ME 434/435 Project

Project title: **Batch Bio-Diesel Reactor**
Project Supervisor:
Start date: **As soon as possible**
Number of students: **3 MEs + 2 CEEs or 2ECEs**

Note: this project was proposed by Jason Chewning

Abstract: The goal of this project is to design, develop, and execute a system whereby used fryer oil is converted into useable Bio-diesel.

Background: Bio-diesel is being researched as an alternative or a supplement to petroleum diesel (Petro-Diesel) as a fuel source for cars, trucks, generators, and farm equipment. The raw material is plant or animal based oil (soybean oil, corn oil, vegetable oil, tallow, etc.) Through a process called transesterification, the raw material is converted to a fuel which operates in a diesel cycle.

One source of raw material which has proven to be useful is used fryer oil from the food service industry. The major drawback of the supply source is the condition of the oil, which contains an increased level of water as well as a deteriorated quality of raw oil. Filtering and cleaning can remove enough impurities to make used fryer oil a valid source for Bio-Diesel production. A slightly different transesterification process – one which involves titration of a sample of the batch – can successfully produce fuel grade Bio-Diesel.

Completed Bio-Diesel can be used as a stand alone fuel source or in conjunction with Petro-Diesel. In either use, on-site production of Bio-Diesel allows for two avenues of savings. First, food services on campus must pay a fee to dispose of used fryer oil. Contracts could be established with local restaurants to obtain their used oil for free. Second, the university pays for diesel fuel for use in vehicles and landscaping equipment. Supplementing Petro-Diesel use on campus with Bio-Diesel will, hopefully, reduce the cost per mile spent on fuel.

Engineering Merit: The entire project merits detailed engineering analysis: pre-design, design, construction, and implementation. Efforts during pre-design will model Petro-Diesel extraction, refinement, delivery, and combustion. A similar model will be developed for Bio-Diesel. The models will be compared and contrasted on the basis of cost, time, and environmental impacts (positive and negative). Using Old Dominion University (ODU) as a project site, production size will be optimized to

use used fryer oil from the dining halls and food services within reasonable distance from the campus. The design of the Bio-Diesel reactor will attempt to minimize the negative impacts while emphasizing the positive impacts.

Once the design constraints are realized, design will begin on the equipment needed to process an optimized sized batch of Bio-diesel. Tanks for raw oil and finished Bio-Diesel will be needed as well as pumps, piping, and controls. All of the equipment will be palletized in order to ease transport and commissioning of the completed system.

For the most part, Bio-Diesel is completely interchangeable with Petro-Diesel. However, to be thorough, an analysis of the equipment slated for Bio-Diesel use will be undertaken to ensure optimal performance of the equipment is maintained.

Opportunity for Multidisciplinary Exchange: This project is firmly grounded in mechanical engineering from a fluids and processing standpoint. However there is opportunity for electrical and civil engineering work. The superstructure will require structural analysis. A storm water analysis could be performed if the final production site or storage site is exposed to rain. The controls for the entire system can range from simple (monitoring only) to very sophisticated (totally automated). The controls may involve a mix of hardware and software.

At the very least a group of mechanical engineers could design a functioning unit, but drawing on civil and electrical will allow for a more sophisticated and efficient design.