A process model to estimate biodiesel production costs.

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Abstract

â€˜Biodieselâ€™ is the name given to a renewable diesel fuel that is produced from fats and oils. It consists of the simple alkyl esters of fatty acids, most typically the methyl esters. We have developed a computer model to estimate the capital and operating costs of a moderately-sized industrial biodiesel production facility. The major process operations in the plant were continuous-process vegetable oil transesterification, and ester and glycerol recovery. The model was designed using contemporary process simulation software, and current reagent, equipment and supply costs, following current production practices. Crude, degummed soybean oil was specified as the feedstock. Annual production capacity of the plant was set at 37,854,118Â l (10Â Ã—Â 10^6Â gal). Facility construction costs were calculated to be US$11.3 million. The largest contributors to the equipment cost, accounting for nearly one third of expenditures, were storage tanks to contain a 25Â day capacity of feedstock and product. At a value of US$0.52/kg ($0.236/lb) for feedstock soybean oil, a biodiesel production cost of US$0.53/l ($2.00/gal) was predicted. The single greatest contributor to this value was

US$0.53/l ($2.00/gal) was predicted. The single greatest contributor to this value was the cost of the oil feedstock, which accounted for 88% of total estimated production costs. An analysis of the dependence of production costs on the cost of the feedstock indicated a direct linear relationship between the two, with a change of US$0.020/l ($0.075/gal) in product cost per US$0.022/kg ($0.01/lb) change in oil cost. Process economics included the recovery of coproduct glycerol generated during biodiesel production, and its sale into the commercial glycerol market as an 80% w/w aqueous solution, which reduced production costs by â‰^6%. The production cost of biodiesel was found to vary inversely and linearly with variations in the market value of glycerol, increasing by US$0.0022/l ($0.0085/gal) for every US$0.022/kg ($0.01/lb) reduction in glycerol value. The model is flexible in that it can be modified to calculate the effects on capital and production costs of changes in feedstock cost, changes in the type of feedstock employed, changes in the value of the glycerol coproduct, and changes in process chemistry and technology.

Keywords

Biodiesel; Cost estimate; Economic analysis; Soybean oil

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