RECLAIMED RESILIENT LAND AND WATER SYSTEMS - WATER

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BACKGROUND

- The energy industry is challenged with environmental impacts from resource extraction, including air emissions and land and water disturbance.
- Process water is a highly complex mix of sands, silts, salts, metals, ammonia and organic compounds such as residual bitumen, naphthenic acids, polycyclic aromatic hydrocarbons, phenols, benzene, toluene, ethylbenzene, xylene and humic and fulvic acids.
- The complex matrix of process water, its toxicity to organisms and recalcitrance of its constituents require treatment using conventional and advanced processes for safe release to the environment.
- Foremost challenges are to develop advanced water treatments, combined with natural attenuation processes and remediation methods and implement them on-site with cost effectiveness and efficiency.
- These processes for developing resilient reclaimed water systems must then be adaptable to meet the needs of legacy and future energy systems in a changing climate and regulatory environment.

End pit lake

OBJECTIVES

- Apply low cost, high capacity adsorbents to process waters to remove contaminants.
- Assess performance of solar driven and catalytic advanced oxidation using mesoporous carbon materials.
- Understand science of engineered passive processes for process water reclamation using end pit lakes.
- Extend and enhance analytical characterization capability of ultra-performance liquid chromatography ion mobility time of flight mass spectrometry analysis for analysis of pollutants in various water samples and their potential by products from treatment processes.

PROJECT OVERVIEW

Biofiltration as a semi-passive approach to treat process water
- Develop indigenous microorganism based, fixed bed, biofiltration systems for water reclamation.
- Use different bed media and gravity as part of the energy source.
- Use biofiltration systems as a pretreatment for end pit lake systems.

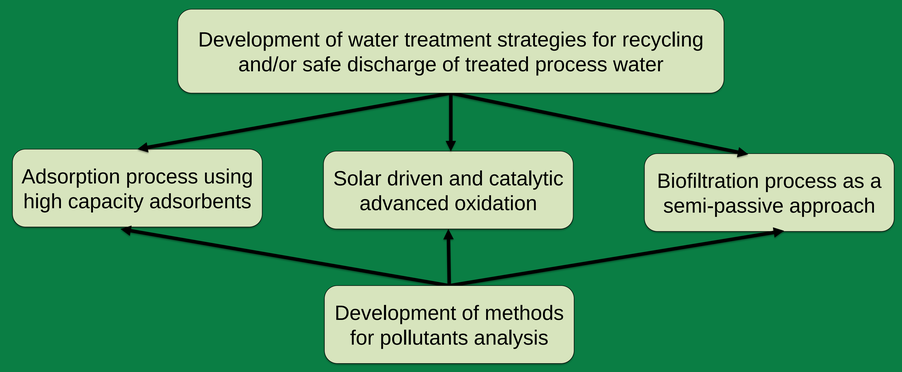
Solar driven advanced oxidation processes for process water reclamation
- Examine the formation of chlorine containing byproducts including the impact of chloride concentration on formation.
- Minimize the generation and impact of chlorine containing byproducts.

Application of catalytic advanced oxidation process for water reclamation in the presence of different catalysts
- Prepare and characterize carbon xerogels with different textural properties and effects on adsorption performances.
- Investigate oxidation mechanisms under catalytic advanced oxidation processes.

Low cost and efficient adsorbents for targeted pollutants removal from process water
- Develop low cost adsorbents from different sources such as biomass, petroleum coke and feathers.
- Modify to obtain higher adsorption for targeted pollutants and test for simultaneous removal of contaminants.
- Simplify and improve modification processes for large scale production.

Development of a new calibration method to achieve extraordinary mass accuracy for pollutants analysis
- Develop a calibration method and a non-depletive extraction method.
- Apply to raw and treated samples to test removal effectiveness of bioavailable naphthenic acids.

Industrial applications of cellulose nanofibers for water remediation
- Isolate cellulose nanofibers from industrial cellulose and modify to recover metal, ionic and non-ionic organic matter.



THEME OVERVIEW

As the world moves towards a low carbon energy future, the legacies of past energy technologies remain a serious concern. Reclamation and restoration of land and water after generations of utilization will be important for our future, and many issues must be addressed. Standards for restoration that have been set across decades and based on varying levels of understanding must be assessed, while the technologies and methods for land and water reclamation are investigated and refined. Complete reclamation might take generations, so it is essential to begin broadening and enhancing our knowledge now. We must also begin to foresee potential issues related to new, sustainable energy technologies, so that future generations are not left with the consequences of questions left unasked.

EXPECTED OUTCOMES

- Integration of achieved knowledge into the water reclamation regulatory framework.
- Integration of achieved knowledge into water management options with industry.
- Development of processes and policies for safe release of process water into the environment.
- Development of process water treatments for use of water in end pit lakes and wetlands.

Biofiltration system

Wetland

EXTERNAL PARTNERS

- Alberta Environment and Parks
- Alberta Innovates
- InnoTech Alberta
- Helmholtz Centre for Environmental Research
- Canada's Oil Sands Innovation Alliance (Syncrude Canada Ltd., Canadian Natural Resources Ltd., Suncor Energy Inc., Imperial Oil Ltd., Teck Resources Ltd.)
- EPCOR Water Services

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