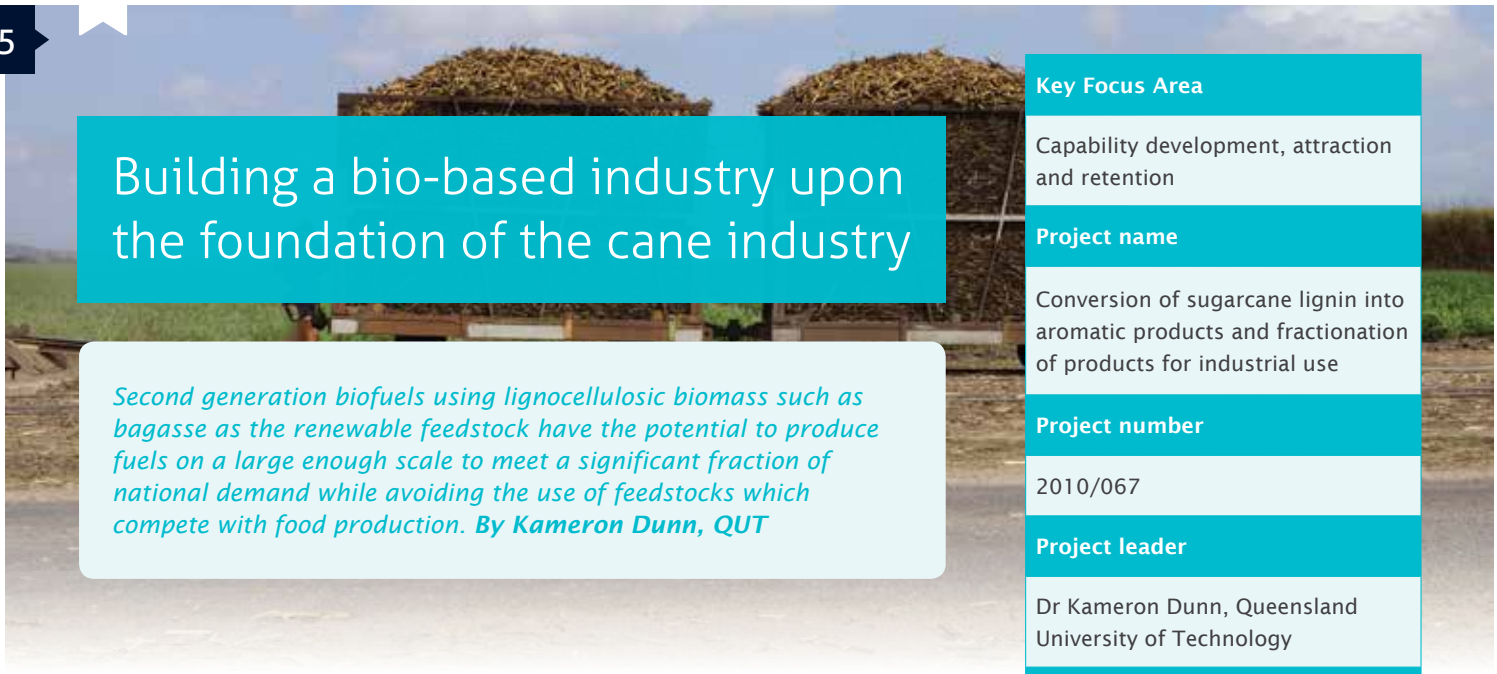

Building a bio-based industry upon the foundation of the cane industry

Second generation biofuels using lignocellulosic biomass such as bagasse as the renewable feedstock have the potential to produce fuels on a large enough scale to meet a significant fraction of national demand while avoiding the use of feedstocks which compete with food production. ***By Kameron Dunn, QUT***

Key Focus Area
Capability development, attraction and retention
Project name
Conversion of sugarcane lignin into aromatic products and fractionation of products for industrial use
Project number
2010/067
Project leader
Dr Kameron Dunn, Queensland University of Technology
Project supervisors
Dr Phil Hobson, Prof William Doherty and Associate Prof John Bartley
Project end date
2014 (complete)

Depending on the conversion technology, production of second generation biofuels is expected to generate significant amounts of lignin or black liquor.

Lignin is an amorphous branched polymer and the second most abundant of the three naturally occurring polymers (cellulose, hemicellulose and lignin) contained in lignocellulosic material.

Lignin is also the only constituent based on aromatic units, an important structural characteristic of high value phenolic compounds currently derived from the petrochemical industry.

Such phenolic compounds are used in applications for pharmaceuticals, food flavourings, resins, plastics, carbon fibre and carbon fibre composites.

We know from previous extensive studies reported in the literature that lignin hydrolysis reactions, used to depolymerise lignin into monomeric or phenolic products, suffer from:

- the generation of a wide spectrum of chemical products, making product recovery and refining difficult;
- low yields of derived phenolic oils (< 25 wt% on dry lignin) or total monophenols (typically less than 10% on dry lignin) and;
- the occurrence of competing repolymerisation mechanisms, thus making the lignin structure less amenable to monomer production.

I recently completed a PhD study aimed at understanding the mechanisms associated with lignin hydrolysis through hydrothermal liquefaction, as a means of deriving high value phenolic compounds from bagasse. This PhD was support by SRA and sought to:

- identify the structural characteristics of technical sugarcane lignin and report on how such characteristics change for different pulping techniques;
- determine the chemical and structural constituents of both the phenolic oil product and the solid residue obtained as a result of different hydrolysis treatments on lignin; and identify lignin depolymerisation pathways.

This study identified the structural attributes of sugarcane lignin, the products resulting from the depolymerisation of sugarcane lignin during hydrothermal liquefaction and the influence on the product distribution resulting from the initial lignin feedstock structure and catalyst used. Specifically the study identified:

- a depolymerisation pathway for some lignin structures to promote higher phenolic oil yields and lower molecular weight residue lignin. Knowledge and manipulation of this pathway subsequently resulted in demonstrated monomeric phenolic yields of 35 wt% from lignin, where previously maximum yields of only 22.5 wt% had been reported in literature i.e. a 60% improvement in yield.

Sugarcane lignin represents a significant renewable resource for the production of high value phenolic compounds.

- that hydrolysis conditions could be tailored to substantially reduce the number of phenolic compounds produced, some of which having considerable commercial value.

QUT is also developing further improvement to the depolymerisation approach, and in the method of recovering and purifying the various lignin derivatives using specialised solvent extraction techniques.

RECORDED

Kameron's webinar, titled 'Awakening the sleeping giant', can be viewed on our website by clicking on the 'Growing Cane' menu item and then selecting 'Milling'.