

Biogas as an Alternative Carbon Source for the Production of Waxes

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Abstract

The current demand for waxes is primarily met by processes converting fossil resources. As industrialized nations try to minimize the dependence in fossil resource alternative process concepts have to be investigated to prevent undersupply.

In recent years the production of electric energy from biogas was heavily subsidized all over the world. Especially in Germany, the governmental support lead to a strong increase of the number of biogas plants up to approximately 8,000. The economic feasibility of these existing plants is highly dependent on the incentive feed-in tariffs. In case of a reduction of the governmental support a large amount of biogas plants could become economically unfeasible. An alternative approach is the utilization of biogas for a gas to liquid process. The production of highly valuable products could allow an economically feasible operation of the biogas plants independent of governmental support. The application of the Fischer-Tropsch synthesis for the production of waxes is an attractive pathway. Waxes produced from Fischer-Tropsch synthesis are especially interesting for cosmetic applications because of the absence of aromatic and polycyclic compounds. The “green” production from biogas is an additional advantage for this application.

It is shown that the specific composition of biogas allows the production of syngas suitable for Fischer-Tropsch synthesis in one process step. The absence of an additional reverse water-gas shift reaction step simplifies the process concept, which is advantageous for the targeted small-scale application. For two reforming concepts, steam reforming and autothermal reforming, the process efficiency is calculated with help of a process model. The results show, that especially the concept based on steam reforming offers a high energetic efficiency of $\eta_{en} > 0.5$.

The majority of Fischer-Tropsch-based processes focuses on the production of gasoline and diesel fractions, but since these are in strong competition to mineral oil based products expected revenues are low. The conducted economic feasibility study reveals the advantage of the biogas-based process for the production of highly valuable waxes. The results are compared to state-of-the-art biogas CHP. For existing biogas plants the developed process concept offers a promising alternative for profitable operation. The process modeling results also show that the technical realization depends on the availability of advantageous inexpensive novel reactor concepts that are specifically developed for small-scale decentralized applications.