the ENERGY lab

PROJECT FACTS

Fuels

Jet Fuel from Bio-Diesel

Background

Due to concerns with limited resources of petroleum-based fuels, the demand for using renewable feedstocks, such as vegetable oils and animal fats, to produce hydrocarbon fuels has increased. Algae are being investigated as a feedstock that could be a superior source of oil. Raw algae can be processed to make biocrude, the renewable equivalent of petroleum, and refined to make gasoline, diesel, jet fuel, and chemical feedstocks for plastics and drugs.

Airplane manufacturers, commercial airlines, and the military have all expressed interest in developing renewable aviation fuels. They have considered everything from babassu palm oil to algae. Once a source is chosen, the triglyceride oils must be converted into fuels. There are a number of well-known methods for making jet fuels from renewable feedstock. Such methods, however, have limitations including producing fuels that are not always acceptable for commercial use.

The National Energy Technology Laboratory (NETL) is partnering with Exelus, Inc., (Exelus) to develop a selective process to convert bio-diesel derived from algae into fuels that meet standard jet fuel specifications (Jet A-1 or JP-8) using innovative chemistry and engineered catalysts.

Project Description

The technology being developed steps far beyond traditional biodiesel synthesis to convert a ready source of fuel—algal oil—into aviation fuel that meets or exceeds all current performance specifications. This project applies completely new chemistry with environmentally benign engineered catalysts that allow conversion of both triglycerides and free fatty acids found in algae oil into long-chain, lightly branched paraffins that are ideal jet fuel components. The process is designed to be competitive with existing jet fuels made from petroleum both in terms of performance and price.

Goals and Objectives

The goal is to create a complete, sustainable, and cost-effective technology that converts algal oil-derived biodiesel into jet fuel. The project objectives for both Phase I and Phase II include (1) construction of a test unit; (2) setting up analytical procedures; (3) conducting catalyst and synthesis tests; (4) optimizing catalyst and reaction conditions; (5) demonstrating lipid extraction using novel solvents; (6) optimizing the high activity catalyst; (7) demonstrating the free fatty acid (FFA)-tolerant catalyst; (8) completing reactor design and development; (9) demonstrating and validating catalyst stability and lifetime; and (10) completing a techno-economic evaluation of the process.

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PROJECT DURATION

Start Date	End Date
06/19/2009	09/14/2012

COST

Total Project Value
$1,099,862

DOE/Non-DOE Share
$1,099,862/$0

AWARD NUMBER

SC0001973

Accomplishments

A unique and highly selective scheme has been developed to convert biological oils and fatty acids into jet fuels. In Phase I, Exelus completed development of one step in the process that yields hydrocarbon jet fuel from an intermediate product. The catalyst and optimum reaction conditions for this step have been identified. Also, viable heterogeneous catalysts for the second key reaction step starting from natural oils and FFAs were identified. The development and demonstration of a stable and highly active catalyst for this key reaction step has been accomplished in Phase II, as well as demonstration of the ability to integrate algal oil harvesting into the process using a low-cost method. High selectivity has been maintained throughout the process in order to keep the cost of the final fuel low.

Benefits

The proposed process converts biological lipids into hydrocarbon fuel. The use of biodiesel fuel helps to reduce the use of conventional petroleum fuels. Unlike typical biodiesel, these fuels are chemically identical to conventional fuels, ensuring that they will be safe to use in any concentration in sensitive applications like passenger jets. Furthermore, since they are completely compatible with existing infrastructure, no significant changes to the nation's storage, distribution, and use infrastructure would be needed, saving considerable resources.

Figure 1. Algae (green flakes) grows naturally diluted in water (blue-green liquid). The Exelus process converts this natural product into jet fuel (golden liquid).