Extraction possibilities of valuable metals from ilmenite after OCAC of waste fuels

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Background

Nordic countries are world-leading when it comes to using waste and biofuels for heat and power production. A new combustion concept, which was developed at Chalmers, is Oxygen Carrier Aided Combustion (OCAC). OCAC consists of a fluidized combustion reactor which is filled with metal oxides, called oxygen carriers. The bed material is reduced in fuel-rich parts of the reactor and oxidized in the oxygen-rich parts. OCAC has positive effects on emissions and the advantage to increase combustion efficiency and capacity. This technology is currently being promoted by the company E.ON and Improbed.

Since the biomass resource base is expanding the composition of biomass may vary considerably. The interaction between bed material and fuel can lead to an uptake of certain elements, such as potassium, calcium, phosphorous, zinc, copper, etc. This could thereafter lead to lower reactivity and a need to change the bed material.

Problem description

The oxygen carrier used in OCAC is ilmenite, an iron-titanium ore. When this material is used in combustion with biomass waste, different elements could be accumulated in the oxygen carrier particles. To use the oxygen carrier for a longer period, it is interesting to investigate different possibilities to extract these elements, both with respect to the reuse of the oxygen carrier, but also for recycling certain elements.

The current project is a collaborative effort with the companies E.ON and Renova. E.ON uses OCAC technology in some of its power plants. We have the possibility to sample materials from these boilers. This project will use these samples and investigate extraction processes both by literature and practical work. The focus will be mainly on zinc since elevated levels are found in waste fuels and Renova and co-workers have developed a method for zinc recovery from waste ash.

Research tasks:

1. Literature study of extraction methods and the possibility to implement these on ilmenite samples.
2. Leaching experiments of ilmenite samples obtained from E.ON.
    a. The aim is to investigate different leaching parameters such as time, leaching agent, and pre-treatments such as crushing, etc.
3. The second phase of this project is to investigate phases and morphology using Scanning Electron Microscopy (SEM), X-Ray Diffraction (XRD) and Brunauer-Emmett-Teller (BET) surface area.

Prerequisites: Interest in experimental work, preferably chemical background
Target group: Master students within chemical engineering, material chemistry, chemistry or energy systems programs
Group size: 1-2 students
Supervisors: Ivana Staničić, Pavleta Knutsson and Karin Karlfeldt Fedje
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