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U.S. Department of  
Agriculture-NIFA

**SunGrant**  
INITIATIVE  
South Central Region



## Project Title: Value-Added Utilization of Biochar in Syngas Cleanup and Conditioning

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#### Project Goal

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

The objectives were:

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

#### Project Outcomes

- Biomass type, air flow rate and gasifier design (insulation) had significant effects on biochar. Wood chips has significantly lower biochar yield, but the surface area of the char was much higher, compared to rice hulls at the same operating conditions. Higher air flow rate led to lower biochar yield but larger surface area. Insulation increased the pyrolysis temperatures so larger biochar surface area was obtained.
- Performance of the Ni/char catalysts was found superior to that of commercial tar cracking catalysts such as Ni/ $\gamma$ -Al<sub>2</sub>O<sub>3</sub>. For example, more than 99% of tars were effectively removed using the Ni/char catalysts. H<sub>2</sub> and CO concentrations in syngas also went up significantly.
- Initial cost analysis indicated that chars are less expensive than metal oxides, olivine, or dolomite that are common catalyst supports. In addition, consumption of Ni can be reduced by using char as the support. Ni particles stay only on the outer surface of the char support. In metal-oxide-supported catalysts, Ni is also formed inside the support via the impregnating and calcining methods. Moreover, mechanical mixing of Ni and char saves energy and time in catalyst preparation.



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