

Synthetic diesel from biomass by Fischer-Tropsch synthesis

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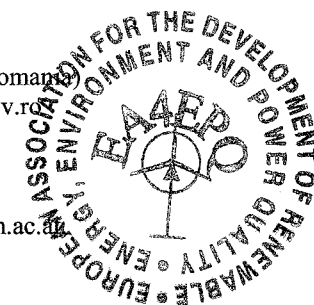
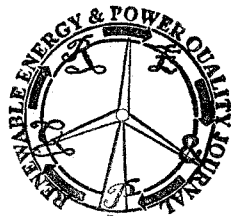
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Abstract. The production of liquid hydrocarbons fuel from biomass by Fischer-Tropsch synthesis has become more and more attractive due to its advantages compared to fossil diesel: environmental friendliness by recycling wood and agricultural wastes and reducing emissions of greenhouse gases (CO, CO₂, SO₂, NO_x, unburned hydrocarbons and particulate matters), absence of sulphur and nitrogen, higher combustion efficiency, higher cetane number and also the compatibility with existing diesel engines and infrastructure.

In this paper the Fischer-Tropsch synthesis process from biomass applied at the Güssing plant was investigated. Each stage of the installation: biomass gasification, gas cleaning and Fischer-Tropsch process, in terms of the equipment used and the parameters necessary for the synthesis, was analysed and discussed.

Also, during the synthesis the gas composition of the syngas before and after each stage was analysed, using gas chromatography. The same analytical method was used in order to determine the carbon distribution of the Fischer-Tropsch fuels obtained in the process. The ASF model was applied and an α value of 0.89 was calculated for the products.

Key words

Biodiesel, Biomass, Fischer-Tropsch synthesis, Syngas

1. Introduction

Nowadays, one of the biggest environmental problems is caused by transportation, which contributes with 21% of the greenhouse emissions in Europe and continues to grow. Road traffic is responsible for more than 90% of these emissions, generating especially CO, NO_x, SO₂, particulate matter, volatile organic compounds and other forms of pollution, due to its continuous growth during 1990-2002 [1].

The limitation of crude oil reserves, high crude oil prices, instability of the crude oil supply chain, as well as the environmental problems lead to EU legislation and strategies which put the transportation fuel sector under pressure [1] and determined the search for alternative

fuels. The term biofuel is referring to liquid or gaseous fuels that are predominantly produced from biomass [2]. Among the renewable energy sources, biomass has the advantages of its availability worldwide (agricultural crops, wood, agricultural and wood wastes, municipal wastes), positive environmental properties due to lower CO₂, sulphur and nitrogen emissions, ability to provide not only liquid, but also solid and gaseous fuels [1], [2], [3]. There are different processes to decompose biomass – extraction, fermentation, thermo-chemical conversion – in order to obtain biofuels, like bioethanol, biomethanol, biohydrogen, bio-char, biogas, syngas, vegetable oils, biodiesel or Fischer-Tropsch products (diesel, gasoline, kerosene, and waxes).

In Europe, among all the biofuels produced, diesel substitutes become more and more attractive, due to the high share of diesel in the transportation fuel sector, with the advantage of high efficiency and lower emissions. There are three main ways for synthetic diesel synthesis:

- Transesterification process that uses oils to produce first generation of biodiesel;
- Hydrogenation of biooils;
- Fischer-Tropsch synthesis that uses syngas obtained by gasification of biomass in order to produce the second generation of biodiesel.

Even if nowadays, transesterification is the most used process for obtaining biodiesel, there are some disadvantages of this process that makes Fischer-Tropsch synthesis more suitable:

- only oils can be used as feedstock;
- competition between biodiesel production and food crops.
- blending rate – only blends of 7% biodiesel with petroleum diesel can generally be used in unmodified diesel engines, while in pure form (B100) biodiesel requires engine modifications to avoid maintenance and performance problems.