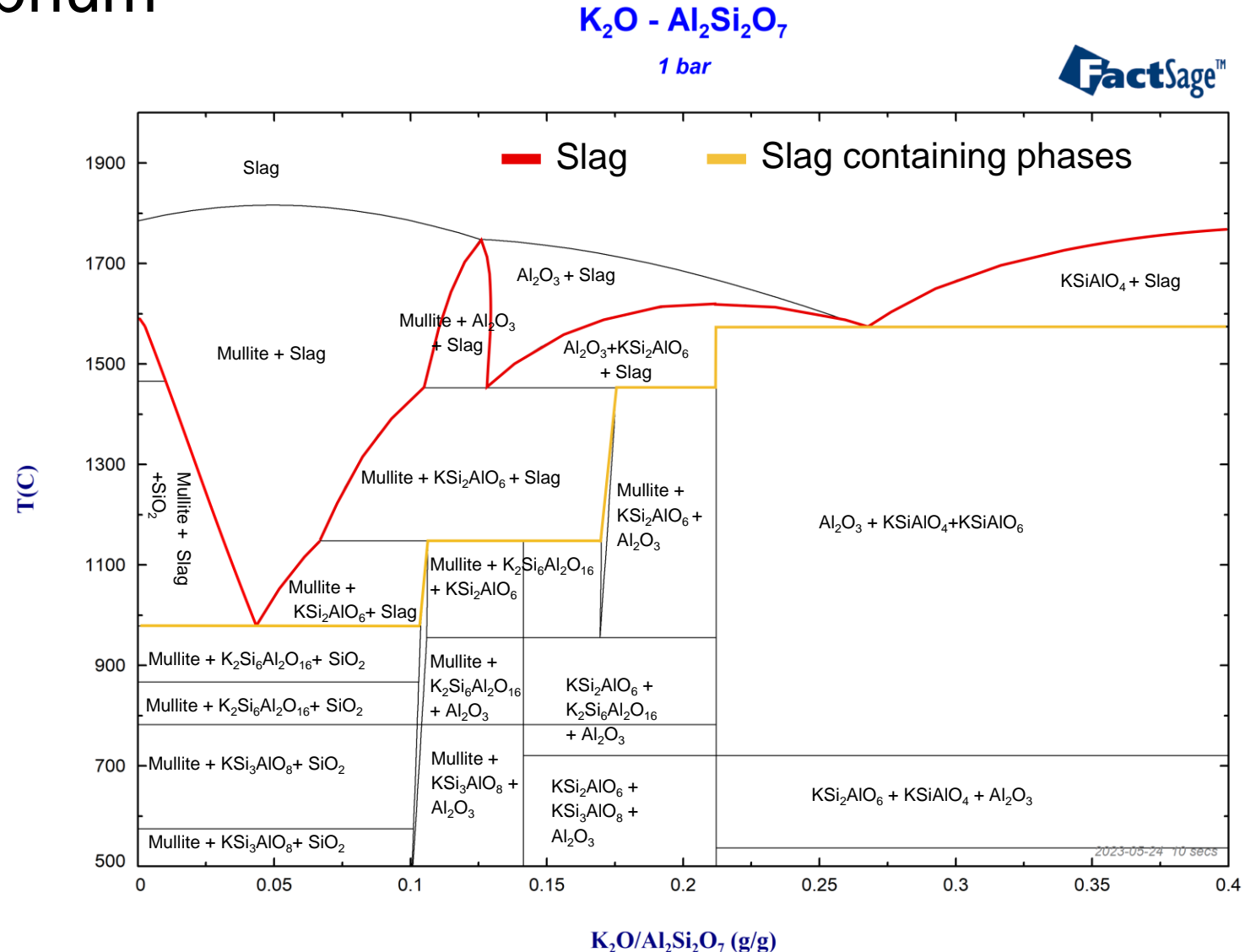
Experimental Setup

- Mass-controlled evaporation

- Stable concentrations starting from 10 ppm

- Up to 1500 °C

- Two component gas flows

Gas Inlet

Upper Balance

Evaporation Heating Zone

Alkali Source

Convection Barrier

Sample

Sorption Heating Zone
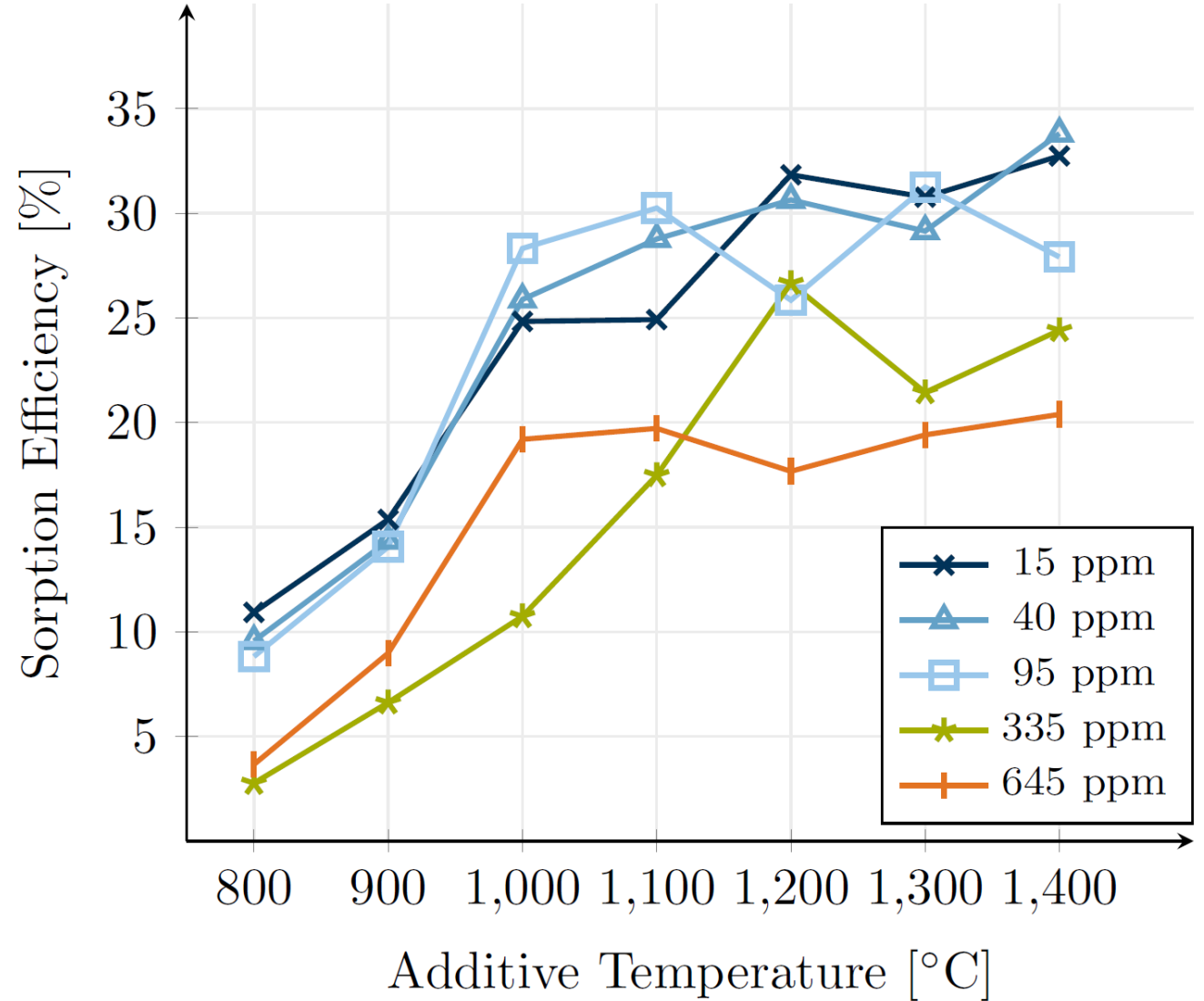
Gas Outlet

Lower Balance

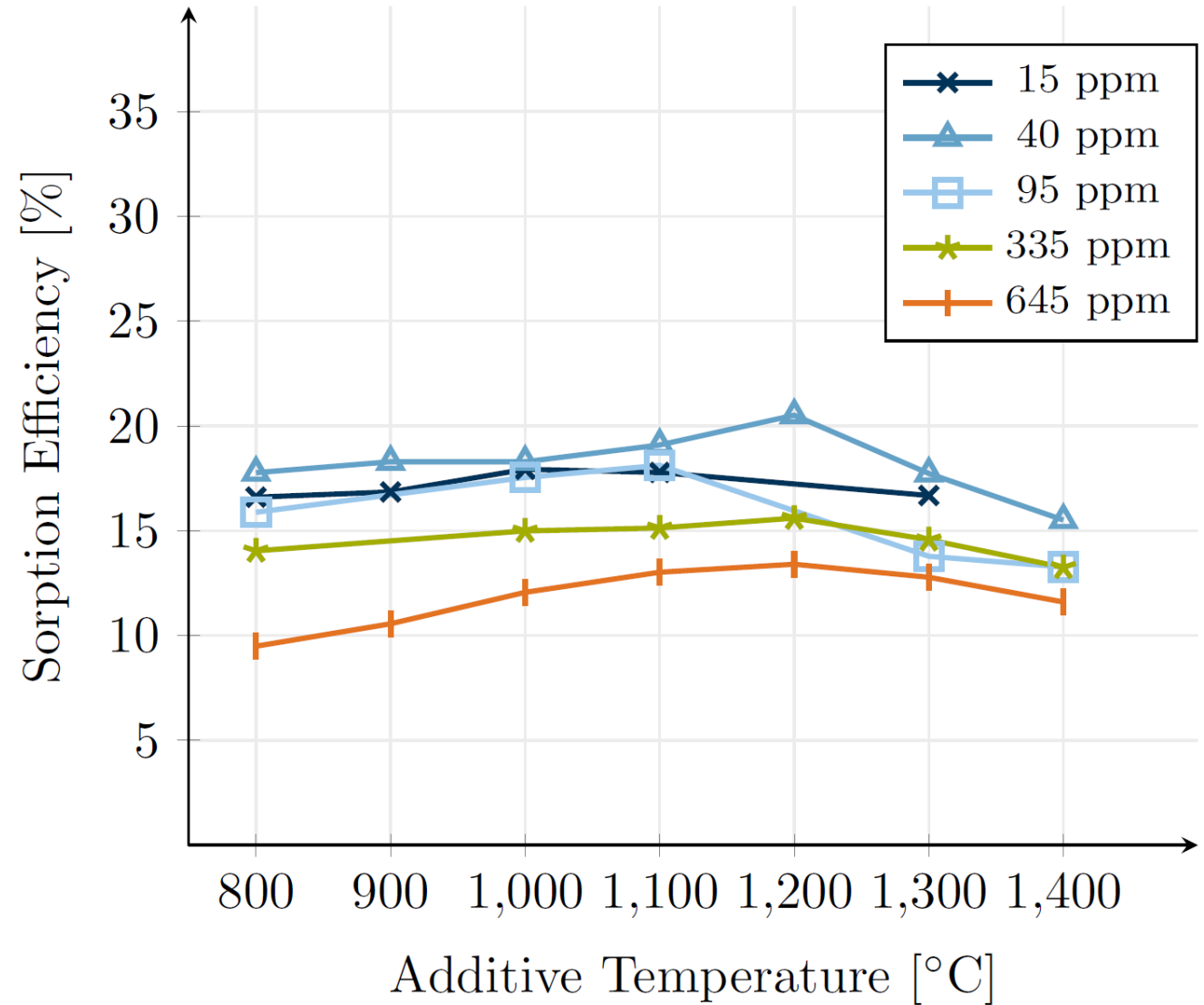# Results

Kaolin + 15 ppm KCl, 1400°C

Results: Kaolin + KCl

$$\text{Sorption Efficiency} = \frac{\text{Mass increase additive}}{\text{Mass decrease alkali source}}$$

Results: Coal fly ash + KCl

$$\text{Sorption Efficiency} = \frac{\text{Mass increase additive}}{\text{Mass decrease alkali source}}$$

Outlook

- Investigation of the different phases

- Variation of alkali sources

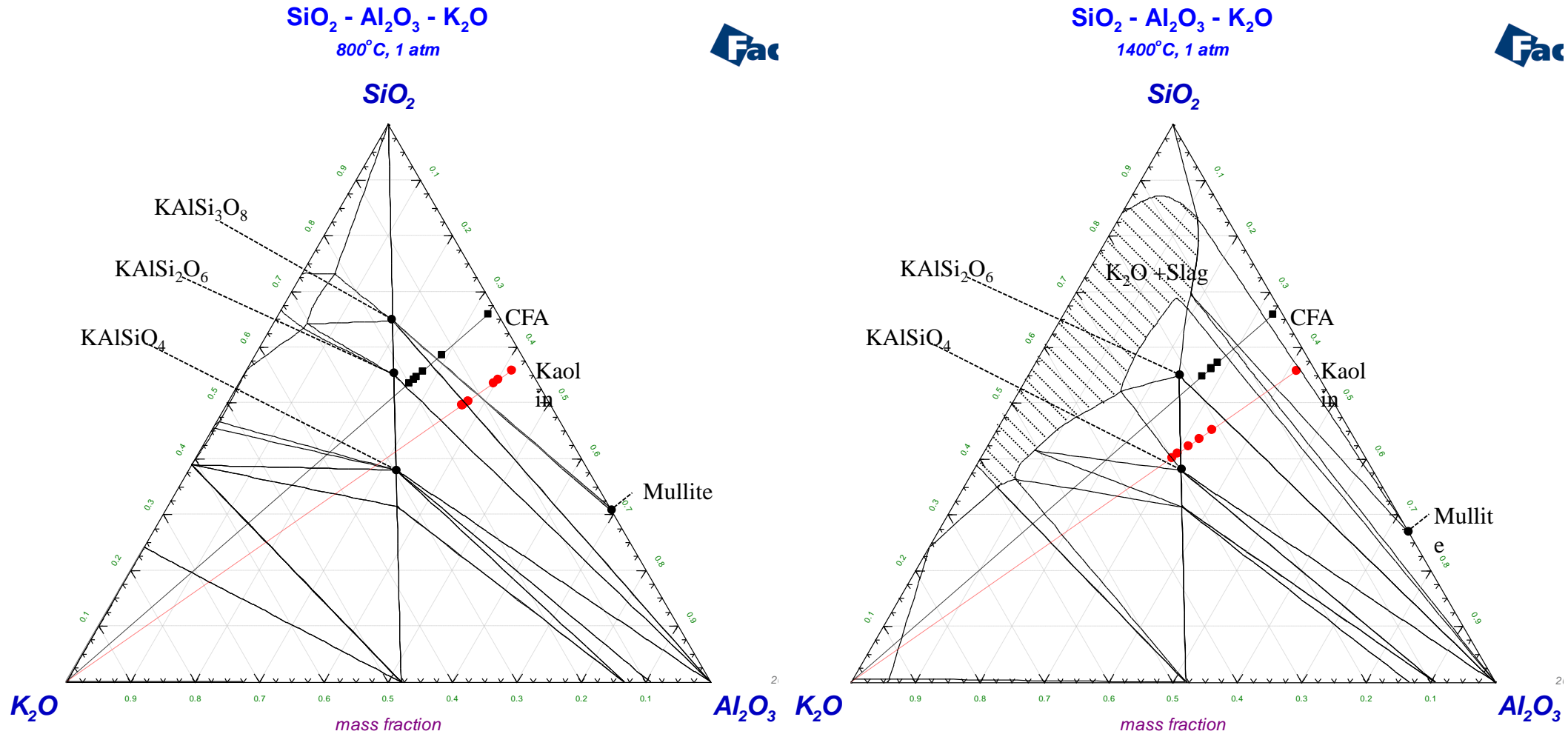- Analysis of the capture rate

Questions?

Thermodynamic Equilibrium

Results: Limitations

- Saturation

- Duration at low concentrations