University of Kassel
Faculty of Organic Agricultural Sciences

Analysis and Design of a System for the Separation of Methanol and Water Impurities from Biodiesel

Masterthesis at the Department of Agricultural Engineering

1. Supervisor: Prof. Dr.-Ing. H. Gaese (University of Applied Sciences Cologne)
2. Supervisor: Dr. H.-P. Löhrlein, Prof. Dr.-Ing. Rüdiger Krause

Author: Ratan Kumar Ghosh

Witzenhausen, December 2003

Abstract

Biodiesel is more clean-burning and renewable than diesel, which has the potential for addressing numerous environmental and economic objectives for the future. Biodiesel fuels are attracting increasing attention worldwide as a direct replacement for diesel in vehicle engines or, more commonly, as a blending component for diesel. It is produced from non-toxic, biodegradable, renewable sources, such as fresh and used cooking oil, animal fats etc. Fats and oils are chemically reacted with alcohols in the presence of a catalyst to produce biodiesel, chemically known as fatty acid alkyl esters (fatty acid methyl esters when methanol is used) and glycerine as a by-product. But due to the influences of different types of impurities, it is difficult to achieve optimum result from biodiesel. These impurities create problems during storage, transportation and have negative effects on engine efficiency. Common impurities include unsaponifiable matter, water, free glycerine, bound glycerine, alcohol, free fatty acids, soaps, residual catalyst, microorganisms and oxidation products. Water and methanol impurities are not from impure feedstock, they come from insufficient separation by the settlers and have many worst effects.

The main objective of this study is to develop a design of a system to separate methanol and water impurities from biodiesel for continuous production. In order to focus a clear picture of the topic, feedstocks for biodiesel, production process, effect of different types of impurities and different aspects of biodiesel have also been discussed.

The above mentioned methanol and water separation system is a type of vacuum distillation, consists of some successive processes, which include heating up biodiesel, increasing the exposed surface area of biodiesel to accelerate evaporation, creating vacuum in the vacuum tank, biodiesel level control in the vacuum tank, discharge of the cleaned biodiesel, disposal of sucked methanol and water vapour etc. A two dimensional Morphological Matrix has been used to analyse and to select the most suitable method among different alternatives of each process on the basis of cost, quality of performance, maintenance, reliability, durability (lifetime), operating cost considering the degree of importance and acceptance of each alternative and finally all possible components of the system have been designed.