Exergy Analysis of Traditional Biodiesel Production Process from Palm Oil

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Abstract
In the present paper, the Exergy Analysis methodology was applied to a biodiesel production process from palm oil, with the aim to identify the location and magnitude of the irreversibilities, and the exergetic efficiency in each one of the equipments. The methodology used in this paper was proposed by Dincer and Rosen. In order to get the mass and energy flows, a continuous process of homogeneous alkaline transesterification was designed and simulated using the software Aspen Hysys 6.5 (industrial process simulator). The plant capacity was set in 80.000 tons/year of biodiesel, that is an average size fort plants for biodiesel production is Colombia. The process was divided in three stages; the pretreatment of the crude palm oil (esterification of fatty acid), triglycerides transesterification reaction with methanol and NaOH as catalyst, and finally the separation system, which correspond to methanol recovery, and the washing and purification of biodiesel and glycerol. For the exergy analysis, the Reference Stable Environment (RSE) was defined at 25 °C and 1 atm, and each process equipment was taken as volume control system. Also a steady state operation was considered. The results obtained sows that the irreversibilities of the biodiesel production process are 74623 MJ/h where 45% is the heat transfer to environment (waste heat), and around 90% of this irreversibility is present in the separation system, specifically the glycerol separation was the main exergy sink because it operates at vacuum pressure. The exergetic efficiency of plant was 78% and this was calculated as the ratio of usefully exergy (biodiesel and glycerol) and the total exergy in the process.
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