FINAL REPORT: PERFORMANCE TESTING OF GEOLA DERIVED BIODIESEL

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Preparation of Biodiesel from Peanut Oil: 100% Peanut oil based Biodiesel was prepared in a 15 gallon Biodiesel reactor constructed by the UGA research team. A cone bottom tank was fitted with an extended ring stand built in the UGA engineering shop. A sight glass was constructed with two valves to control the flow of glycerol byproduct, product and waste streams. Agitation was accomplished by modifying the lid of the reactor to accommodate a variable speed electric drill fitted with a mixer. A preliminary 3 gallon batch of peanut Biodiesel was made to determine procedure and reactant quantities. Each 3 gallon batch was made using 3 gallons of peanut oil, 0.6 gallons of Methanol and 3.5 oz of Potassium Hydroxide catalyst. Catalyst and methanol were mixed for 15 minutes using a stir plate; this mixture was then added to the main reactor containing the peanut oil. The reactants were mixed for 2 hours under constant, vigorous agitation. The mixture settled for 24 hours and the glycerol byproduct was drained. The product was washed twice with 1 gallon of water mist. Washes were allowed to settle for 48 hours and waste water was drained. Alkalinity of the Biodiesel was monitored until the pH reached near 7.0 at which time the product was ready for use. No major complications were encountered during processing of peanut oil to Biodiesel and final product had adequate energy and viscosity values.

Engine Testing of Peanut Based Biodiesel: Preliminary fuel screening tests were performed on peanut based Biodiesel. Fuels were tested in two 6-kW single cylinder direct injection water cooled test engines (Kubota E750) operated on the "torque test" cycle established by Korus et al. (1985). This engine was selected because it is representative of modern on-road engines having similar injection and cooling systems, a relatively high compression ratio of 18:1, and rated rpm of 2500. Exhaust emissions were monitored real-time using an ENERAC 3000E analyzer. Fuel consumption and power output were also monitored throughout the test cycle. At the end of the two-hour test period the injectors were carefully removed. Injectors were soaked for 15 minutes in acetone and the wash liquid was filtered on to a pre-weighed filter. Final weights were used to estimate the amount of coke deposited on the injector tips during each test. A coking index was determined by normalizing all coking measurements to a baseline test using No. 2 diesel.

Peanut based Biodiesel was tested in two concentrations 100% Biodiesel (B100) and 20% Biodiesel in 80% No. 2 Diesel (B20). The results of these tests were compared to those obtained by 100% Diesel and 100% commercial ASTM quality poultry fat based Biodiesel provided by US Biofuels (Rome, GA). Preliminary emissions data from peanut Biodiesel suggest that all measured emissions were lower than those seen from petroleum diesel fuel as was the coking index suggesting better performance from the peanut based Biodiesel. Volumetric fuel consumption was not found to be significantly higher with Biodiesel despite the slightly lower heating value of this fuel. Performance characteristics of UGA peanut based Biodiesel were comparable to those seen with commercial ASTM grade Biodiesel. Cold ignition tests on 100% peanut Biodiesel were performed by cold cranking engines while being fueled solely on peanut Biodiesel. These tests were successful suggesting adequate cetane numbers for this fuel. Additionally, a 5% Peanut Biodiesel blend was used to fuel a Kubota M8580 tractor for one fueling cycle. Cold start and normal operation were not affected by the fuel replacement. Overall, the initial screening of peanut based Biodiesel had promising results as it is comparable or better than petroleum diesel fuel in key fuel properties. *Please note, as tests performed here were not replicated for statistical analysis and were with an unknown cultivar, further analysis is still required to confirm these results and to compare this cultivar to other promising high oil cultivars.

References: Korus, R.A., J. Jo, and C.L. Peterson. 1985. A rapid engine test to measure injector fouling in diesel engines using vegetable oil fuels. *Journal of the American Oil Chemists' Society*. 62(11):1563-1564.

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