Process Development for Transportation Biofuels

SOUTHWEST RESEARCH INSTITUTE®

Microalgae and agricultural oilseed crops have effective natural processes for utilizing solar energy to sequester carbon dioxide into energy oil resources. Southwest Research Institute® (SwRI®) has developed processes to convert these renewable natural oil feedstocks including seed crop oils, waste vegetable oil, algae oil and animal fats into clean and sustainable transportation fuels.

To support these alternative renewable energy technologies, SwRI has extensive laboratory facilities in organic and inorganic chemistry for analysis, synthesis, and development. In addition, SwRI is equipped with the resources to support the full range of utility, maintenance, and other infrastructure needs of pilot plant and semicommercial scale demonstration operations.

Capabilities

SwRI's expertise in advancing renewable biofuels includes:

- Biofuel process development
- Bench scale testing, including engine tests
- Pilot and demonstration plant design and operation
- Feedstock life cycle analysis
- Process modeling
- Catalyst evaluation and development
- EPA emissions testing for new fuel certification

Biodiesel

SwRI developed production of biodiesel by an automated continuous supercritical methanol (SCM) transesterification process (patent pending) which converts triglycerides from diverse feedstocks into fatty acid methyl esters (biodiesel). Laboratory-developed nanostructured heterogeneous catalysts were used to lower the temperature and pressure of the transesterification reaction, with over 99% conversion at a residence time of 7 minutes. The continuous SCM process is designed to operate in a temperature range of 250–400 °C and a pressure range of 1,500–4,000 psig.

Advantages of the SCM process compared to conventional biodiesel processes include:

- Less toxic waste generated
- Toleration of free fatty acid and moisture content: No saponification byproducts produced
- No pretreatment of feedstocks required
- No post-purification of biodiesel products necessary


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The 40,000-square-foot Chemical Engineering building contains 9,200 square feet of high bays and 4,000 square feet of analytical, process and biological laboratories.


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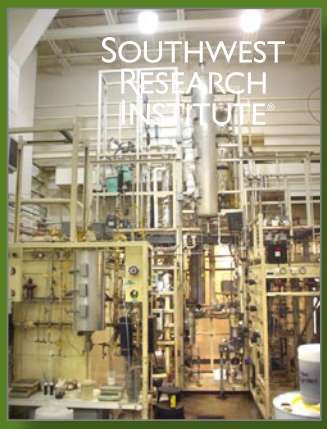
Alternative fuel demonstration plant


D018407

Continuous supercritical methanol process



Fixed-bed hydrotreating and hydrocracking pilot plant

Continuous fractionation unit

Green Gasoline, Diesel, Kerosene, and Aviation Fuel

SwRI operates a Fuel Processing Center that can accommodate a wide variety of feedstocks, waste vegetable oil, animal fats, microalgae, and plant oils. Features of the hydroprocessing facility include:

- Throughput of 50–100 gallons per day
- 2 continuous vacuum-distillation columns
- Operation up to 220 bar (3,200 psig) and 538 °C (1,000 °F) in the reaction section
- Recirculation of hydrogen up to 250 SCFH

The hydroprocessing unit has three reactors aligned in series, and the plant equipment configuration can be modified to meet project needs. In addition, the pilot plant can be modified for hydrogenation, hydrocracking, hydroisomerization, catalyst activity studies, and other fixed-bed reactor processing.

Conversion of Glycerin to Higher-value Chemicals

Glycerin is a byproduct from transesterification of renewable vegetable oils and animal fats to biodiesel. The increase in demand for biodiesel has led to a continued increase in supply of the biobased byproduct glycerol well beyond the demand for use in chemical applications. The economics of biodiesel production could improve if value-added products such as fuels or liquid chemicals could be produced from glycerol.

SwRI has developed a process to convert glycerin to higher-value oxygenated molecules using heterogeneous catalysts. Under catalytic thermal reaction, value-added chemicals such as ethanol, proponal, dimethyl ether, isobutanol, and propylene glycol can be produced. These products can be used as fuel additives, fuel components, heat exchange media, and pharmaceutical compounds.

SwRI scientists are evaluating the use of biological fermentation to convert the glycerine byproduct of biofuel processes to produce value-added chemicals such as isobutanol and 1,2-propanediol, using microorganisms such as strict anaerobic bacteria and yeast to facilitate these conversions.

Southwest Research Institute is an independent, nonprofit, applied engineering and physical sciences research and development organization using multidisciplinary approaches to problem solving. The Institute occupies 1,200 acres in San Antonio, Texas, and provides more than 2 million square feet of laboratories, test facilities, workshops, and offices for more than 3,000 employees who perform contract work for industry and government clients.

We welcome your inquiries.

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Development of renewable transportation biofuels is a principal focus of SwRI's International Alternative Fuel Technology Center.

Benefiting government, industry and the public through innovative science and technology