BIOFUELS: STRAIGHT VEGETABLE OIL RESEARCH

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Introduction

The Bio-Fuels: Straight Vegetable Research Team was created in order to provide our clients, Matt Walsh and SIM in Mahadaga, Burkina Faso, with the research and information necessary to run agricultural equipment off of locally sourced Vegetable Oil or a Vegetable Oil-Diesel Mix. Our client will use this information to empower the local economy and reduce his consumption of imported diesel fuel.

Goals of the Project

Currently, the team's goal is to have a tested fuel system that can be delivered to our client by January 2017. In order to achieve this, the team will need to test multiple fuel blends and types in the engine to determine how the fuels affect the motor with respect to fuel consumption, damage to motor components, and changes in power output. This will require us to design and create new fuel systems for the vegetable oil and monitor the long term affects the fuels have on the motor. Once this information has been acquired, the team may proceed to advise our client on what is best for him. Our research and work over the past year was completed to progress toward these goals.

In the long term, the goal of the Bio-Fuels: SVOR is to be able to make energy more accessible to people globally by creating a modular diesel-vegetable oil system that can be installed on single cylinder diesel engines around the world.

Client

Matt Walsh, SIM and the people of Mahadaga, Burkina Faso

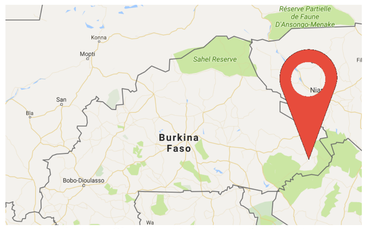

Fig 1: Map Showing Mahadaga, Burkina Faso

Progress Toward Goals

. Viscosity Testing

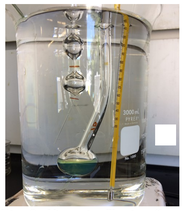

Fig. 2: Viscosity Testing Setup

During this past year, the team determined that of the various properties of the fuels, the increased viscosity of the vegetable oils would have the most significant affect on the operation of the engine. Therefore, we found it necessary to test the viscosity of several oils and blends to determine whether they could run in our engine. Increasing the temperature of the oil was chosen to be the best method to decrease the viscosity, therefore we found the temperature at which the oils and blends could be run directly in our engine. This establishes the operating temperatures that we need to achieve for our designs.

Ranking 3 Locally Available Oils

Fig. 3: Jatropha, Cottonseed, and Neem Oil

Through correspondence with the client, the team was provided with three potential oils to research; Neem Oil, Jatropha Oil, and Cottonseed Oil. In order to decide between these three oils, each was rated based on its Availability, Fuel Blend Percentage, Uses for both the seed cake and the plant itself, the energy content of the oil, and the cetane number. Each oil was awarded a score out of 48. With scores of 26, 31.5, and 38.5 respectively, the team and the client decided that it made the most sense to proceed with cottonseed oil.

. Testing Procedure

Fig. 4: Dynamometer Setup

The testing procedure, consisting of qualitative and quantitative tests, was created to aid in the acquisition of consistent data on how the motor components wear with various fuel types and blends.

- Qualitative

  This form of testing consists of general observations such as appearance and sound of various parts of the motor before, during, and after testing periods. The team will qualitatively inspect the exhaust, fuel injector, fuel filter, lubricating oil, and general performance of the motor.

- Quantitative

  This form of testing consists of obtaining numerical data about the motor's wear and performance. The team will use a dynamometer for power and torque values, weighing filters for deposits from fuels, and monitor fuel consumption.

Future Work

Come next fall, the team is looking forward to continuing the work towards being able to test our engine. In order to accomplish this, the team will need to iron out the finer details of our testing procedure. The team will also begin working on designing the heating system that will be used to preheat the oil or mix to the desired temperature. This system will utilize the engines 321°C exhaust, and use that to heat the oil to 120°C.

Running a 30/70 Vegetable Oil/Diesel Blend

This year we spent a lot of time working to find a blend of vegetable oil and diesel fuel that a user could theoretically run straight through an engine with little to negligible side effects. From research, the team found that the biggest factor in this would be the viscosity of the mix. Using the ASTM standard for diesel fuels, we determined that in order for a fuel mixture to flow at that same rate as straight diesel fuel its viscosity would need to fall below the highest standard of diesel fuel, which is 6.0 mm^2/s^2. In order to take the viscosity of the vegetable oil down to the necessary rate, we ran tests to find where the rate would be below 6.0 mm^2/s^2. Below illustrates data on our fuel blend that utilizes cottonseed oil, which is our first step toward helping our client reduce his diesel consumption.

30/70 Cotton-Diesel 40°C	742.33 Seconds	5.89 $mm^2/$	746.72 Seconds	5.92 mm^2/s^2	746.85 Seconds	5.92 mm^2/s^2

Fig. 5: Viscosity Data on Cottonseed-Diesel Blend

We communicated these results to our client, but he had not run the blend yet in his engines so we did not know if this would actually work in a real application. To test whether or not this could actually work, the team set up a test to run the engine on the mix. The team was able to run approximately 250 ml of Cottonseed oil-diesel mix through the engine with no noticeable problems. From this test we can conclude that the blend does work, and can be run straight through an engine. Further testing will have to be done in order to ensure that an engine can be run off of this blend for more than a few hours, but this test was reassuring.

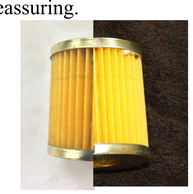

Fig. 6: Diesel Fuel Filter Before and After Blend Test

Fig. 7: Cottonseed-Diesel Blend

Conclusions

Everything that the team has seen through research and testing this year shows the potential for a two tank system. The work the team has completed up to this point should allow for the project to continue to move forward and stay on track as it enters the 2017/2018 calendar year. The sooner that this system can be delivered, the quicker we can get this technology into the hands of other communities and achieve our goal of providing a method to make energy more accessible to communities around the world.

Acknowledgements

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