

Biodiesel – Transesterification of Vegetable Oils with Guanidine Carbonate

Anna Grevé, Eckhard Weidner, Fraunhofer UMSICHT
Oberhausen, Germany

Today, more than 30% of the energy consumption in the European Union accounts for the transportation sector - this is even assumed to expand in the next years. The discussion on the reduction of CO₂ and the increasing demand on fuels lead to an enforced search for production of fuels from renewable sources. In the EU and also in south-east Asia the production of fluid fuel from vegetable oil is favoured. The target of the EU-commission is the substitution of 5.75% fossil fuel with fuel from biogeneous resources until 2010.

Biodiesel as an alternative to fossil fuels is produced by the transesterification of oils of biological origin. In this process, the high viscosity of vegetable oil is reduced by converting the oils with methanol to methyl-ester and glycerol. The oil is mixed with methanol in presence of a catalyst (mostly NaOH). Typically in a first reaction stage a partial conversion to methyl-ester and glycerol is achieved. After removal of the glycerol phase, an almost complete conversion is reached in a second reaction stage. In both reaction steps the formation of soap is observed. The catalyst remains in the products (preferably in glycerol) and has to be carefully removed by washing with water, phase separation and distillation processes. In the entire process certain waste water streams accrues.

To increase the competitiveness of biodiesel it is necessary to intensify the process by accelerating the reaction, facilitating downstream processing, and by improving the yield of methyl-esters. These demands were fulfilled by a new catalyst based on amines (guanidine carbonate). Experiments to investigate the effect of free fatty acids, water-content, amount of catalyst and reaction time on the yield of methyl-esters were performed. It was found that conversions of >95% could be reached within one reaction step in less than one hour. Particularly, in transesterification of oils containing free fatty acids, guanidine carbonate showed significant advantages as no soap formation was observed. The process is applied in an industrial pilot plant with a capacity of approx. 1t/h.