NexantECA

Technology and Costs

Biorenewable Insights: Biomass Gasification

Biomass Gasification is one in a series of reports published as part of NexantECA's 2019 Biorenewable Insights program.

Overview

A promising alternative way to produce bioenergy, biofuels, and bio-based chemicals is through thermochemical conversion—the controlled heating or oxidation of biomass. Bioenergy production covers a range of technologies including pyrolysis, gasification, and combustion, which can be variously configured to produce outputs of heat, electricity, or gaseous or liquid precursors for upgrading to liquid fuels or chemical feedstocks Oxidation with air, oxygen from an ASU (air separation unit) and/or various modes of indirect heating may be used. Thermochemical technologies show great promise for the production of renewable electricity, both in the context of biomass co-firing in existing coal power plants and for decentralized electrification projects in developing countries.

For chemicals and biofuels production, thermochemical conversion provides a means of crossing over from the world of biological (biomass) resources of the widest-ranging types to the world of petrochemical-type processing, by leveraging established catalytic technologies for converting syngas (carbon monoxide – hydrogen mixtures) to chemicals and fuels, or by converting bio-based naphtha-like fractions to olefins in steam reformers.

Technologies

Biomass feedstock for gasification must fit certain criteria to be implemented economically at commercial scale. The primary criteria are composition considerations, such as energy density, which influences yield or efficiency of the process, and dryness. Secondary criteria, but with similar importance, include supply and logistics of feedstock. The latter dictates cost of feed (including recovery costs and transportation) and location suitability.

Most types of gasifiers can be placed in one of the following categories:

- Fluidized bed gasifiers
  - Bubbling Fluidized Bed
  - Circulating Fluidized Bed
- Moving-bed gasifiers
  - Updraft
  - Downdraft
  - Cross draft
- Entrained flow gasifiers
- Plasma gasifiers

Each of these has a different range of feed particle size requirements and all involve some level of challenge to feeding different types of biomass, generally more so than for coal, from which application these technologies derive.

Process Economics

Cost of production models for USGC, Brazil, Western Europe and China are shown for various products of gasification (from Agricultural Residues, Wood, and MSW):

- BFB:
  - FT
  - Methanol
  - Hydrogen
- TRI
  - FT
  - Methanol
  - Hydrogen
- CO_2 Methanation
- Syngas-Based (SNG)
- Electrofuel

Capacity

NexantECA has catalogued existing and planned biomass gasification capacity.

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Technology@NexantECA.com or www.NexantECA.com

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The BI program (sister program to the world renowned TECH program, formerly known as PERP) is globally recognized as the industry standard source of process evaluations of existing, new and emerging of interest to the renewable energy and chemical industries.

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Technology@NexantECA.com or www.NexantECA.com

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Technology and Costs comprises the Technoeconomics – Energy & Chemicals (TECH) program, the Biorenewable Insights program (BI), and the new Cost Curve Analysis. These programs provide comparative economics of different process routes and technologies in various geographic regions.

NexantECA serves its clients from over 10 offices located throughout the Americas, Europe, the Middle East, Africa, and Asia.

Americas
Tel: +1 914 609 0300
44 S Broadway,
5th Floor White Plains
NY 10601-4425
USA

Europe, Middle East & Africa
Tel: +44 20 7950 1600
110 Cannon Street
London EC4N 6EU
United Kingdom

Asia Pacific
Tel: +662 793 4600
22nd Floor, Rasa Tower I
555 Phahonyothin Road
Kwaeng Chatuchak
Khet Chatuchak
Bangkok 10900
Thailand

For more information. please contact
Technology@NexantECA.com or www.NexantECA.com