

Biofuels Research Contact

For more information contact:

Dr. Raymond L. Huhnke, Professor
Biosystems & Ag. Engineering
223 Ag Hall
Oklahoma State University
Stillwater, OK 74078-6021
405-744-8417
raymond.huhnke@okstate.edu



GRASSohol



Oklahoma Agricultural
Experiment Station

Division of Agricultural Sciences
and Natural Resources

Oklahoma State University

GRASSohol

Introduction

Fossil-based reserves are used almost exclusively worldwide for the production of liquid fuels. Continued use of nonrenewable resources creates ongoing environmental, economic, and political concerns.

Several national initiatives demonstrate strong commitment to developing energy sources and industrial products from biomass. These initiatives aim to reduce the nation's dependency on foreign oil, while improving energy self-sufficiency and preserving environmental quality. Income derived from producing raw materials and value-added income from jobs at bioconversion plants holds great potential in helping revitalize economies in rural America.

One goal of the Oklahoma State University biofuels research team is to demonstrate the commercial feasibility of a gasification fermentation process. The team is also showing how underutilized biomass, such as perennial grasses and crop residues, can be converted to ethanol and other value-added products. For every 1 unit of energy put into the GRASSohol process, as much as 3 units of energy are returned. Traditional corn-based ethanol production provides about 1.6 units of energy per 1 unit of energy input.



From the field to the lab to automobiles: OSU researchers transform perennial grasses into liquid fuel.



Potential Impact and Benefits to Oklahoma

As with most products, one of the most critical factors in bringing bio-based products to the marketplace is cost of production. The goal of the research team is to produce ethanol at a cost less than \$1.50 per gallon based on a conversion efficiency of more than 75 gallons per dry ton of biomass (Starch-based ethanol was more than \$2.50 per gallon when this brochure was printed).

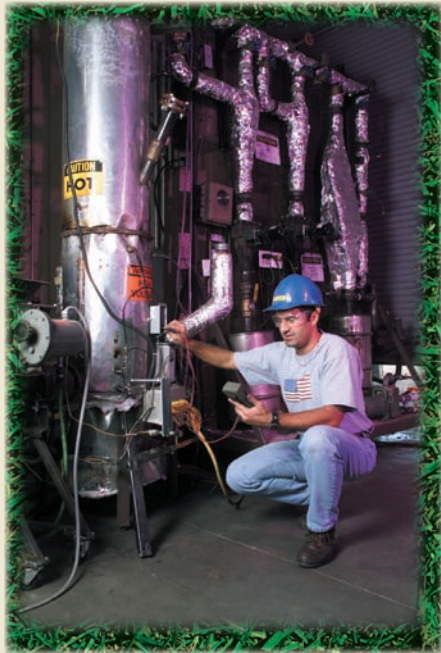
It is envisioned that this work could result in the establishment of numerous, small- to medium-scale ethanol production facilities that can be located throughout cultured biomass production and waste biomass-generation areas. Each facility could have a significant positive impact on the rural economy. A recent OSU study predicted a 50 million-gallon/year biomass-to-ethanol conversion facility would provide more than \$40 million in economic effect, while the facility would employ more than 30 individuals.



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Biomass-Based Energy Research at OSU



OSU researchers use a unique gasification-fermentation process to turn biomass into liquid fuel.

Process Description

The OSU process begins with biomass gasification (#1 in the illustration below) where, under a controlled oxygen supply, cellulose, hemicellulose, and lignin are converted to a producer gas (primarily carbon monoxide, carbon dioxide, and hydrogen). The producer gas then flows through a cleaning and cooling system (#2) and is subsequently directed to a bioreactor (#3). The gas is then bubbled through the bioreactor where a unique microorganism converts the gas into ethanol and other value-added products. From the bioreactor, the mixture is further processed to separate and recover these products. Ethanol is then distilled into a fuel-grade resource (#4).

Accomplishments

The multidisciplinary team is taking a “total system” approach, addressing the

more critical issues from the production of biomass to its conversion to liquid fuel. The team is the first research group to document successful conversion of biomass-derived producer gas to ethanol and other products. Some of the team’s more notable accomplishments include:

- Release of new switchgrass and bermudagrass cultivars with wide adaptation and high biomass-yielding abilities.
- Successful gasification of selected feedstocks, such as switchgrass, bermudagrass, and corn fermentation waste, to generate producer gas.
- Identification of several novel strains of acetogens that show much greater ethanol-producing potential compared to other known microbial catalysts.

As a natural complement to the extensive research efforts, a multidisciplinary gradu-

ate training program in bio-based product development is being initiated. The program will provide fully trained scientists and engineers to work in the bio-based economy of the future.

Personnel and Facilities

A multidisciplinary team of science and engineering faculty from OSU, the University of Oklahoma (OU), and Brigham Young University (BYU) has been assembled. OSU departments and schools represented are: Biosystems and Agricultural Engineering, Food and Agricultural Products Center, Chemical Engineering, Plant and Soil Sciences, and Agricultural Economics. OU is represented by the Department of Botany and Microbiology. BYU is represented by the Chemical Engineering Department.

Sponsors

State

- Oklahoma Agricultural Experiment Station, OSU Division of Agricultural Sciences and Natural Resources
- Oklahoma Secretary of Energy
- Oklahoma Bioenergy Center

National

- USDA-CSREES through Special Research Grants
- U.S. Department of Transportation through the Sun Grant Initiative - South Central Region

Industrial

- Coskata Inc., Warrenville, IL



Biomass

(1) Gasifier

(2) Cleaning & Storage

(3) Bioreactor

(4) Distiller

Ethanol & Other Products