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MODELING OF CALCIUM DISSOLUTION FROM OIL SHALE ASH

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Present study is considered to be the first step of the modeling of the promising process for reuse of solid waste of Estonian heat and power industry - oil shale ash - for production of precipitated calcium carbonate (PCC) as a valuable commercial product. The main focus of this paper is the separation of free lime from oil shale ashes formed in boilers operating with different combustion technologies. Special attention was addressed towards the mass transfer of *Ca* ions from ash particles into an aqueous solution. Paper includes experimental data and mathematical modeling of the *Ca* dissolution (leachability) process from oil shale ashes in a batch reactor [1] as well as in a packed-bed leaching column [2].

Fig.1. Modeling of Ca dissolution during PF ash washing in a batch reactor (ash/water ratio 1/500): experimental (▲;■) vs. simulated (—) Ca concentration profiles: ■ Ca concentration in liquid phase c(t), g/L; ▲Ca concentration in solid phase (ash) q, g Ca/L ash.

The main characteristics of the *Ca* dissolution equilibrium and dynamics have been established. Leaching equilibrium equations of *Ca* for two types of ash were obtained on the basis of experiments, and estimation of the *Ca* internal mass transfer and effective diffusion coefficients, k_s and D_s, was made. By conducting continuous washing process of the oil shale ash layer, the values of the overall and liquid phase mass transfer coefficients, K and k_L, were evaluated. Based on the collected data, *Ca* dissolution models from oil shale ashes, describing the changes in *Ca* content in the solid (ash) and liquid phase, were developed for batch (Fig. 1) and continuous washing processes (Fig. 2).

Fig.2. Modeling of Ca washing process for PF ash layer (water flow rate 146 mL/min): experimental (♦;▲;■) vs. simulated (—) Ca concentration profiles: ♦ Ca concentration in the outlet flow, g/L; ▲ mass of Ca in the solution collector, g; ■ average Ca concentration in the ash q, g Ca/L ash.

References

1. O. Velts, M. Hautaniemi, J. Kallas, R. Kuusik, *Fuel Process Tech*, (2010), doi:10.1016/j.fuproc.2009.12.008, in press.

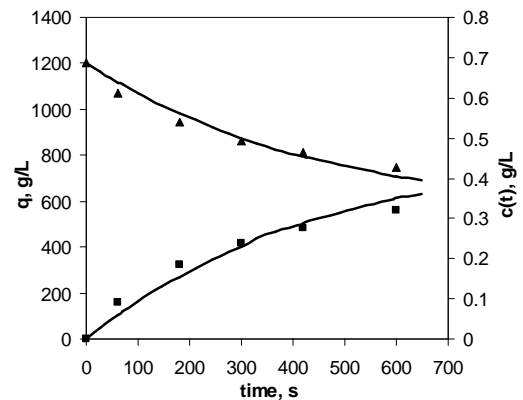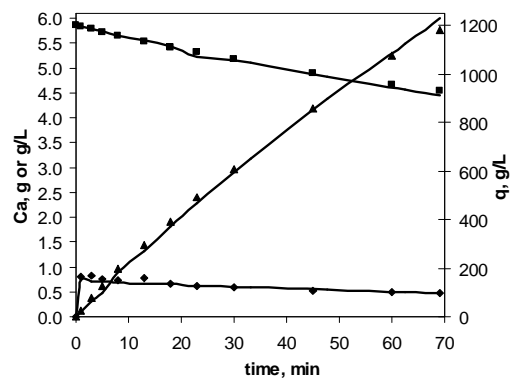2. O. Velts, M. Hautaniemi, J. Kallas, M. Kuosa, R. Kuusik, *Fuel Process Tech* (2010), doi:10.1016/j.fuproc.2009.12.009, in press.