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Production of advanced biofuels via biomass gasification

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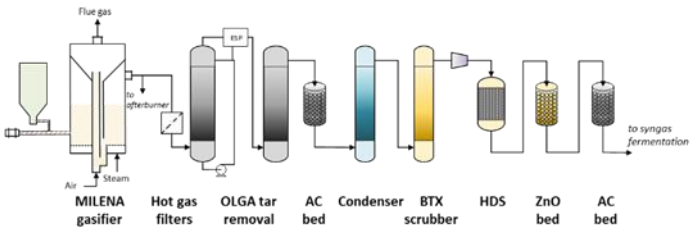
Abstract

Statement of the Problem: The development of lignin derived energy products is one way to increase the value of bio-refinery residues. Gasification of (lignin-rich) biorefinery residues, followed by product gas cleaning and anaerobic fermentation, offers a potential to produce higher added-value products such as biofuels and chemicals. MILENA indirect gasification allows complete fuel conversion and produces a high value gas composed of CO, H2 and CO2, as well as compounds such as CH4, C2-C4 gases, benzene, toluene and xylene (BTX), and tars. The separation of the most valuable components of the product gas is a good way to maximize the value from the feedstock via co-production schemes. The product gas, after appropriate cleaning to remove impurities, can be applied in the gas fermentation process. Some anaerobic microorganisms, can be used as a biocatalyst for the microbial conversion of syngas into short-chain organic acids and alcohols (i.e. acetate and ethanol). The ability of these microorganisms to withstand some of the impurities contained in the syngas and their flexibility to use different syngas compositions makes them an attractive alternative to the chemical catalytic processes. Methodology: A lignin rich feedstock is gasified with steam at 780°C using MILENA indirect gasifier, at TNO. The product gas after removal of the main impurities, consists of CO, H2, CO2, N2, CH4 and traces of other gaseous hydrocarbons, benzene and H2S. The influence of the obtained syngas quality and composition is evaluated in the fermentation process. Conclusion & Significance: Despite many advantages, the integration of gasification with syngas fermentation is still in an early stage of development, where many questions exist concerning the syngas quality needed in the fermentation process. In this work a first attempt to combine the two processes is presented.



. Figure: Experiment layout of the gasification and gas cleaning process.

Recent Publications

1. Liakakou E.T., Vreugdenhil B.J., Cerone N., Zimbardi F., Pinto F., et al. (2019) Gasification of lignin-rich residues for the production of biofuels via syngas fermentation:
2. Boymans, E., Vreugdenhil, B., Abelha, P., Buffi, M., Chiaramonti, D. (2019) A value chain for large scale ft production: The case of pyrolysis oil-char slurry gasification. European Biomass Conference and Exhibition Proceedings 544-550.
3. Mourão Vilela, C.F., Aranda Almansa, G., Vreugdenhil, B.J., Bos, A., Kuo, Y.T. (2018) Co-production schemes in the bio-SNG process: BTX production and harvesting. European Biomass Conference and Exhibition Proceedings 947-952.
4. Chiodini, A., Bua, L., Carnelli, L., Zwart R., Vreugdenhil, B., Vocciante, M. (2017) Enhancements in Biomass-to-Liquid processes: Gasification aiming at high hydrogen/carbon monoxide ratios for direct Fischer-Tropsch synthesis applications. Biomass and Bioenergy 106:104-114.
5. Ramachandriya K.D., Kundiyana D.K., Sharma A.M., Kumar A., Atiyeh H.K., Huhnke R.L., et al. (2016) Critical factors affecting the integration of biomass gasification and syngas fermentation technology. AIMS Bioengineering, 3:188-210.

11th Edition of International conference on Biofuels and Bioenergy, London, UK, March 23-24, 2020

Biography

Eleni T. Liakakou is a Chemical Engineer with a PhD in catalysis. Her research interests lie in the area of renewable energy sources and more specifically in the development of catalytic processes for the conversion of biomass to high-added value green chemicals and fuels. In 2017, she joined TNO, working in the biomass and energy efficiency unit, with a focus on bio residues and wastes gasification, product gas cleaning, separation technologies and conversion of syngas to fuels and chemicals. Her research experience is manifested by her participation in national and EU research projects, publications in highly recognized refereed international journals and multiple presentations in national and international conferences.

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