Projektexamenskod: KBTX16-23-06

Avdelningen för Energi & material
Institutionen för Kemi och kemiteknik, Chalmers tekniska högskola

Projektförslag för kandidatarbete inom inst. Kemi och kemiteknik och Biologi och bioteknik

Ash layers as active surfaces in thermal conversion of waste and biomass?

Bakgrund
Growing energy demand worldwide has been coupled with increasing levels of fossil-CO_2 emissions into the atmosphere. In order to decrease the dependency on fossil fuel and at the same time decrease the consequently emitted greenhouse gases, alternative fuels such as biomass and waste are tested. Fluidized bed reactors have proven to be one of the most energy efficient environments for thermal conversion of heterogeneous fuels such as biomass and waste. Even though providing the possibility for fuel flexibility and allowing a good mixture between the fluidized gas and the fuel, one of the remaining challenges that the thermal conversion in fluidized bed faces are the unconverted C-containing species. Unconverted species represent not only loss of energy but also need for additional handling and in certain cases even costly unplanned stops. Different solutions have been implemented such as post-treatment of the produced gases and use of additives.
Different minerals have been also tested as bed materials for process improvement. While properties such as oxygen carrying and catalytic activity have been often linked to the choice of specific material, during the last years it has been observed that the ash layer that is forming on the materials is not to be neglected. In multiple tests it has been shown that ash layer can both lead to oxygen carrying and to catalytic conversion of hydrocarbons. But are all the ash layers active? And how stable are ash layers? Can properties be transferred between different processes or is the ash layer easily lost due to diffusion or attrition? In-depth analysis of used bed material particles needs to be done to understand the mechanism of ash layers development, their content and elemental distribution. Further experiments on the activity of the differently formed ash layers can lead to more understanding of the ash layer role. By doing so, tailor-made ash layers can be aimed which can have the desired activity and can both improve the thermal conversion process and optimize the existing material flows.

Problembeskrivning
In the proposed project, students will do exposures that aim to follow the ash layer development. As a next step the students will characterize the materials sampled after biomass and waste ash exposures and the materials after their own exposures. Based on the results from the characterized materials, additional laboratory experiments that confirm the effect of the formed ash layers can be performed. The goal is to find similarity and differences in the formed ash layers as well as to understand how ash layer develop in different conditions (oxidizing, reducing, with and without ash compounds). The aim is to find an optimal composition of the ash layer that can allow increased residence time and material activity.

Genomförande /Viktiga moment/teknikinnehåll
Literature research as well as material characterization of sampled and exposed materials (Electron microscopy - SEM-EDX, X-ray diffraction - XRD, Ion chromatography (IC)). Design and performance of own experiments.

Speciella förkunskapskrav: Basic chemistry knowledge and interest in energy and environment
Möjlig målgrupp: Kemi och Kemiteknik, Bioteknologi
Gruppstorlek: 4-6 studenter
Förslagsställare/kontaktperson/huvudhandledare: Pavleta Knutsson
Övriga handledare: Robin Faust, Fredrik Hildor