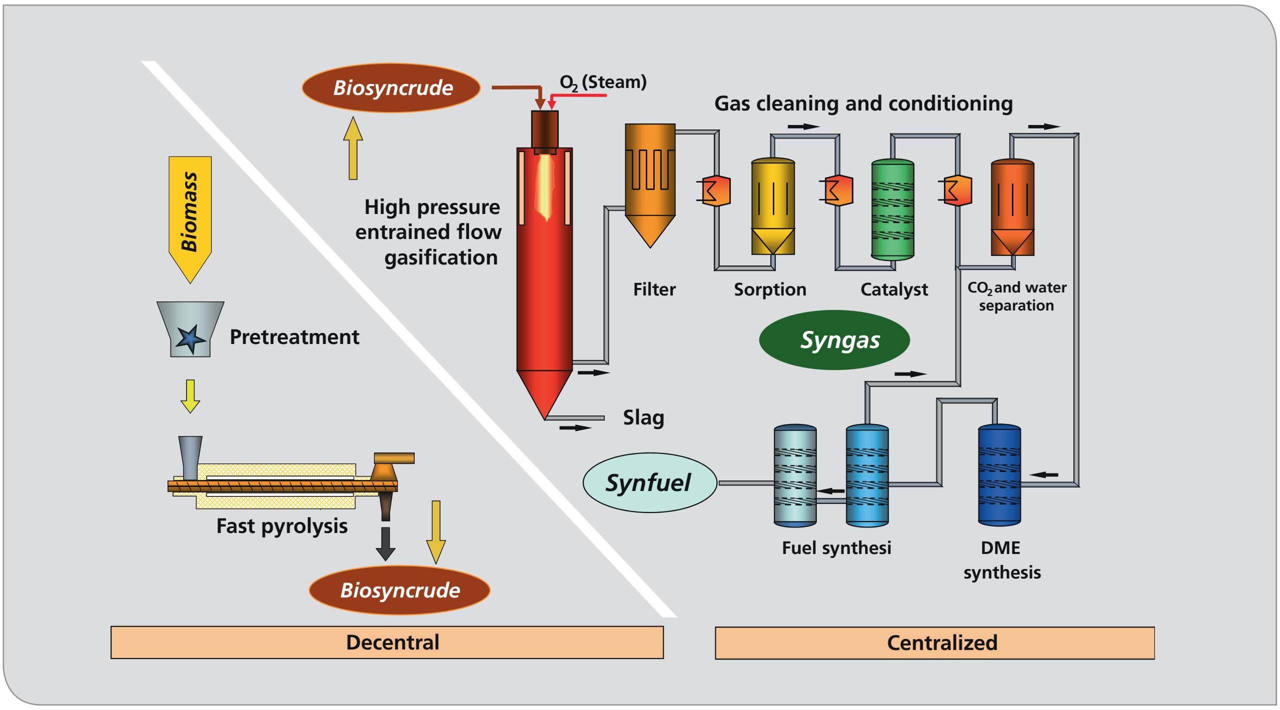
Karlsruhe Institute of Technology

Institute of Catalysis Research and Technology (IKFT)
Institute for Technical Chemistry (ITC)
Engler-Bunte-Institute, Division I (EBI-CEB)

The Karlsruhe bioliq® Process

Integrated Processes to Produce Synthetic Fuels and Bulk Chemical Products from Dry Residual Biomass



Description

Karlsruhe Institute of Technology (KIT) is studying various thermochemical processes for production of chemical energy carriers from biomass. The Karlsruhe bioliq® process has been developed to convert so far largely unused residual biomass into tailored synthetic fuels in a pilot plant. These BTL (biomass to liquid) fuels are synthesized mainly from dry, biogenous residues, such as cereal straw or residual wood from agriculture and forestry. The integrated process chain does not only allow for the production of biofuels, but also of industry-relevant basic products, such as synthesis gas and bulk chemicals. In the future, the biofuels produced will replace part of the petroleum-based fuels. In addition, they have numerous environmentally and climate-relevant advantages that result from clean combustion and the use of the renewable carbon feedstock biomass.

Economic Efficiency and Less CO_2 by Energy Concentration

As biomass arises in a regionally distributed manner, it mostly has to be collected on large areas and transported to processing over long distances. To reduce CO_2 and long transport paths, the Karlsruhe BTL concept combines a decentralized production of an energy-rich intermediate product from biomass with its central processing to an end product on the industrial scale. Regionally arising biomass is subjected directly to Fast pyrolysis. An easily transportable, energy-rich biosyncrude is produced. It is converted chemically into synthesis gas and further into fuels or bulk chemicals at a central plant. The energy density of the biosyncrude exceeds that of dry straw by more than an order of magnitude.

The Five Steps of the bioliq® Process

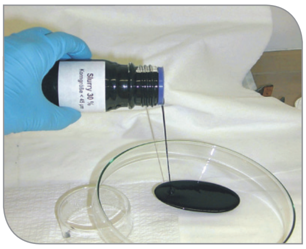
1. Fast pyrolysis: Biomass is converted into pyrolysis oil and pyrolysis char by heating in the absence of air.
2. Energy concentration: The porous pyrolysis char is mixed with the pyrolysis oil to a liquid energy slurry, the biosyncrude.
3. Entrained-flow gasification: The biosyncrude is gasified with oxygen in a high-pressure entrained-flow gasifier and converted into a tar-free, low-methane raw synthesis gas that mainly consists of CO and H_2.
4. Gas cleaning and conditioning: Particles and disturbing trace substances are removed from the raw synthesis gas.
5. Fuel synthesis: The clean synthesis gas is converted into fuel by chemical synthesis.

Key Process Features

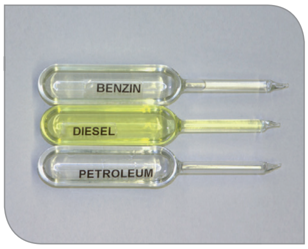
- Large feedstock spectrum due to the use of various types of biomass and unused residual biomass
- Use of biogenous residues does not compete with food production
- Decentralized/central bioliq® concept allows for the mobilization of large amounts of biomass
- Regional plants for biomass pretreatment provide further agricultural income sources
- bioliq® enables full utilization of both the substance and the energy of mainly dry biological residues
- Synthesis gas production at large-scale plants increases the economic efficiency of the process

Key Product Features

- Synthetic fuels are purer, more homogeneous, and environmentally more compatible due to clean combustion
- Biofuels can be tailored. A wide variety of fuels can be synthesized for various types of engines, e.g. biokerosene
- Production of high-quality synthesis products by innovative technology results in a high value added



Energy-rich, liquid intermediate product biosyncrude.



Synthesis fuels are purer than petroleum-based fuels.

Technical Features

- On its way from straw to biosyncrude, energy is densified by a factor of up to 15 through the bioliq® rapid-pyrolysis stage
- Process energy originates from the biomass used, which results in a high CO_2 reduction potential
- The liquid, energy-concentrated preliminary product (biosyncrude) can be processed easily and efficiently on a large technical scale
- There is no need for complex gas compression procedures prior to production of the synthesis gas
- Hot-gas cleaning may reduce energy consumption by about 10 % compared to conventional gas cleaning
- One-stage DME synthesis shortens the process chain and, hence, reduces investment costs

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