RESEARCH CATALOGUE

ENERGY TECHNOLOGY

INTEGRATIVE PRESSURIZED ACID AND ALKALINE CATALYZED LIQUID PRETREATMENT, HYDROLYSIS AND DELIGNIFICATION OF BIOMASS FOR SUGAR PLATFORM BIOREFINERY

MR. KHATIYA WEERASAI

Doctor of Philosophy in Energy Technology

Advisors

Prof.Dr. Navadol Laosiropojana

Advanced Fuel Processes Laboratory (AFPL)
The Joint Graduate School of Energy and Environment

Dr. Verawat Champreda

The National Center for Genetic Engineering and Biotechnology (BIOTEC)
National Science and Technology Development Agency (NSTDA)

The research work was performed during 2013-2018 and aimed at investigating practical pretreatment processes for sugarcane bagasse by using an organic solvent in the presence of diluted acid or alkali promoters under mild operation conditions for subsequent conversion to sugars using enzymes or alternative catalytic hydrolysis. The process was optimized based on the product yield and reaction selectivity. The isolated components were characterized by relevant physicochemical properties for further processing. Additionally, precipitation methods were studied for recovery and purification of the isolated lignin in the downstream process.

Preliminary step

the study of the acid/base promoter in organosolv pretreatment was studied in order to find a suitable solvent system and promoter.

After the pretreatment process, the obtained solid as cellulose-enriched pulp was hydrolyzed by cellulase enzymes in the saccharification step. The concentration of monomeric sugars was determined by high-performance liquid chromatography (HPLC). Also, the composition of the solid pulp was analyzed to demonstrate selectivity on the removal of the non-cellulosic fractions. Then, the best-selected pretreatment system comprising selected solvent and promoter was evaluated by response surface methodology (RSM) based on a central composite design (CCD) to achieve the optimized conditions for maximizing product recovery and solvent recycling.

Downstream process

The downstream processing of the lignin-rich fraction was investigated by different lignin precipitation method (acidification and supercritical CO_2). The performance of the lignin separation process was considered in terms of yield and purity. In the final part of my research work, an alternative catalytic hydrolysis of pretreated bagasse was applied with sulfonated-activated carbon as heterogeneous catalysts under hot-compressed water for the production of monomeric sugars.

Main outputs / outcomes

During my PhD studies, through the JASSO scholarship, I had the opportunity of spending one year at the Kumamoto University in Japan. There, I worked on setting up a supercritical fluid system and I am grateful for the support I received from Prof Tetsuya Kida and Prof Armando T. Quitain. This research work has led to a patent with PTTGC and to international publications in Food and Bioproducts Processing, and in BioResources.