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Subject Area	Waste management and technologies
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Development of high temperature barium based sorbents

for hydrogen chloride removal from syngas

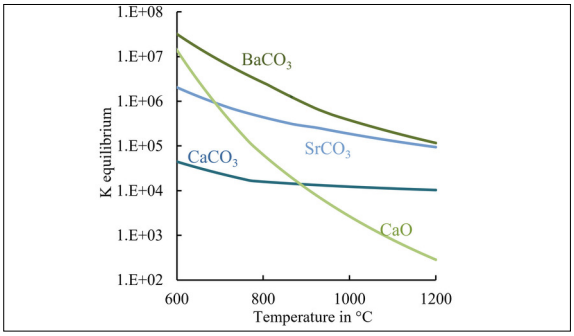

Figure 1: Constant equilibrium for the reaction of barium, strontium and calcium carbonate with HCl over temperature.
Own presentment

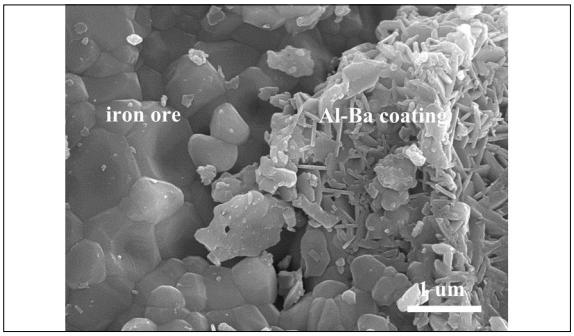

Figure 2: Scanning electron microscopy image of iron ore coated with nanostructured aluminium-barium.
Own presentment

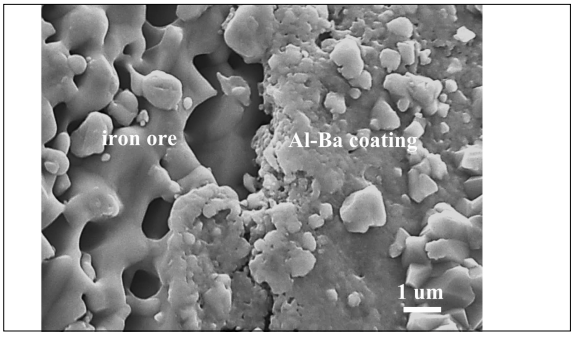

Figure 3: Scanning electron microscopy image of iron ore coated with aluminium-barium after one cycle.
Own presentment

Introduction: The annual generation of municipal solid waste (MSW) is rising worldwide. Thermochemical treatment of MSW is a sustainable solution for the waste management system, since it reduces the volume and mass of waste and generates energy. Due to the presence of hydrogen chloride (HCl) in flue gas, steam boilers of waste-to-energy (WtE) plants typically operate at low steam conditions (400 °C and 40 bar), which results in a relatively low net electrical efficiency of 20-23 %. An HCl removal technology for WtE plants at high temperature (800 °C) is needed in order to eliminate HCl from flue gas prior to the boiler system and, therefore, increase the steam conditions and the electrical efficiency.

Result: A barium sorbent shows from a thermodynamic point of view to be the most promising sorbent for HCl removal at high temperature compared to strontium and calcium based sorbents (see Figure 1). The barium based sorbent was produced in the lab and consists of iron ore coated with 5 wt% barium carbonate and aluminium oxide. The barium aluminium coating was represented by a mixture of nanorods and nanoplates on the surface of iron ore (see Figure 2). Changing the synthesis temperature had the pronounced effect on sorbent morphology, whereas the molar ratio of aluminium to barium had no effect. The adsorption capacity of the barium based sorbent was tested in a lab scale reactor using a model syngas. The experiment showed that both iron ore coated with and without barium were able to remove HCl from syngas. Further studies are needed to clarify the contribution of each components on HCl capture. To investigate the stability of the sorbent, a sequence of adsorption and regeneration was performed. The regeneration was at 1000 °C while introducing flue gas. The sorbent showed a sintered aluminium oxide coating after one cycle, probably caused by the high regeneration temperature (see Figure 3). Further optimization of regeneration step would be required to develop a regenerable sorbent.