ABSTRACT
Ford Motor Company has been focusing on reducing emissions through their “Fumes to Fuel” project by looking at the exhaust from automotive finishing as an opportunity for energy. When painting automobiles, volatile organic compounds (VOCs) are released into the air. These may be processed in order to create hydrogen for the fuel cells used in forklifts throughout the plant. This process also mitigates the need to invest energy into incinerating the compounds to avoid the release of harmful chemicals into the atmosphere. The VOCs are first concentrated in a fluidized bed reactor and then treated using autothermal reforming (ATR) to generate pure hydrogen and clean air. Unlike the original process of using a regenerative thermal oxidizer (RTO), ATR does not produce harmful NOx and SOx and produces significantly less CO2. Additionally, ATR has a net energy gain as the hydrogen is used in fuel cells around the plant, reducing the need for traditional fuels. VOCs are the result of many other industrial processes, such as pulp and paper, in addition to automotive finishing. As a result, the Fumes to Fuel project could be expanded to other industries and other car manufacturers to greatly reduce environmental impacts across the board. Therefore, the Fumes to Fuel technology could be expanded to these other automotive companies in order to further reduce the national environmental impact of VOCs. Overall, this process considerably decreases the company’s carbon emissions by both offsetting the effects of VOCs and generating usable energy, thus reducing the need for fossil fuels in the plant. This, along with specific government incentives, encourages other companies in the industry to reduce their footprint and invest in similar technologies on a larger scale. Not only does this aid society by reducing potential health risks, but it also encourages industrial sustainability by decreasing reliance on fossil fuels.
ABSTRACT
Diesel generators are relied upon for distributed generation in Northern Canada, resulting in negative environmental and health impacts. Electricity could be generated more efficiently using a steam reformer and solid oxide fuel cell system. The new system would make use of existing diesel infrastructure and could be seamlessly integrated with future renewable energy projects. However, the new system suffers from higher costs associated with being a lower maturity technology. In addition, the highly endothermic nature of steam reforming can be problematic if the required thermal energy cannot be provided by the fuel cell. This talk will outline the UniSim and Ansys Fluent models used to simulate the new system’s behaviour. Furthermore, I will discuss the efficiency and cost differences between the new and old systems for a remote community test case.
ABSTRACT

Two-phase partitioning bioreactor (TPPB) technology is a proven means of improving bioreactor productivity by reducing substrate and/or product cytotoxicity. This is accomplished by toxic solute absorption into an immiscible material that provides a combination of cell biocompatibility, high partition coefficient (PC) and high selectivity. In this study, we demonstrate the novel application of absorbent ionomers in TPPB applications. Imidazolium-based derivatives of brominated poly(isobutylene-co-para-styrene) (BIMS) demonstrated dramatic increases in PC (10-fold) and selectivity (4-fold) for target solutes (alcohols) with the addition of low levels of ionic functionality (~1 mol%). A comparison with ionic liquid (IL) analogs revealed that PC scales linearly with a material's ion pair concentration. Although the ILs proved to be cytotoxic towards several industrially pertinent microorganisms, covalently tethering the ionic moieties to the polymer matrix resulted in complete biocompatibility. Interestingly, the ionomers possessed surface antimicrobial properties in addition to suspended cell biocompatibility.
ABSTRACT
It is widely known that anthropogenic nutrient loadings in lakes and rivers negatively affect the health of aquatic ecosystems. As a result of inadequate agricultural drainage techniques, a plethora of nutrients is discharged into poorly-mixed water bodies resulting in an algae bloom which in turn decreases the ability of oxygen to dissolve in water. This causes extreme losses of aquatic ecosystem and the formation of “hypoxic” (dead) zones. Moreover, these dead zones are also formed as a result of high temperature. This study aims to investigate the accumulated effect of agricultural drainage and the expected increase in global temperature due to climate change on different lakes and rivers. The proposed cost effective solution is the introduction of effective policy measures to regulate the discharge of agricultural pollutants at source along with an end-of-field technology, namely; denitrifying bioreactors coupled with controlled drainage.
ABSTRACT
Poly-3-hydroxyalkanoates (PHAs) are aliphatic polyesters, produced as intracellular granules from renewable resources by many bacterial species and may be classified as short-chain-length (scl) or medium-chain-length (mcl) depending on the carbon chain length of its repeating units. Medium-chain-length Poly-3-hydroxyalkanoates (Mcl-PHAs) can provide a viable green alternative to petroleum-based thermoelastomers and may find practical applications in paint, coatings, adhesives, drug delivery, toners, tissue engineering, and other biomedical applications. Many of these applications require use of mcl-PHA as a latex but few studies have reported their behavior in aqueous suspension, and none have studied dense aqueous suspensions required commercially. For the first time, dense mcl-PHA suspensions were prepared. The effects of formulation and processing parameters including ultrasonication time and amplitude, choice and concentration of surfactant, and the choice of organic solvent on mcl-PHA particle size and stability were investigated. In this system, the dispersed phase consists of mcl-PHA dissolved in methylene chloride, while the continuous phase is water, sodium dodecyl sulfate (SDS) and polyoxyethylene octyl phenyl ether (Triton X-100). Water soluble solvents, such as acetone, that dissolve mcl-PHA could not be used to make dense suspensions of PHA nanoparticles. Mcl-PHA nanoparticles were also produced in high-shear microfluidic device. Suspensions prepared by both ultrasonication and microfluidizer were stable with zeta potential above ± 30 mV. Stable suspensions required high amount of surfactants (> 2 % of PHA weight). Based on this, work is in progress to produce more hydrophilic mcl-PHA with carboxylated side chains which could reduce emulsifier requirement for mcl-PHA latexes and even produce smaller particle sizes.