

Biomass and Biofuels Technologies



Drawing on decades of experience in advanced gasification research and catalyst development, RTI International is conducting R&D to help make biomass-to-liquid fuel processes technically and economically viable. Our scientists are developing process technologies to remove tar, ammonia, and sulfur from biomass gasification-derived syngas and are developing catalysts for converting syngas into transportation fuels. RTI is also actively researching pyrolysis—an attractive alternate method for converting biomass into transportation fuels that utilizes the existing infrastructure for fuel production and distribution.

Mounting environmental concerns, increasing fuel prices, and the growing gap between petroleum production and demand have stimulated intense interest in R&D of alternative fuels, both synthetic and bio-derived. Current commercial options for biofuels are limited to ethanol from sugarcane and grains or biodiesel from oilseed crops. The debate over using these food sources for fuel has accelerated R&D of second-generation biofuels technologies that convert lignocellulosic biomass into transportation fuels.

The U.S. Department of Energy is actively funding R&D in both bio- and thermochemical conversion technologies to accelerate the deployment of biofuels technologies in the near future. Thermochemical conversion technologies include gasification and pyrolysis, promising options for maximizing biomass resource utilization for the production of biofuels. RTI has active R&D programs in both biomass gasification and pyrolysis.

Novel Process to Lower Cost of Cleaning Biomass Syngas

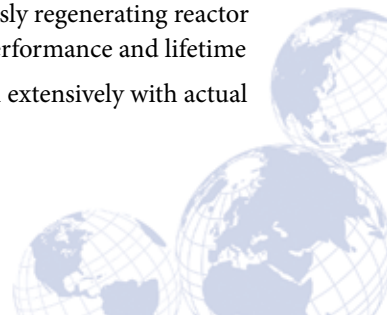
The most technically defined thermochemical route for producing alternative fuels from biomass involves

gasification of biomass. Significant cleaning of the resulting syngas is usually required prior to production. Generally involving an integrated, multistep approach, syngas cleanup can add significantly to the capital and operating costs of the total process.

RTI is developing and validating technologies to reduce syngas cleanup costs, thereby lowering the risk for commercializing biomass gasification/fuel synthesis processes for biofuel production. One potentially cost-effective option is RTI's Therminator technology, which removes tars, ammonia, and sulfur from biomass-derived syngas.

The goals of this research effort are to

- Develop a tri-functional catalyst system for cracking or reforming tars, dissociating ammonia, and removing sulfur to specified target levels
- Develop a circulating, continuously regenerating reactor designed to maximize catalyst performance and lifetime
- Evaluate the Therminator system extensively with actual biomass-derived syngas.



New Catalytic Technologies for Synthesizing Fuels from Biomass-Derived Syngas

RTI has extensive know-how and world-class laboratory facilities to synthesize, scale up, and test syngas conversion catalysts in laboratory- to bench-scale, fixed-bed and slurry reactors. Our R&D projects in syngas conversion include

- Testing numerous Fischer-Tropsch (FT) catalysts at laboratory and bench scales
- Developing an attrition-resistant, iron-based FT catalyst for slurry bubble column reactor systems
- Converting biomass-derived syngas to C₂-C₄ alcohols through various catalytic routes
- Exploring options to produce gasoline from biomass as a drop-in replacement fuel.

Over the past two decades, RTI has developed significant expertise in converting coal-derived syngas to liquid fuels and chemicals and has used this expertise to develop a strong biomass-to-fuels technology R&D program.

We have developed a highly active and selective iron-based FT catalyst (U.S. Patent No. 7,259,286) with exceptional attrition resistance. This high chain-growth ($\alpha > 0.93$) catalyst is well suited for converting biomass-derived syngas to liquid fuels.

Understanding the Effects of Contaminants in Biomass-Derived Syngas on Catalytic Performance

Working with Süd-Chemie, Inc., RTI is studying and quantifying the effects on water-gas shift and FT catalysts caused by syngas contaminants generated during co-gasification of coal/biomass. We are investigating a select group of contaminants—including hydrogen sulfide, ammonia, sodium chloride, potassium chloride, arsine, hydrogen selenide, and mercury—and their impact on catalyst activity, selectivity, and physical and chemical properties.

The goal of this research effort is to identify which contaminants impose the greatest negative impact on catalyst performance and to what level they must be removed from coal/biomass-derived synthesis gas to allow for the most efficient production of liquid transportation fuels.

Research to Enhance the Viability of Biomass Pyrolysis

An alternative option for producing liquid transportation fuels, pyrolysis involves the thermal depolymerization of biomass at modest temperatures in the absence of added oxygen. While traditional flash pyrolysis processes have demonstrated a liquid product yield of about 70%, the resulting bio-crude

- Requires upgrading or refining
- Has chemical and physical properties that make it unsuitable in the production of transportation fuels
- Has high oxygen content and low pH, limiting its long-term storability.

The quality (e.g., miscibility, viscosity, acidity, stability, heating value) and utility of bio-crude can be significantly improved by reducing its oxygen content.

RTI is currently developing highly active and robust catalysts for stabilizing bio-crude through catalytic deoxygenation of pyrolysis vapors. We are extending this research to develop a catalytic biomass pyrolysis process that generates a liquid hydrocarbon intermediate that can be upgraded into fuels using traditional hydrocarbon refining technology.

Doing Business with RTI

Both the U.S. Department of Energy and commercial companies are involved with catalyst and sorbent R&D at RTI, either as technology development partners or as clients for specialized R&D or analytical services. RTI offers comprehensive catalyst and sorbent development and testing services to industrial and government clients, aiming to provide the most efficient and cost-effective R&D services possible. RTI takes a pragmatic approach to managing intellectual property to best serve clients' needs.

More Information

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