Environmental Impacts of Biodiesel Produced from Wastewater Greases

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Biodiesel is a renewable diesel substitute that can be produced domestically and can have lower greenhouse gas emissions than petroleum-based diesel. Conventional biodiesel is produced from vegetable oils, animal fats, and waste cooking oil; however these feedstocks can be expensive and have limited opportunity for growth. Alternatively, wastewater greases are inexpensive, underutilized, high-lipid waste streams that have the potential to be converted into biodiesel. Two wastewater greases investigated in this dissertation are grease trap waste (GTW) and sewage scum grease (SSG). GTW is kitchen effluent that is collected in grease interceptors and SSG is floating material collected from settling tanks at wastewater resource recovery facilities. Because wastewater greases are heterogeneous, degraded, and contain large amounts of water, solids, and impurities, wastewater greases require different chemistry and additional processing steps for biodiesel production compared to conventional biodiesel feedstocks. While technical feasibility of biodiesel production has been demonstrated, the amount of wastewater greases available and their composition variability could limit the environmental benefits and economic success of commercial biodiesel production.

The research presented in this dissertation investigates the environmental impacts of the production of biodiesel from wastewater greases through four objectives: (1) monitor the statistical variability in wastewater grease composition and its subsequent impact on biodiesel production capacity, (2) investigate processing methods and their performance in meeting biodiesel fuel specifications, (3) evaluate the environmental performance of biodiesel produced from wastewater grease feedstock, and (4) analyze economic and environmental feasibility of producing biodiesel from wastewater greases.

Results show that wastewater greases have the potential to be economically feasible as a feedstock for urban low-carbon biodiesel production while at the same time reducing the need for petroleum diesel, reducing the greenhouse gas emissions. Technical challenges include the variability of the amount of brown grease available in wastewater greases and the sulfur content of the final product biodiesel. The average lipid content of SSG is seasonally dependent; lipid content is 15-40% in cooler months and 3-21% in warmer months. This result leads to seasonal variability in the economic feasibility; an SSG-biodiesel process operating during the cool season with above 600 gal/h and 20% lipid content has a payback time less than 5 years. Alternatively, GTW variation is not seasonally dependent and shows an average lipid content of 4% in the raw GTW; however, settling GTW produces a floating layer with an average lipid content of 34%. A GTW biodiesel process operating above 2,000 gal/h and 5% lipid content has a payback time less than 5 years. Environmental challenges include the high environmental impact due to the disposal of the solid wastes produced from separating brown grease; however, the impacts of these processed wastes are part of the current disposal practice. The combination of biodiesel production and disposal of the remaining solids has lower greenhouse gas emissions than current practices due to the displacement of petroleum fuels.