# Thermochemical modeling of the ash behavior of coals and biomasses/waste materials for co-utilization

Markus Reinmöller[1], Stefan Guhl[1], Marcus Schreiner[1], Markus Neuroth[2], Bernd Meyer[1]

[1]TU Bergakademie Freiberg, Institute of Energy Process Engineering and Chemical Engineering, Fuchsmühlenweg 9, 09599 Freiberg, Germany

[2]RWE Power AG, Kraftwerk Niederaußem, Werkstraße 1, 50129 Bergheim, Germany

Realizable conversion processes for solid fuels are determined by the contained minerals, since agglomeration, sintering or melting of the ash will strongly affect the potential processes. As a consequence, the investigations of ash composition and contained mineral phases of the applied fuels are indispensable to enable a reliable operation. Thermochemical modeling can be used to understand and predict the temperature-dependent behavior of ashes, e.g. transformations of mineral phases, selective vaporization of species, and the ash fusion behavior.

Principle analyses of two coals (hard coal and brown coal) and three biomasses/waste materials (oat husks, plastic waste, and sewage sludge) were executed. Mixtures of the coals with addition of 10, 25, and 50 wt.% (raw basis) of the substitute fuels were produced. The base fuels as well as the jointly ground blends are ashed at 815 °C. For all ashes, the composition was studied by XRF, which has approximately followed the rule of mixtures. The ash fusion behavior was strongly influenced by the blending, which has led to a reduction of the ash fusion temperatures in the order of up to 250 K.

FactSage calculations are performed using the data bases FToxid, FTmisc, FTsalt, and FactPS in that order. A list of the applied solution species can be found in ref. [1]. The determined ash composition is used as an input for the FactSage calculations. Those calculations have illustrated the mineral phase composition of the ashes as a function of admixture rate of biomass/waste in comparison to XRD results. Selected temperatures of the ash fusion behavior are reproduced by a mass-based approach [2]. For the flow temperature, the values are determined within the experimental error. Thus, the FactSage calculations have enabled an analysis of the mineral phases and the resulting ash fusion behavior. In addition to that, experimental limitations of the predictability are perceptible.

[1] M. Reinmöller et al., Fuel, 202 (2017) 641-649.

[2] D. Schwitalla et al., Fuel Processing Technology, 175 (2018) 1-9.