Atlantic BIOCON | BIOCON Atlantique

Growing the Bioeconomy in Atlantic Canada

May 23rd – 24th, 2018

Fredericton, New Brunswick, Canada

Poster Abstracts

Atlantic BIOCON is showcasing the innovative research findings of academics from across the region. Posters will be on display at Atlantic BIOCON for delegates to view and ask questions. Judges will choose the best student poster for an award to be announced at the end of the event.

Wastewater Management in Rural Pakistan

Zach Denny

University of Prince Edward Island

Water contamination is a major issue in rural Pakistan. Poor wastewater management practices are the leading cause of contamination and human disease. In many villages, wastewater from houses flows freely in open channels and unlined ditches before draining directly into fields for irrigation.

Water hyacinths are an invasive, aquatic plant that is abundant in Pakistan. They have been tested before on treatment of industrial wastewater, providing promising results, but were not yet tested on human wastewater. Testing was performed using human wastewater, to determine remediation rates and overall reductions of wastewater parameters. The hyacinths provided major reductions, making them a simple and available form of treatment for the village. The proposed solution has two methods of reducing contamination. The first subsystem is the implementation of graded 4" PVC pipes in side ditches to transport wastewater. The second subsystem is the use of phytoremediation units in the main channel, which will provide basic treatment and cover the waste. The water hyacinth was selected as a plant for phytoremediation based on its rapid growth, hyperaccumulator capabilities, widespread abundance in Pakistan, and high reduction rates found through testing.

Critical to the success of this design are the accompanying implementation and education plans that were completed in conjunction with the project. The implementation plan includes information on materials, assembly, and maintenance and will offer an easy way for villagers to execute the proposed solutions. The education component has a brief curriculum to educate villagers on the dangers of wastewater and how this solution provides a safer alternative.

Isolating Nanocrystalline Cellulose from Local Invasive Tunicates

Matthew Dunlop

University of Prince Edward Island

Cellulose is well known as the most abundant organic polymer on Earth. Nanocrystalline cellulose (NCC) is a valuable commodity, which consists of the nanoscale crystalline region of the cellulose polymer. Tunicates are marine invertebrate animals, whose name originates from their unique integumentary tissue known as the tunic. Tunic tissue utilizes cellulose microfibrils which act as a skeletal structure. Tunic tissue constitutes the only known animal source of NCC. Isolation of NCC from tunicates can be achieved using a three step prehydrolysis - kraft cooking - bleaching technique. This work seeks to isolate NCC from two species of invasive tunicates on PEI, and to utilize this NCC in multiple real world applications. Laying academic ground work, towards the industrialization of NCC isolation from tunicates on PEI. In an effort to mitigate or eliminate the many problems posed by local invasive tunicates. Particularly to the local aquaculture community, as well as our island economy. Well concurrently opening the door to new value added economic resources, sourced from harmful invasive species. The resulting NCC is characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD) Energy-dispersive X-ray spectroscopy (EDX) Optical Microscopy and thermal gravimetric analysis (TGA). The percent yield, crystallinity, thermal properties and surface morphology of the NCC will be discussed. Isolated tunicate sourced NCC will be utilized in three applications; nanocomposites, superabsorbing materials and bioinks for 3D bioprinting. This information will be used to determine which invasive species of tunicate is best

suited for industrial scale up, and in which applications this NCC shows greatest potential. This work directly addresses the challenges invasive tunicates are causing local fisherman, in a distinctly different way than past research. Ultimately this academic ground work may be the first step towards addressing these challenges in a lasting and beneficial way.

Biocomposites Derived from Natural Fibres and Seafood Byproducts.

Emily Dunn

Acadia University

Seafood processing and fisheries industries in the Maritimes produce significant amounts of byproducts, which are routinely disposed-off as waste. These resources, if selectively processed, they have valuable constituents that can be utilized as ingredients in bioproducts. Our research study, explored the feasibility of using hemp fibres, seafood processing byproducts, and fly-ash to produce Hemplime-Crete (HLC). The hydrate lime was successfully extracted from mussel shells, then blended with industrial hemp and fly-ash. The test specimens were prepared, evaluated for compressive strength and modulus of elasticity. The test results all surpassed the minimum requirements for the structural suitability for use in walls and roofing according to the French Professional Rules (FPR). Further researches are underway to construct a unique furnace for seafood shells calcination process and to establish optimum biomaterials blends formulation to meet specific requirements for similar biocomposite applications.

Conversion of Municipal Wastewater Treatment Plant Sludge to Biocrude Oil through a Hydrothermal Liquefaction (HTL) Process

Andrew Mergl

University of New Brunswick

Increasing demands for energy and new methods of production, along with the depletion of conventional fuel sources, has led to significant research focusing on eco-friendly fuels. An interesting solution and promising feedstock alternative to conventional fossil fuels or agricultural biomass is the use of municipal or industrial organic waste products. Of the various available processes, thermochemical conversion technologies have gained interest due to their ability to transform everyday wastes into valuable fuels and fuel feedstocks.

Hydrothermal liquefaction (HTL) stands as an effective thermochemical process to convert a multitude of biomass feedstocks to biocrude oil. Wet waste streams such as wastewater treatment plant sludge, which normally requires drying and transportation to landfill, can be converted under suitable conditions to refinable fuel. In collaboration with New Brunswick-based Chief Defense Contractors (CDC), the Centre for Nuclear Energy Research (CNER) at the University of New Brunswick is aiming to determine the optimum operating conditions for the HTL of wastewater treatment sludge, as well as quantify the reaction kinetics of the process. A detailed engineering and economic assessment of available technologies has demonstrated net positive returns on investment that will be further refined and validated through lab-scale testing with the goal of constructing a pilot-scale demonstration plant within the next few years.

An Integrated System for Anaerobic Digestion of Thin Stillage and Microalgae Cultivation for Nutrient Recycling and Bioenergy Production

Farid Sayedin

Dalhousie University

Microalgae as feedstock for bioethanol production have gained a lot of attention due to increasing demand for clean energy sources. However, production of biofuel from microalgae is currently not sustainable due to a high-energy demand associated with microalgae cultivation and harvesting. Integration of algal-bioethanol with an existing corn-bioethanol plant can significantly reduce the capital and operating cost, enabling a more sustainable biofuel production process by nutrient recovery and carbohydrate production through microalgae cultivation. To evaluate the feasibility of the proposed integrated process, thin stillage, which is a liquid nutrient-rich byproduct of corn-ethanol plant was digested in an anaerobic baffled reactor (ABR) under various operating conditions to determine the optimum removal efficiency of organic materials and methane production yield. The anaerobic digestion releases the nutrient to soluble forms making them available to microalgae. The resulting digestate of thin stillage was used to cultivate microalgae under various dosage of digestate. Several microalgae species showed that they are able to grow on thin stillage digestate. Research is in progress to determine the optimum growth condition to maximize the biomass growth, carbohydrate productivity and nutrient removal.

Sea Lettuce to Biocarbon and Biogas with Recovery of Nutrients

Ankita Shrestha

University of Prince Edward Island

In Prince Edward Island, excessive growth of sea lettuce has become a problem in island estuaries. The growth of sea lettuce in water is the result of increase in level of nitrate due to use of commercial fertilizer in land which gets carried away by rain to the waterways. Sea lettuce blocks the waterways, harms marine organisms and its decay process creates unpleasant smell. The problem can be addressed with the development of continuous hydrothermal carbonization (HTC) system for sea lettuce- a thermochemical conversion process of biomass at a temperature of 180-250°C and pressure of 2.5-5 MPa with biochar and process water as the end product.

The research aims to study the production of sea lettuce in PEI, develop HTC system for sea lettuce, optimize the process depending on various operating parameters, analyse the anaerobic digestion of process water to produce biogas and nutrients and investigate the application of biochar, biogas and nutrient recovery on soil. The biochar obtained will be characterized by proximate analysis, ultimate analysis, heating value and the process water will be set to anaerobic digestion for production of biogas.

Experimental Modeling of Microwave-Pyrolysis-Biochar Reinforced GFRP Biocomposites

Chase Wallace

University of New Brunswick

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