INTEGRATION OF PIPELINE HYDRO-TRANSPORT AND HYDROTHERMAL CONVERSION TECHNOLOGIES TO PRODUCE BIOFUELS

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BACKGROUND

Lignocellulosic biomass; materials derived from living or recently-living organisms, come from agricultural sources, forest sources and wastes. Because of Canada's large agricultural and forest industries, there are potentially large amounts of biomass available to produce energy. Lignocellulosic biomass can be converted to energy through two key sets of pathways that are currently under development; thermochemical and biochemical conversions.

key challenge in utilizing biomass for energy, that this research study is trying to address, are:

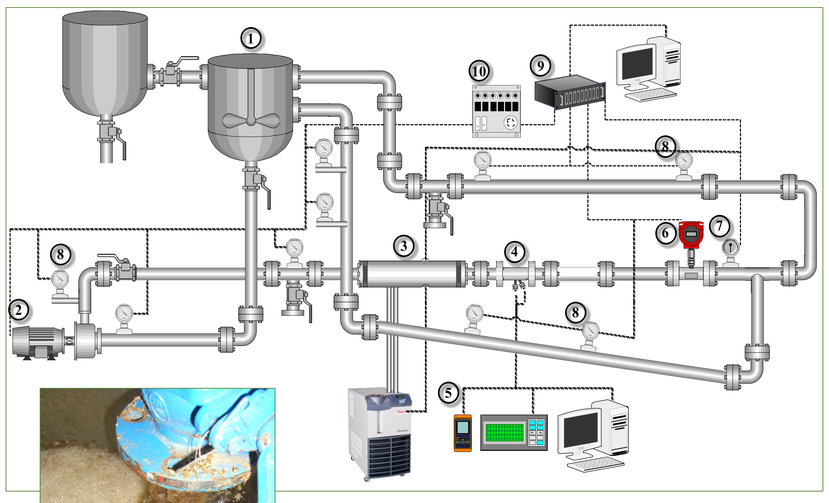
- ❑ Accommodating the variation in biomass feedstocks properties,
- ❑ Large costs of collection and transportation, as well as the availability of feedstock,
- ❑ Challenges in the thermochemical and biochemical conversion pathways in terms of scale up of technologies, process development and economic viability.

AIMS AND OBJECTIVES

This research project is aimed at assessment of agricultural and forest residue biomass for transportation via pipeline, and conversion using hydrothermal technologies to produce biofuels. Pipeline hydro-transport of biomass benefits from economy of scale, as well as eliminating traffic congestion and environmental issues of overland transportation. Hydrothermal processing is also a state-of-the-art thermochemical conversion technology to process high moisture content biomass.

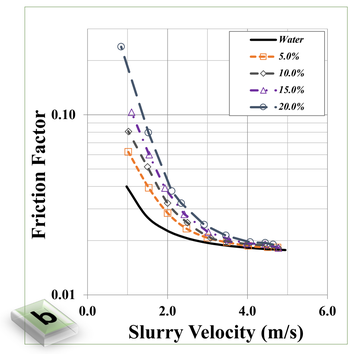
This research will develop data intensive techno-economic model of integrated pipeline hydro-transport and hydrothemal conversion technologies. The technical information on pipeline hydro-transport will be obtained through experimental measurements on a lab-scale pipeline facility. Technical data on hydrothermal processes will be achieved via computational modeling using AspenPlus software as well as experimental studies using a small-scale hydrothermal reactor.

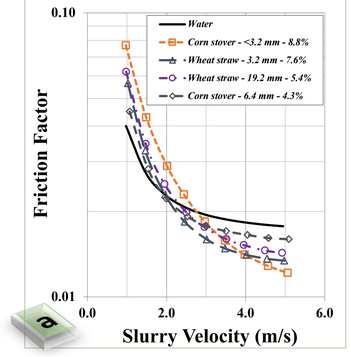
RESULTS



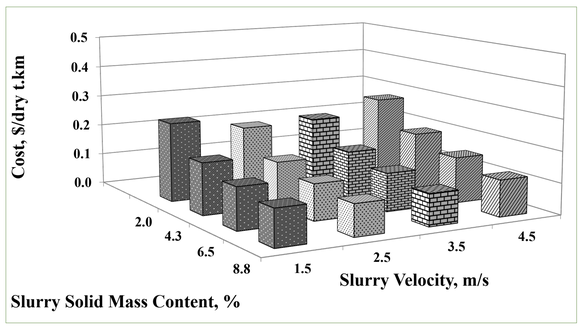
Pipeline facility in Large Scale Fluids lab. - schematic diagram

Wheat straw biomass-water mixture (slurry) in closed-circuit pipeline facility in Large Scale Fluids Lab.

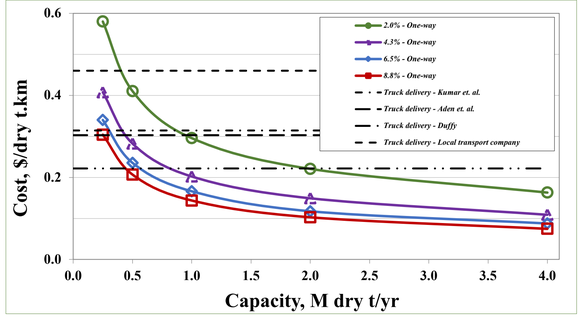




Friction factor vs. slurry bulk velocity in 50 mm diameter pipeline for various dry matter solid mass content slurries of (a) play sand particles, (b) wheat straw particles



Distance variable cost of one-way pipeline hydro-transport of 2,000,000 dry t/yr of <3.2 mm wheat straw particles over a 200 km distance as a function of slurry velocity and solid mass content



Costs of one-way pipeline hydro-transport of <3.2 mm wheat straw particles at 2.5 m/s over 150 km as a function of pipeline capacity and slurry solid mass content

FUTURE DIRECTIONS

- ❑ Obtaining in-depth understanding of technical challenges of integrating pipeline transport with hydrothermal processes
- ❑ Developing a procedure for preparing and transporting biomass slurry adoptable to hydrothermal processing facilities
- ❑ Obtaining clear understanding of hydrothermally processing pipeline-delivered biomass via experimentally investigating HT processes
- ❑ Gaining critical information for the scale-up of the pipeline transport facility integrated with hydrothermal technologies
- ❑ Deployment of the biomass conversion technology in the domestic market for abundant forest and agricultural biomass residues in Canada, contributing to the sustainable development of Canadian economy

PARTNERS

The proposal is part of larger initiative on pipeline transport of biomass. This initiative has been supported by NSERC and Future Energy Systems.

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FES PROJECT OVERVIEW

Eg. T01-P05

We already know how to create fuels from certain types of biomass, but many other feedstocks can potentially be transformed in a similar manner. In order to identify new viable sources, we must develop more sophisticated understanding of the technological processes that might be used to convert biomass to fuel, and assess the potential business cases for adopting certain sources that might have other economic uses, or compete with established cash crops. We can also explore the potential for tailor-made fuels for the transportation sector, developed from biological sources.

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CANADA FIRST RESEARCH EXCELLENCE FUND

This research has been undertaken thanks in part to funding from the Canada First Research Excellence Fund.