ALBERTA INNOVATES

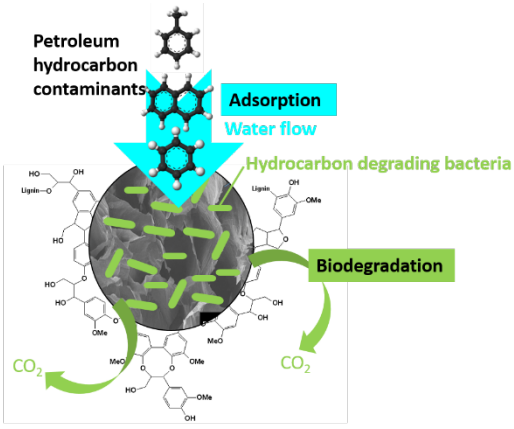
CLEAN RESOURCES

ALBERTA BIO FUTURE

LIGNIN PURSUIT

Synthesis and Evaluation of Lignin-based Soil Amendments for the Remediation of Hydrocarbon Impacted Sites

This project aims to develop a scalable reaction process for the synthesis of water dispersible lignin-based materials (named lignochars) with high surface area and porosity that will be used to accelerate the biological degradation of fuel hydrocarbons impacted soils in Alberta. The project builds and expands an ongoing research and development collaboration between Federated Co-operatives Limited (FCL), United Farmers of Alberta (UFA) and the Northern Alberta Institute of Technology (NAIT) where an in-situ microbial remediation technology is being developed and tested in hydrocarbon impacted sites. In this project, a library of lignochars is being synthesized and bench evaluated for their hydrocarbon adsorbing and biodegrading capability. The successful synthesizing and testing of lignochars would result in bench-validated soil amendments integrated into the in-situ microbial remediation technology that would enable NAIT to enter into a field test with FCL and UFA in the next step.



Lignochar particles in petroleum hydrocarbon contaminated soil

FUNDING DETAILS

RECIPIENT:

NAIT – Weizheng Shen

PARTNERS:

West Fraser

Federated Co-operatives Ltd

United Farmers of Alberta

TOTAL BUDGET:

$249,127

AI FUNDING:

$168,675

PROJECT DATES:

May 2019 – July 2021

PROJECT TRL:

Start: TRL 2

End: TRL 5

APPLICATION

The lignin-based soil amendments produced and validated in this project can be integrated into the in-situ microbial remediation technology to accelerate the biodegradation of the hydrocarbon contaminants in the sites. Their unique function combining hydrocarbon adsorption and microbial stimulation can significantly retard contaminants migration, decrease dissolved phase concentrations, facilitate formation of active biofilm and biodegradation, and eventually reduce the time and cost to reach remediation objectives.

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LIGNIN PURSUIT

PROJECT GOALS

- Synthesis and characterization of a library of lignochars that are carbon rich, highly water soluble, and with high surface area and porosity
- Evaluation of lignochars as soil amendments by determining their adsorption capacity for fuel hydrocarbons
- Evaluation of lignochars as soil amendments by stimulating the bacteria degradation for fuel hydrocarbons
- Determination of the most suitable lignochars and their optimal dosage in the consideration of both the adsorption and the biodegradation of fuel hydrocarbon for the field test

BENEFITS TO ALBERTA

- This project will develop new application for the products of the hydrothermal conversion of lignin. These materials will be water-soluble, highly porous, and able to adsorb fuel hydrocarbon while stimulating their biodegradation
- The results will provide a key player in the Provincial forestry sector, West Fraser, with an economically competitive solution and a position of technical advantage in the supply chain of in-demand advanced materials for the remediation of fuel-impacted sites
- The forestry sector is a major economic driver for Alberta, accounting for ~$4.5 billion of annual GDP, employing ~13,000 people, and serving as the backbone to more than 50 rural communities. The commercialization of lignin-based material will contribute to the economic diversification of the region while generating new high-paying manufacturing and engineering services jobs

2 Publications

2 Students Trained

4-5 Project Jobs

5-20 Future Jobs

1 New Products/Services

Indirect Project GHGs Reduced

300-3,000 kT/yr Future GHGs

CURRENT STATUS

JANUARY 2020

NAIT completed the synthesis and characterization of a library of lignochars (Phase 1). The adsorption capacity of lignochars to fuel hydrocarbons was determined from hydrocarbon contaminated water samples. The results show that lignochars are able to adsorb toxic aromatic hydrocarbons from water, including toluene, o-xylene, and naphthalene etc. Currently, NAIT is completing the hydrocarbon adsorption study on lignochars in soil columns mimicking the site condition (Phase 2).