

MIHAJLO PUPIN TECHNICAL FACULTY

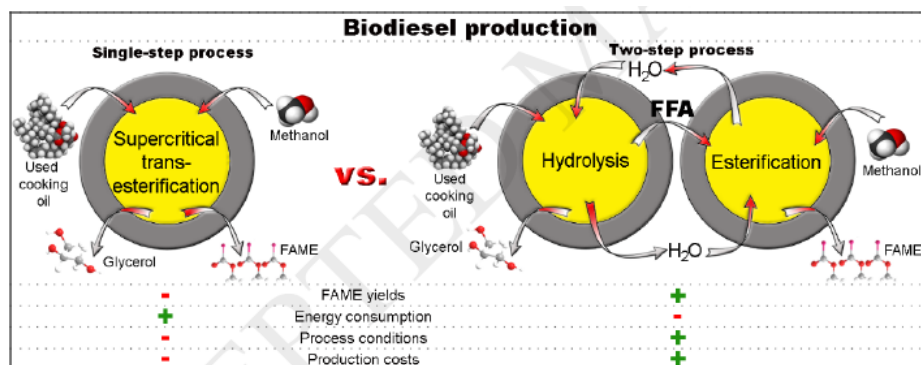
Comparative techno-economic analysis of single-step and two-step biodiesel production with supercritical methanol based on process simulation, (2018), Chemical Engineering Research and Design 132, 751-765.

Scientific Paper

Martinović, L.; Kiss, E.; Mičić, R.; Simikić, M.; Tomić, M.

Two alternative processes for biodiesel production from used/waste cooking oil, the single-step supercritical transesterification and the two-step process consisting of oil hydrolysis and subsequent supercritical methyl esterification, were designed and simulated using the Aspen Plus 8.8 software and assessed from a techno-economic point of view. Detailed operating conditions, material and energy flows, and equipment designs were provided for biodiesel plants with 15,000 t and 30,000 t annual inlet capacities.

Results revealed that both technologies offer a techno-economically viable solution for biodiesel production from low quality feedstocks such as used cooking oil. The two-step process requires milder operating conditions, lower investment and overall production costs per unit of biodiesel produced, however, it has higher process energy requirements. Total capital investments for a 15,000 t capacity plant which applies the single- or the two-step process were estimated as 6.1 million EUR or 5.8 million EUR, respectively, whereas the production cost of biodiesel are estimated as 0.824 EUR/kg and 0.786 EUR/kg for the single- and two-step processes, respectively (at used cooking oil price of 0.500 EUR/kg). Higher plant capacities have lower production and capital costs per unit of biodiesel output. Supercritical transesterification should lead to a clean, flexible and modular method to process used cooking oil for the production of a more valuable product.



The detailed results of sensitivity analyses are only showed for the 15,000 t inlet capacity plants applying the single-step or two-step production process. The main conclusions are, however, also valid for plants with higher production capacities. The default prices of oil feedstock, energy and glycerol are given, whereas the default value for the investment in fixed capital is available. In sensitivity analyses the prices are varied from -50% to +60% around the default values which should cover the expected uncertainties associated with capital cost assessment and historic and regional variations in prices oil feedstock, glycerol and energy.