

Ionic liquids: what are they?

Project Description

Ionic liquids (salts in the liquid state) are considered a very hot topic in the current process industry in view of their wide range of applications. Indeed, they can be efficiently used for separation techniques (e.g. Water desalination), but also as catalysts.

In this project we aim at designing two relatively new kinds of ionic liquids:

- Polymeric ionic liquids based on polyketones;
- "Green" ionic liquids based on the use of sugar derivatives.
- In both cases, a first theoretical, literature based study will be followed by experiments (2-3 weeks).
- *The project is intended for 2 students, but can accommodate 3 when necessary*

Subject of Design

- > Two relatively new kinds of ionic liquids.

Field of Knowledge

- > Product Engineering

Company-logo

The University of Groningen (UG), together with one industrial partner, is the main stakeholder. Cooperation with prof. M.Kobrak (Brooklyn College, currently at UG).

Picture of the product/process/system



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Polymeric surfactants

Project Description

Polymeric surfactants are polymers with an hydrophobic and hydrophilic nature. They are basically the high molecular weight analogues of soaps. These materials attract a lot of interest by industry because of their combined role as surface active chemicals and rheology (e.g. Viscosity modifiers). In this project we aim at designing (technology push) relevant applications for a series of polymeric surfactants already prepared at the University of Groningen (UG). By measuring relevant material properties (e.g. viscosity), suitable applications should be tested and a feasibility study carried out.

The project is intended for 2 students

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- > Polymeric surfactants

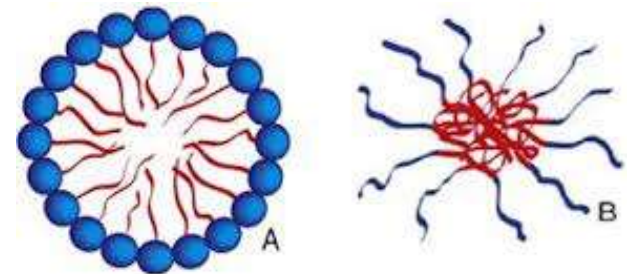
Field of Knowledge

- > Product Engineering

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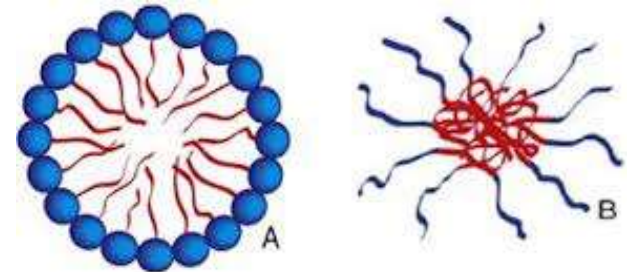
Field of Knowledge

- > Product Engineering

Company-logo

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Picture of the product/process/ system



Hydrogen (H₂) network

Project Description

Hydrogen (H₂) is the most simple molecule you can think of. It can be conveniently used in many chemical reactions or as energy vector/fuel. In this project we aim at preliminary design for an hydrogen network infrastructure close to Groningen. Idea in this case is to establish a first network between producers and users (all in the same region) as well as a first idea for an infrastructure connecting these entities.

The project is intended for 1 student.

Subject of Design

- > Network infrastructure.

Field of Knowledge

- > Process Technology

Company-logo

The University of Groningen together with one industrial sponsor



Picture of the
product/process/
system



Valorising sewage sludge by supercritical water gasification

Project description

Sewage sludge is an abundant, wet biogenic residue stream, which currently in the Netherlands is disposed of mainly by fluidized bed combustion. A novel process is supercritical water gasification by which either hydrogen or methane -rich gas is produced. A Dutch company – Gensos BV – is currently in the process of scaling it up.

Subject of design

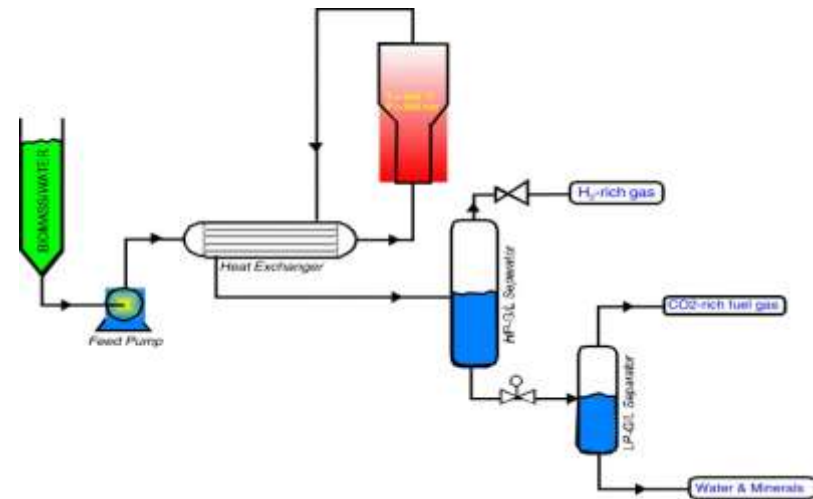
- Identification of possible value chains for all products derived.
- Experimental investigation of the reactive behavior of less explored classes of compounds in the sludge: fats, oils, and/or proteins.
- Basic process design calculations

Field of knowledge

Process selection and design, chemical reaction engineering (kinetics, analyses)

Stakeholder company

CRE group university of Groningen,
Gensos B.V., TU Delft



Biobased alternatives for BisPhenol-A (BPA)?

Project description

Bisphenol A (BPA) is an organic synthetic compound, derived from fossil oil and in commercial use since 1957. BPA is employed to make certain plastics such as polycarbonate and epoxy resins, e.g. for food can linings. In 2015, an estimated 4 millions tonnes of BPA were produced for manufacturing polycarbonate plastic, making it one of the highest volume chemicals produced worldwide.

However, BPA exhibits estrogen mimicking, hormone-like properties that raise concern about its suitability in consumer products and food containers. Therefore it is desired to find environmentally-friendly biobased alternatives that do not pose a danger to human health.

Subject of design

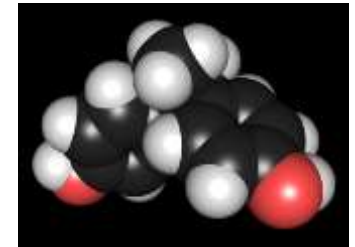
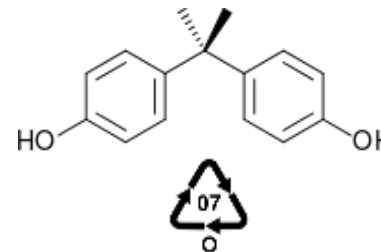
- Identification of possible biobased substitution options for BPA and/or for its end-use applications (polycarbonate, resins,..)
- Identification of the corresponding value chains
- Selection of the techno-economically most viable chain
- Preliminary process design of the core of the selected chain

Field of knowledge

Polymer chemistry, process selection and design, techno-economic evaluations, chemical toxicity

Stakeholder company

CRE group university of Groningen



Catalytic production of lactic acid from biomass

Project description

Lactic acid is an important commodity chemical with many applications in food, pharmaceuticals and cosmetics. Its annual market has been estimated to be 3.3×10^5 tons by 2015. Conventionally, lactic acid is produced via fermentation process suffering from low-purity lactic acid and low productivity. Catalytic production of lactic acid from biomass represents an attractive alternative.

Subject of design

- (1) Identify main catalytic routes for lactic acid production from different biomass(-derived) feedstocks
- (2) Suggest the most promising route and compare with the industrial fermentation route in terms of the technological, environmental and economic potentials.
- (3) Make a rudimentary plant design of the selected route.

Field of knowledge

Process and product technology
Chemical plant design and economics

Supervisor: Dr. J. Yue

Stakeholders

- Green Chemical Reaction Engineering Group at the RuG



Lactic acid



Polylactic acid bottles

Valuable from spend frying and cooking fats

Project description

Discarded oils and fats used for cooking and frying are an interesting source of renewable carbon. These days such sources are already used for the production of biodiesel. However, when the fatty acid chains in these fats contain (poly)unsaturations, these can potentially be used for higher value applications such as biobased polymers.

Subject of design

Identification of possible frying/cooking oil sources.
Investigate stability of and composition of these oils upon use.
Establish viability of utilisation of this renewable carbon source for polymer production.

Field of knowledge

Feedstock selection by experimentation as well as techno-economic evaluations and logistics

Stakeholder company

CRE group university of Groningen



Biogas from flocculated microalgae

Project description

Food companies are looking for natural colorants to replace synthetic dyes to give food products such as candy, ice cream, or sport drinks an appealing colour. The red microalga *C. merolae* produces a blue pigment that can replace synthetic blue in confectionary. After extracting the blue pigment from *C. merolae* biomass, a protein and carbohydrate-rich fraction is left that can be turned to energy through the production of biogas. This project deals with evaluating the potential to generate biogas from flocculated *C. merolae* biomass.

Subject of design

Process design

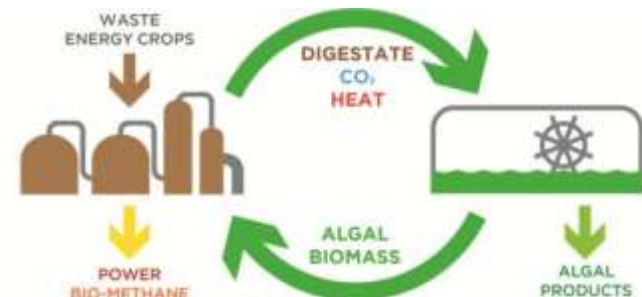
Field of knowledge

Biotechnology, process technology

Stakeholder company

None. This project is part of an idea to create a start-up company in a tropical region to produce blue food colorant from red microalga

Picture of the project



Blue pigment from flocculated microalgae

Project description

Food companies are looking for natural colorants to replace synthetic dyes to give food products such as candy, ice cream, or sport drinks an appealing colour. The red microalga *C. merolae* produces a blue pigment that can replace synthetic blue in confectionary. The production of the blue pigment involves biomass production, harvesting, and extraction of the pigment. This project deals with extracting the blue pigment from flocculated *C. merolae* biomass.

Subject of design

Process design

Field of knowledge

Biotechnology, proces technology

Stakeholder company

None. This project is part of an idea to create a start-up company in a tropical region to produce blue food colorant from red microalga

Picture of the project



Producing microalgae in the tropics

Project description

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Subject of design

Process design

Field of knowledge

Biotechnology, proces technology

Stakeholder company

None. This project is part of an idea to create a start-up company in a tropical region to produce blue food colorant from red microalga

Picture of the project



Efficient harvesting of microalgal biomass

Project description

Food companies are looking for natural colorants to replace synthetic dyes to give food products such as candy, ice cream, or sport drinks an appealing colour. The red microalga *C. merolae* produces a blue pigment that can replace synthetic blue in confectionary. The production of the blue pigment involves biomass production, harvesting, and extraction of the pigment. This project deals with finding an efficient extraction method that does not influence the subsequent pigment extraction.

Subject of design

Process design

Field of knowledge

Biotechnology, proces technology

Stakeholder company

None. This project is part of an idea to create a start-up company in a tropical region to produce blue food colorant from red microalga

Picture of the project



Large scale production of Acetic Acid from organic waste streams

Project description

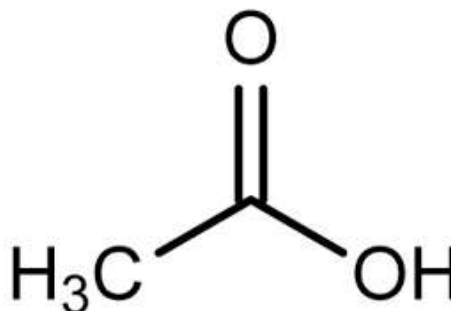
The demand for green chemical building blocks is growing. Acetic acid is one of these possible building blocks, which can be produced through fermentation of organic residue streams. Extraction and purification of the desired building blocks is key in the further development of this value chain.

Subject of design

This project will focus on the business case of extraction, purification, and high-quality and large scale application of volatile fatty acids, with a focus on acetic acid.

Field of knowledge

Chemistry, biochemistry, business development



KNN Advies is a research and consultancy firm specialized within the biobased and circular economy. We are involved in different steps of the value chain by developing both our own technologies as well as business concepts. With our hands-on knowledge we support others in reaching their sustainability goals and help co-create new biobased and circular value chains.

Real time protein and moisture measurement

Project description

Two years ago a new IFT spray dryer was built at FrieslandCampina Domo in Bedum. Samples are currently manually taken by operators to determine the moisture and protein content of the powder. With these measurements the process is controlled and adjusted.

Subject of design

During this project the inline measurement system (NIR) should be put in operation and validated in order to get real time and reliable data of the moisture and protein content of the powder. Next, the feasibility of further optimization steps for process control should be discussed.

Field of knowledge

Process technology, product quality, powder characteristics, process optimization, team player, data analysis.

FrieslandCampina Domo

FrieslandCampina Domo is a leading producer of ingredients, base powders and total formulas for the Infant and Toddler markets and ingredients for the Medical and Cell nutrition markets.

We believe firmly in providing nutrition that is safe, secure and ultimately enriches people's lives.

We believe every child has the right to grow up healthy, just as every person has the right to grow old gracefully.

We have a true passion for what we do: providing superior quality, nutritional products for the most vulnerable in society.



THERMFILLY

Project description

A full scale reactor, with a capacity of 6 m³ per hour sludge, will be build in the waste water treatment plant (wwtp) in Garmerwolde. In an energy efficient way using heat exchangers the secondary sludge will be heat treated to increase the amount of material available for digestion in a biogas fermentation.

Subject of design

During this project the sludge is being pretreated before it enters the biogas fermentation. The effect of the pretreatment will be determined using two 40 liter continuous reactors and in small 250 ml batch reactors. A model will be developed to calculate the efficiency of these additional step in the sludge treatment

Field of knowledge/interest

(Bio-)Process technology, pilot plants, laboratory experiments, societal relevance.

Waterschap NOORDERZIJLVEST



Among others, we purify wastewater from industry and households in northwest Groningen, northwest Drenthe and the Frisian part of the Lauwersmeer. (345.000 people). The additional waste water of the industry is comparable to the amount of 45.000 people.

The waste water is treated in 15 purification plants that are fed by 401 kilometer pipes and 110 pipes that transport the water from the houses and industry.

Waste water is purified in a natural way using bacteria. If the water is clean it is discharged into the surface water e.g. the Eemskanaal or the van Starckenborghkanaal.



The waste we produce is called sludge. Most of it is biomass and is converted in biogas digestion plants to produce methane. The remainder is dried and used as a fuel in energy power plants and cement ovens.

INNOVATIVE LACTOSE RECOVERY FROM MILK

Project description

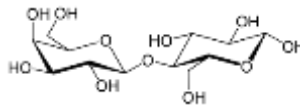
FrieslandCampina purifies lactose from milk as a substrate to produce galactooligosaccharides (GOS). GOS is an important and expensive ingredient in baby food. The current process for lactose purification leaves a solution containing 30% lactose unused. In this project you will use an innovative method to investigate if this method to purify lactose is technical and economical feasible.

Subject of design

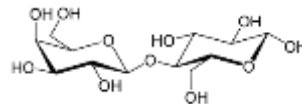
During this project you will immobilize a lactose binding protein to a solid matrix. With this affinity material you will design a process to purify lactose from a 30% solution. A model will be made to determine the efficiency of the process.

Field of knowledge / interest

Separation technology, laboratory experiments, chemistry, proteins, process optimization, data analysis.



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