



U.S. Department of  
Agriculture  
National Institute of  
Food & Agriculture



Project Title: **Value-Added Utilization in Syngas Cleanup and Conditioning**

## DR. AJAY KUMAR

### Project Goal

The goal of this project was to improve the economic and environmental sustainability of biomass gasification through value-added utilization of biochar by-product and effective cleanup and upgrading of syngas.

Specific objectives are as follows:

- 1) Determine the effect of biomass type, gasification condition, and gasifier design on biochar characteristics.
- 2) Evaluate and optimize the performance of biochar-supported Ni catalysts in syngas cleanup and conditioning in various types of gasifier systems.
- 3) Conduct an economic justification and analysis of using biochar in biomass gasification.

### Project Outcomes

This project was conducted in several parts. One of the studies focused on investigating detailed properties of biochar obtained from several biomass feedstocks and two gasifiers. Results show that the Brunauer–Emmett–Teller (BET) surface areas of most of the char were 1-10 m<sup>2</sup>/g and increased as equivalence ratio increased. Char moisture and fixed carbon contents decreased while ash content increased as equivalence ratio increased. The Fourier Transform Infrared spectra showed that surface functional group of char differed between biomass types but were similar with change in equivalence ratio. Catalysts were developed at OSU and from collaborators and some of the catalysts were tested in gasifier condition. Another study evaluated the environmental benefits of biochar-based catalysts through life cycle analysis (LCA). The LCA results indicated that biochar has a 93% reduction in greenhouse gas emissions and requires 95.7% less energy than the metal catalyst to produce. Novel biochar catalysts can reduce environmental impacts while providing economic benefits to biorefinery.



**PI: Dr. Ajay Kumar**

**Co-PIs:**

**Dr. Danielle Bellmer**

**Dr. Krushna Patil**

All Senior Personnel are employed by Oklahoma State University in the *Biosystems & Agricultural Engineering Department*

**Funded:** \$79, 266

**Start Date:** 11/01/2011

**End Date:** 10/31/2014

### Other Sources of Funding:

Oklahoma State University is meeting the required matching component of this project.