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## Ethylc biodiesel: The bottlenecks for process optimization

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Biodiesel is mainly produced using the methylic route. Ethanol has the advantage of being a renewable alcohol, but the ethylic route has drawbacks that must be overcome for process optimization. Ethanol enhances the mutual solubility of the hydrophilic and lipophilic substances that occur along the production process and makes more problematic the purification steps. Along the reaction path two liquid phases are formed, the upper one is rich in monoalkyl esters and the bottom one contains glycerol. The industrial process uses basic homogeneous catalysts and requires a sequence of purification steps. The use of alternative approaches, such as bio-catalysis, heterogeneous catalysis or supercritical conditions, also generates a two-phase reaction system and requires the use of alcohol in excess due to the reaction's reversible character. This means that phase splitting and alcohol recovery are steps required for purifying biodiesel as well as for recycling the reactant in excess. In case of bioethanol as reactant, the sequence of purification steps used in the methylic route is not the best option. For instance, the ethylic route potentially requires a specific and complete dehydration unit for recovering bioethanol, increasing the production costs of biodiesel. A new approach must be developed for the ethylic route, based, for instance, on the concept of using bioethanol in the whole sequence of the biofuel production, from the seed to the tank. This approach involves the following main steps: Extraction and de-acidification of vegetable oils using bioethanol as solvent, reactive steps applied to both ethylic miscelas containing de-acidified oil or free fatty acids, biodiesel purification steps with minimal addition of washing water and a recovery and dehydration step of the bioethanol by extractive distillation using glycerol as dehydrating agent. The bioethanol used as reactant can also be acquired in hydrated form (azeotropic mixture) and be dehydrated within the proposed process. The main bottlenecks of the production process were addressed and process optimization performed. Different sources of fatty compounds were considered, including the most important for the Brazilian case, such as soy and palm oils, as well as other sources of potential relevance for the future, as microalgae oil. Experimental runs and modeling approaches were conducted with the aim of measuring and predicting the relevant phase equilibrium data and for evaluating the performance of equipments for oil extraction and for oil de-acidification by liquid-liquid extraction or ion exchange. The sequence of ethylic biodiesel production was investigated using ASPEN PLUS, including the bioethanol recovery and dehydration step. Some aspects related to the integration of food, feed, bio-products and biodiesel production were considered, for instance the quality of the deffated meal after oil extraction with bioethanol and the recovery of minor components (tocopherols, sterols, etc.) during oil de-acidification and the biofuel production.

## Biography

Meirelles A J A graduated in Food Engineering (Unicamp, 1980), Master's degree in Food Engineering (Unicamp, 1984), PhD in Process Engineering at TH Merseburg (now Martin Luther Universität, Germany, 1987) and a PhD in Economics (IE- Unicamp, 1997). He is a professor at FEA -Unicamp and Fellow of CNPq Research Productivity - Level 1B. He has supervised 24 doctoral theses, 28 Master's theses and 47 undergraduate research works, published 115 articles in professional journals, 176 full papers in conference proceedings, eight book chapters and a book. He has developed three patented processes or patent applications under review by the PTO. He was awarded the Young Scientist Award (First, 1989) and the Academic Recognition Award Zeferino Vaz (2001). He has conducted research in thermodynamics of phase equilibria, mass transfer phenomena and substances purification processes, with emphasis on the production of food fluids, oil and bioproducts derived biofuels and sugar cane.

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