An Efficient Method and Gasification Device for Producing Synfuel from Biomass

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a self-sufficient gasification device and method for efficiently producing synthesis fuel.

OVERVIEW

Solid, carbon-containing materials, such as wood chips, may be converted into liquid fuels using a gasification process. The potential of this technology has been long overlooked because energy production using traditional methods has been more cost-effective. However, with the recent increases in the cost of energy and concerns about carbon emissions, gasification is becoming more attractive as an alternative energy source.

The gasification process converts organic material or feedstock called biomass into a synthesis gas, referred to as syngas, that is converted into fuel using a well-established process called the Fischer-Tropsch synthesis. However, conventional conversion methods experience severe losses in efficiency during an intermediate step called pyrolysis, in which high temperatures are used to break down the biomass. During this step, the biomass is heated using a bed of sand, steel particles, air or water as the heat carrier.

The pyrolysis process becomes expensive as it requires the biomass to be presented as sawdust or in liquid form. Additionally, current heat carriers can lead to problems with efficiency, scaling up or syngas contamination. Using liquid metal heat carriers with high heat transfer rates and wide operating temperature ranges could enable the development of a new gasification system with reduced complexity, size and cost.

THE INVENTION

UW Madison researchers have created a more efficient gasification method and device that uses liquid metal to heat the organic feedstock and produce synthesis gas. Feedstock or raw biomass comprised of any carbon-containing organic material, such as wood chips, may be used in this method. The process produces syngas at levels near the theoretical maximum for a gasification method.

This new gasification process begins with heating the feedstock in a bath of molten metal between 100 °C and 200 °C, a temperature that drives out all moisture without breaking

down the organic components. The dried biomass is then pumped into a hotter bath, generally 300 °C to 1,200 °C, of the same molten metal. In this high temperature phase, water is added back in a controlled manner to drive fast pyrolysis, thereby releasing gas byproducts and leaving behind tar and char.

In the final step, gases that were released in the second step may be pumped into the chamber to increase the temperature and pressure levels. Natural gas feedstock also may be added to aid in the gasification reaction and further improve the system efficiency. The char, tar and gases react to produce syngas, which consists mainly of hydrogen and carbon monoxide. The syngas then is siphoned off and used in a Fischer-Tropsch synthesis to produce ethanol, methane, diesel or other fuel. The molten metal from the final bath is filtered and recirculated, and a portion of the product syngas may be used to heat the baths and drive the reactions to increase the self sufficiency of the system.

APPLICATIONS

- Convert carbon-containing biomass into fuel

KEY BENEFITS

- Offers efficient small and large scale conversion of biomass into fuel
- Faster than conventional gasifiers as complete gasification occurs in seconds instead of minutes
- More completely gasifies biomass
- Yields high quality and relatively clean syngas
- Uses low-cost feedstock
- Includes biomass of any organic material produced by plants or animals
- Increases system efficiency by recirculating the liquid metal and a portion of the syngas
- Provides a self-powered, self-contained mobile recirculating fuel producer
- Uses liquid metal that absorbs contaminants such as sulfur, which can be filtered out later
- Adapts to various levels of fuel output
- Metallic catalysts can be added to increase reaction speed.
- Recovers and reuses water, making an external water source unnecessary
- Provides a carbon-neutral energy source
- Requires no external energy to run the gasifier
- Cheaper to assemble, operate and maintain than conventional gasifiers
- May be developed as a self-powered mobile unit or a large-scale power plant

ADDITIONAL INFORMATION

Publications

Anderson M.H. and Dietenberger M.A. 2007. Vision of the U.S. Biofuel Future: A Case for Hydrogen-Enriched Biomass Gasification. Ind. Eng. Chem. Res. 46, 8863-8874.

Tech Fields

Clean Technology - Biofuels & renewable fuels

CONTACT INFORMATION

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