

IS THERE A FUTURE FOR YOU IN THE BIO-FUELS INDUSTRY?

TURNING CROPS, WASTES & ENVIRONMENTAL PROBLEMS INTO ENERGY & FUEL

THIS TECHNOLOGY IS UNIQUE

DR. JAMES GADDY OF BIOENGINEERING RESOURCES, INC. (BRI) of Fayetteville, Arkansas has been working for the past 15 years on a renewable liquid fuels technology. This technology converts any organic material or hydrocarbon into ethanol. It also creates low-cost electricity as a by-product of the process.

The BRI process (gaseous substrate fermentation) can take woody plants, crop residues, municipal wastes, indeed any carbonaceous materials, convert them to gas, and feed the gas to a bacterial culture that will create a renewable liquid fuel, ethanol. This process is more than a possibility. It has been operating for four years in a pilot facility at the University of Arkansas, and will be going into commercial production throughout 2006.

It is widely reported that the most efficient form of ethanol production – cellulosic ethanol – is at least 5 years away from being commercially feasible. **The BRI Process makes it a reality today.**

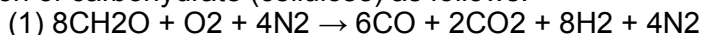
BRI's patented biocatalytic process offers the opportunity for renewable crops and the wastes of our society to be converted into liquid fuel, steam, hydrogen and electricity. This process is unique:

- The BRI Process involves the fermentation of syngas. Unlike other fermentation technologies, the bio-catalytic process is highly selective and produces only ethanol, resulting in very high yields while avoiding costly additional processing to separate ethanol from other lower grade products.
- The cooling of the syngas exiting the gasifier creates the opportunity to produce steam and generate electricity. This can supply up to 50 M BTU per gallon of ethanol produced.
- The BRI reaction time in the fermentation vessel is a matter of a few minutes. This compares well with the long reaction time of 36-48 hours for the other processes currently in use.

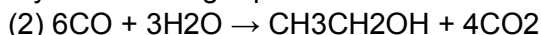


THE CHEMISTRY

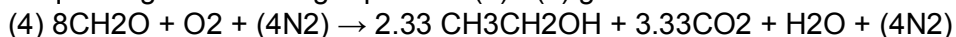
The overall chemical reaction during the gasification of biomass can be approximated as the partial oxidation of carbohydrate (cellulose) as follows:



This equation is typical of an air blown gasifier, with nitrogen present in the effluent. If pure oxygen is used, nitrogen is eliminated. Steam also may be used as the oxidizer, producing a gas richer in hydrogen. The CO, CO₂ and H₂ are then converted by proprietary microorganisms to produce ethanol by the following equations:



All of the carbon and hydrogen in the initial raw material could be converted into ethanol; hence yields are quite high. Combining equations (1) - (3) gives:



From Equation (4), the maximum theoretical yield of ethanol is computed to be 135 gallons per dry ton of carbohydrate. By comparison, hydrolysis/fermentation processes which convert only the cellulose and, possibly the hemicellulose, have maximum theoretical yields of about 85 gallons per dry ton. Equation (4) shows a 60% carbon to ethanol yield with an oxygen blown gasifier. From Equations (2) and (3), it can be shown that with a 2:1 hydrogen-to-CO ratio in the syngas, the process becomes CO₂ neutral, and only ethanol (no CO₂) is produced by the fermentation.

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