Study on the catalytic heterogeneous direct liquefaction of bovine serum albumine under subcritical water conditions: The case of ammonium

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Motivation

The production of biofuels from biomass requires large amounts of nutrients, usually provided to the plants in the form of high quality fertilizer. Sustainable production of biomass requires the recover and reuse of nutrients such as nitrogen, sulphur and phosphorus contained in the biomass.

PSI’s catalytic hydrothermal process (see figure 3) consist of an intermediary salt separation step, where nutrients, in the form of salts are separated through gravitational precipitation from the organic phase. However a potential efficient salt recovery is only achieved if the organically bounded nutrients are previously released from the biomass during the liquefaction of the biomass in PSI’s catalytic hydrothermal process preheating step.

Objective

Study the first step in PSI catalytic hydrothermal process:

- Optimize liquefaction of biomass, with a special focus on proteinaceous biomass which contains large amounts of nitrogen.
- Recover the nitrogen as ammonium.
- Find a suitable catalyst which improves the release of nitrogen from proteinaceous biomass.
- Avoid tar and coke formation

Method

A 10 wt % aqueous Bovine Serum Albumine (BSA, protein composed of 607 amino acids) solution is filled into a 5 ml mini-batch reactor, either in presence or absence of a catalyst.

- No catalyst up to now showed significantly better performance after 9 min. residence time than other catalysts or runs done in the absence of catalyst.
- However catalysts made or doped with TiO2 show slightly better performance than others (run TM360B and run SM360B).
- After two hours residence time, ammonium recovery reaches ~ 80 % NH4+ N/feed-N in the absence of catalyst.
- Future catalysts hopefully can speed up nitrogen split off to ammonium for shorter residence times, i.e. residence times around 9 min. which are typical operating conditions for PSI catalytic hydrothermal process.
- Potential bottlenecks, such as chemical equilibrium of nitrogen split off and reactant limitation need to be indentified as well as parameters influencing the ammonium recovery.
- Variation of solution pH should give further insights into nitrogen split off and its chemistry.

Results

Biomass liquefaction takes place at 370 °C and RT between 1 – 120 min. Standard conditions are 370 °C and RT = 9 min.

Conclusion and Outlook

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