BIOdiesel TechNOTES

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Biodiesel Education Program, University of Idaho

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ENVIRONMENTAL IMPLICATIONS OF CAMPUS-PRODUCED BIODIESEL IN FLEET VEHICLES

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The Biodiesel Education Program at the University of Idaho continues to perform biodiesel outreach and research relating to the production, fuel quality, testing procedures, material compatibility, and economics. Furthermore, engineering staff and students actively produce biodiesel fuel made using the waste vegetable oil that is generated by the campus dining facilities at the University of Idaho. Currently, department staff and students pick up approximately 110 gallons (416 liters) of waste vegetable oil from the campus commons every two weeks. This amounts to about 1,800 gallons (6,814 liters) of waste vegetable oil picked up annually which is converted into about 1,720 gallons (6,500 liters) of biodiesel fuel. Waste vegetable oil can be sourced from other oil collection sites on campus to produce additional biodiesel if demand increases. Figure 1 shows samples of the waste vegetable oil collected on campus and biodiesel produced from waste vegetable oil.

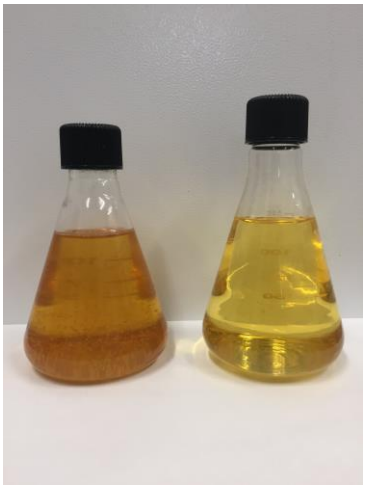

Figure 1: Waste Vegetable Oil (left) and Biodiesel Produced from Waste Vegetable Oil (right)

The waste oil is converted to biodiesel in a batch reactor configuration using methanol, sodium methylate as catalyst, heat, water, and various refining processes. The resulting by-products are biodiesel, crude glycerol, and wash water (Figure 2).

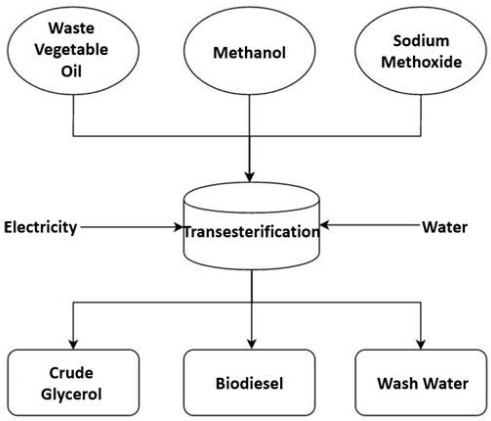

Figure 2: Transesterification Material Flow

The biodiesel produced from the waste vegetable oil generated on campus is used to perform research, supply some campus vehicles, and fuel the three (B100) vehicles that are maintained by the Biological Engineering department. Currently, the department sells a portion of its biodiesel to the campus steam plant who use a B20 blend in their front-end loader (Figure 3), skid-steer, and woodchip truck. Additionally, campus dining services own and operate two large delivery trucks that have been supplied enough biodiesel for the vehicles to run

a B10 blend. The University of Idaho is committed to becoming a carbon-neutral campus by the year 2030, as is outlined in the University of Idaho Climate Action Plan. Since biodiesel combustion reduces greenhouse gas emissions, the use of biodiesel in more University of Idaho campus vehicles would help the school meet their carbon neutrality goals. Additional benefits of biodiesel include renewability, non-hazardous, biodegradability, improved engine lubricity, reduced exhaust particulate matter, improved fuel economy, and the ability to be blended with petroleum diesel at any percentage.

Figure 3: Campus Vehicles Utilizing Biodiesel

Reductions in greenhouse gasses, water consumption, energy usage, and fuel costs will result from the reduced quantities of emissions, water, energy, cost from the production and combustion of a B20 blend of fuel versus the production, combustion, and cost of petroleum diesel alone. To more accurately quantify the reductions in environmental impacts, it is necessary to perform a process cycle analysis.

University dining services manage ten food service locations throughout the campus including convenience stores, fast food, casual dining, and cafés to students, faculty, and guests. The university generates large quantities of waste vegetable oil from the on-campus dining locations. In discussions with dining services personnel, it is estimated that the university generates approximately 3,600 gallons (13,627 liters) of waste vegetable oil annually from its campus dining locations.

Furthermore, University of Idaho facilities personnel indicated that the university consumes about 18,000 gallons (68,137 liters) of petroleum diesel annually via their large fleet of diesel vehicles. The waste vegetable oil that is generated can potentially be converted into renewable biodiesel fuel. This could offset the consumption of non-renewable petroleum diesel fuel while reducing waste, harmful emissions, water consumption, and reducing costs. In order to convert the university's diesel supply to a B20 blend, the school would need to purchase 3,600 gallons of biodiesel from the on-campus biodiesel laboratory.

According to this case study analysis, if the University of Idaho switches all diesel fuel to a B20 blend of biodiesel, there will be both environmental and economic benefits. An environmental impact assessment was conducted for well to pump (waste oil to biodiesel use), the implementation of fueling university vehicles with 20% biodiesel blended fuel will result in an 14% decrease in global warming potential (kg CO_2 eq./year) and a 15% reduction in embedded water consumption when compared to petroleum diesel.

Not only would the university see reductions in environmental impacts related to harmful exhaust emissions and embedded water consumption, but the university could realize fuel cost savings by switching to a B20 sourced from on-campus. Based on the cost analysis in the case study, at current market value, the university pays approximately $45,360.00 per year for petroleum diesel. If biodiesel were to be purchased internally, the university would pay $43,488.00 per year. The annual fuel cost savings to the University of Idaho would be $1,872.00.