Effect of HCl on the Formation of Calcium Silicates in Sand Beds in Fluidised Bed Boilers

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$$CaO(s) + SiO_2(s) \rightarrow CaO \cdot SiO_2(s)$$
$$(CaSiO_3(s))$$

slow at T < 1000 °C

EXPERIMENTAL WORK WITH A TGA

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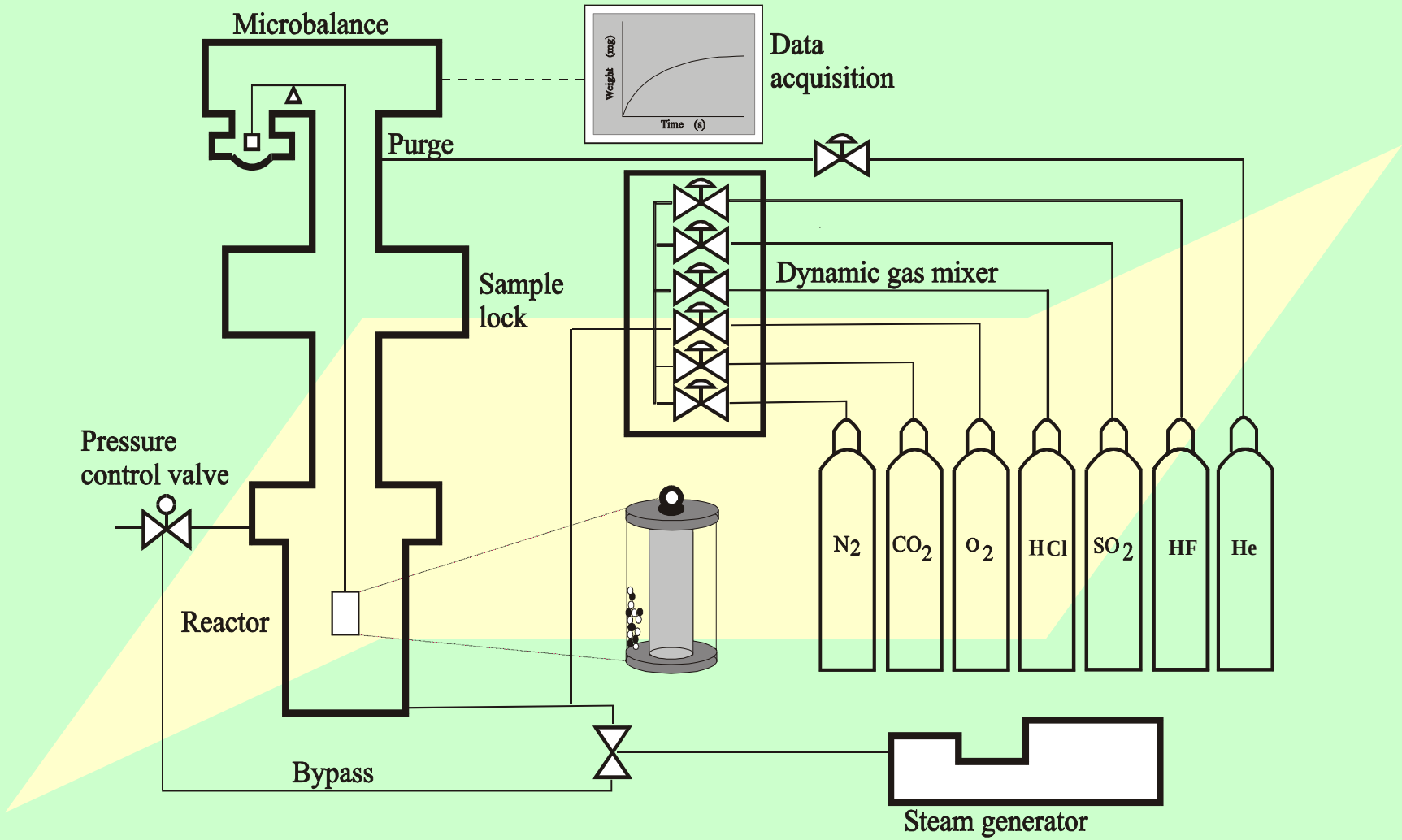
THERMOGRAVIMETRIC APPARATUS (TGA)



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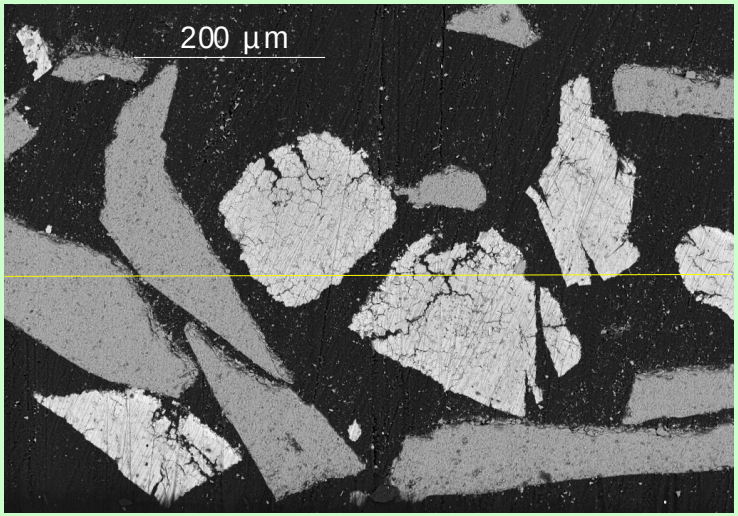
- Approximately 205 mg of quartz sand (Merck, pro analysi) was mixed with 40 mg limestone powder.

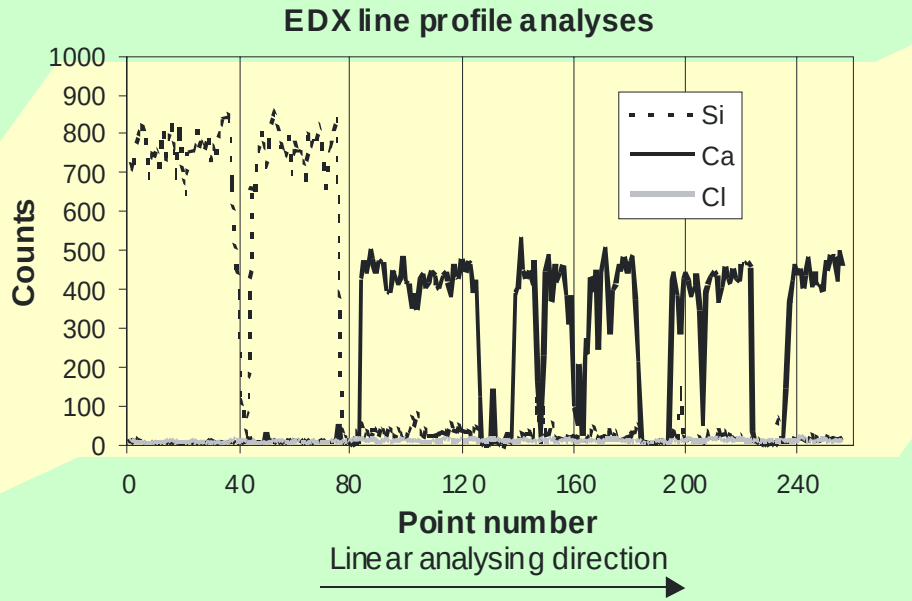
- Experiments of varying duration were made at 850^{o}C.

- The samples were examined by scanning electron microscopy (SEM) and energy dispersive spectrometry (EDS) to verify the chemical changes in them.

- On the following page SEM-EDS results are shown for a sample prepared at 850^{o}C, but after being in a gas containing 5% O_2 in nitrogen and no HCl for 90 min. the TGA did not show any change in the sample's mass during this experiment, and the SEM-EDS results clearly show that no calcium silicates were formed in the absence of HCl.

- This supports the claim that CaO and SiO_2 do not react with each other under FBC conditions through a direct solid-solid reaction.





EDX line profile analyses of Si, Ca and Cl for a sample of SiO_2 and CaO treated in O_2 and N_2 at 850°C. Reaction time: 90 min.

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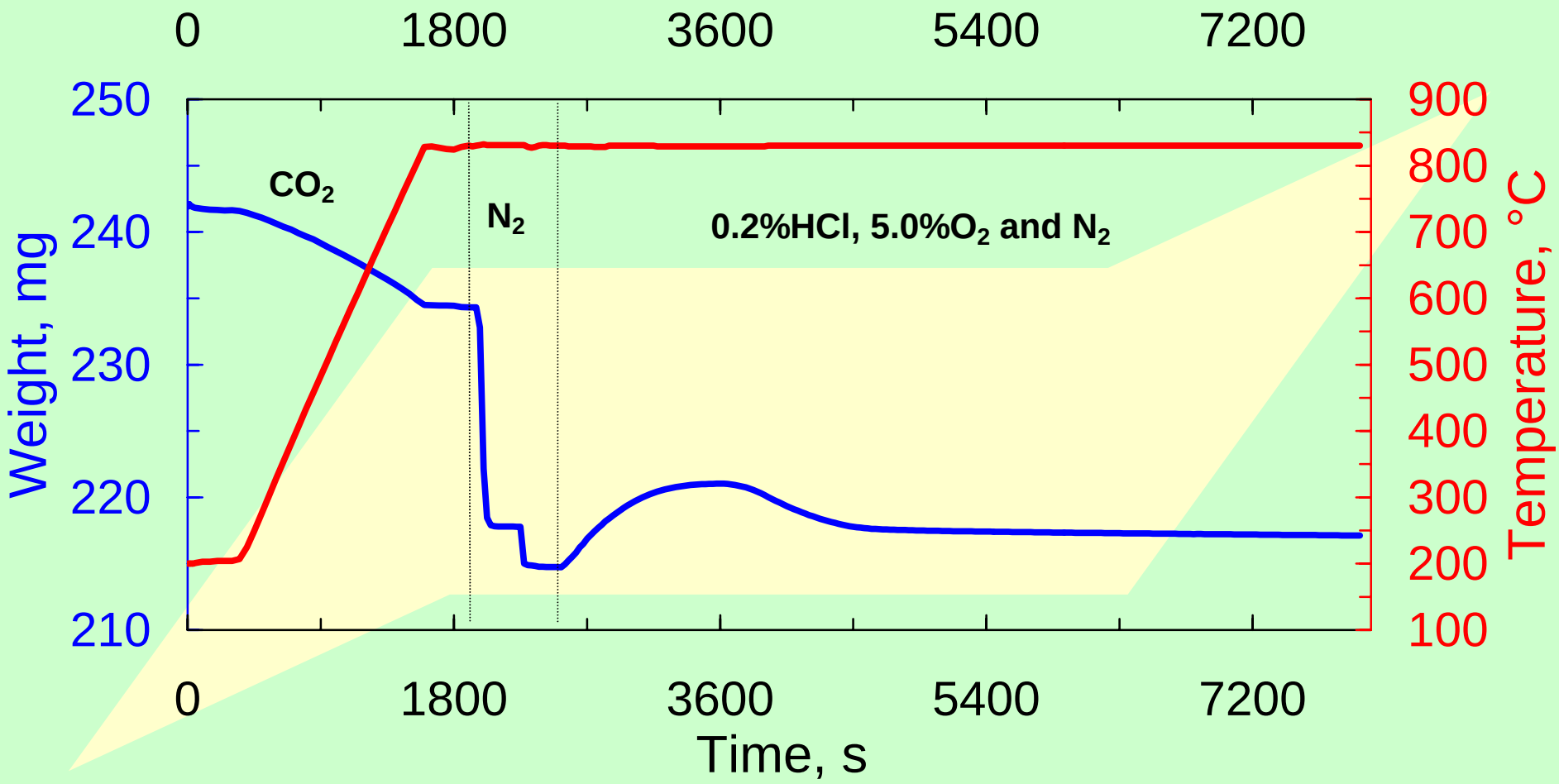
Temperature and sample mass versus time

Gas atmosphere during reaction step: 5% O_2 and 2000 ppm HCl in N_2



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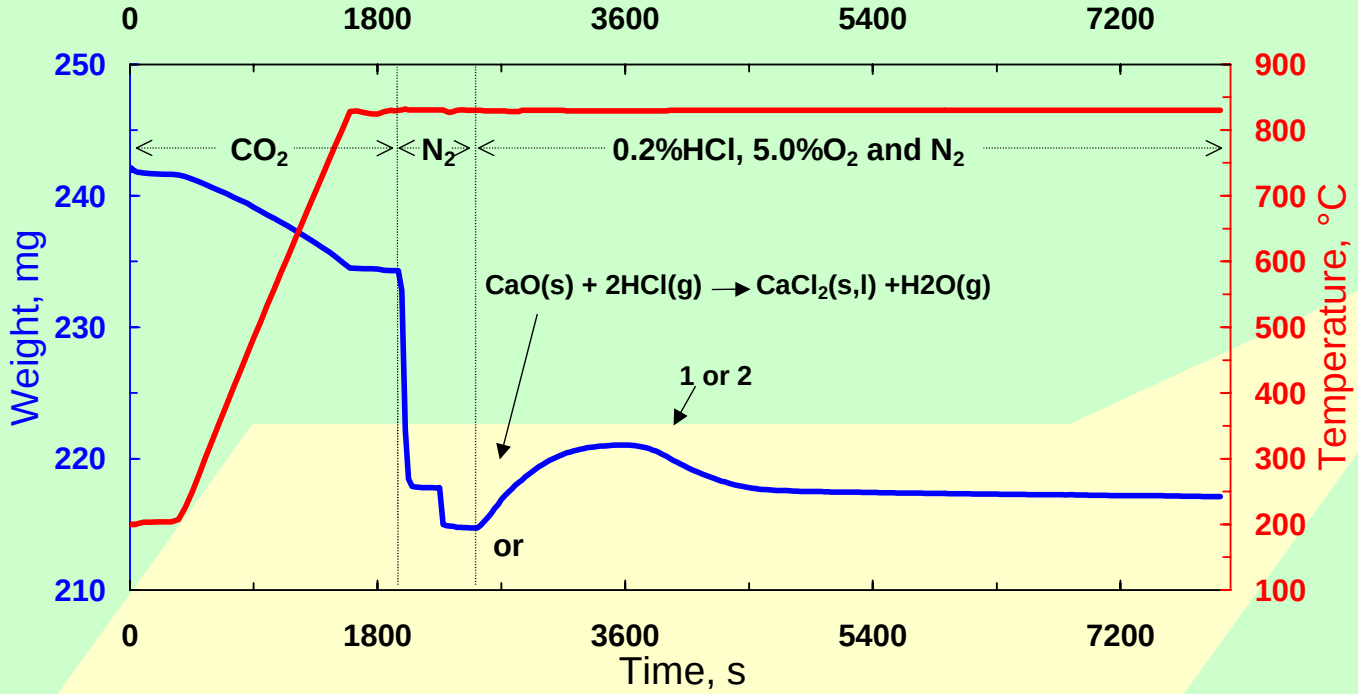

1. $CaCl_2(l) + SiO_2(s) + 0.5\ O_2(g) \Rightarrow CaSiO_3(s) + Cl_2(g)$

or

2. $CaCl_2(l) + SiO_2(s) + H_2O(g) \Rightarrow CaSiO_3(s) + 2HCl(g)$

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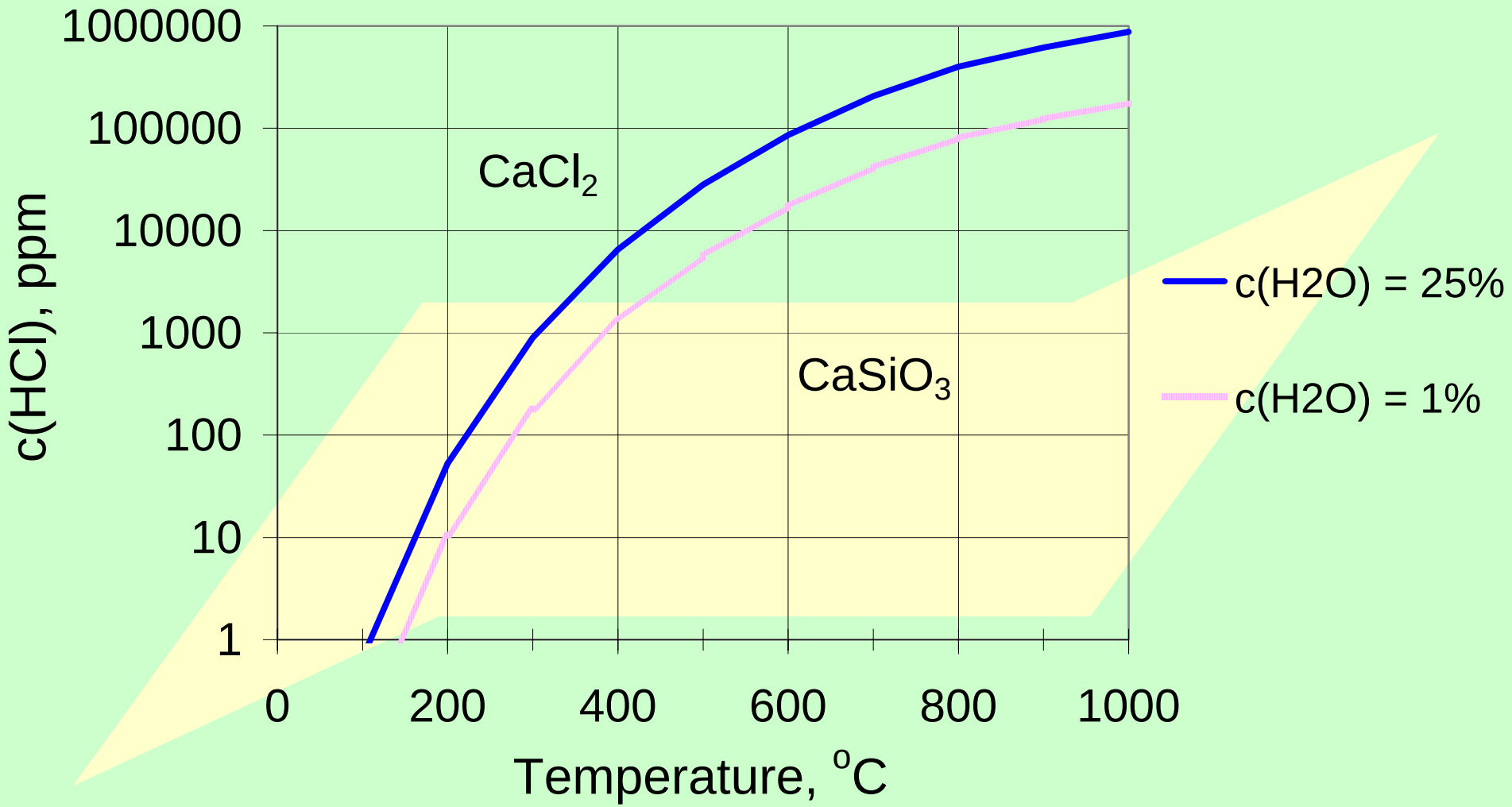
$CaCl_2 + SiO_2 + H_2O(g) = CaSiO_2 + 2HCl(g)$ (HSC 4.1)



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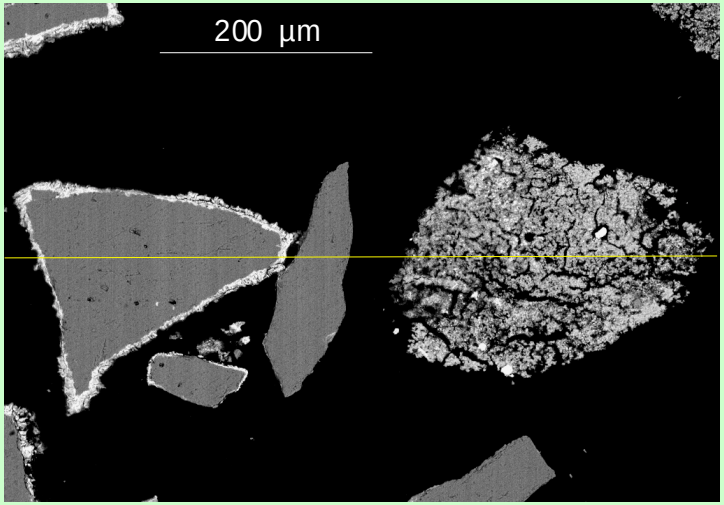

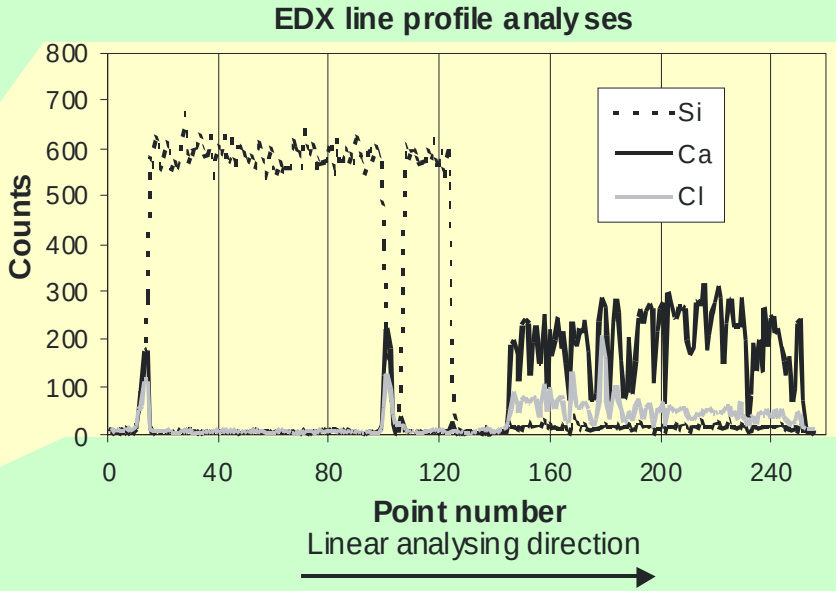

EDX line profile analyses of Si, Ca and Cl for a sample of SiO_2 and CaO reacted with HCl, O_2 and N_2 at 850°C. Reaction time: 10 min.

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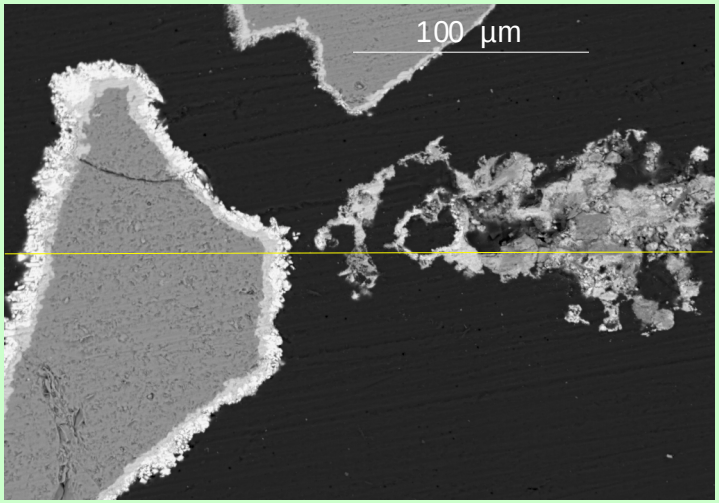

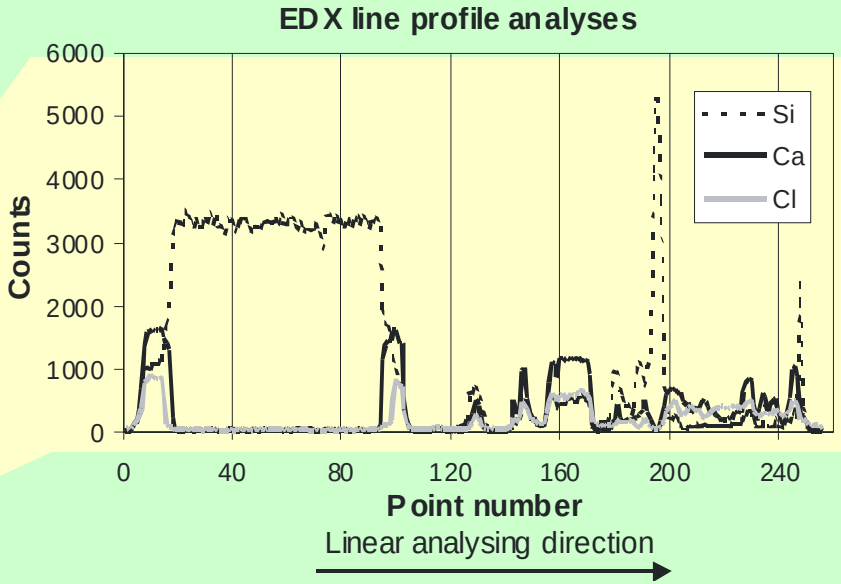

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More information:

Partanen, J., BACKMAN, P., and HUPA, M.,

The Effect of HCl on the Formation of Calcium Silicates in Sand Beds in Fluidised Bed Boilers, Combustion and Flame 2002