Title

Economic evaluation and design of the production process of biodiesel out of Macauba oil

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Assignment Description

In the society of today the environment is very important. This is because of the global warming that occurs nowadays. Therefore, solutions need to be find. One of those possible solutions is discussed in this project.

The goal of this project was to design a process whereby, oil is converted into biodiesel. This process includes the Glycerolysis reaction and the Transesterification reaction. Thereby the used oil is from a palm that grows in different countries of south america but specially in Brazil. This palm is the Macauba palm that has oil containing nuts on the leaves and has a capacity of oil of 72.774 kg/h. Thereby, the goal was to find the optimal parameters of the used reactions in this process and make economic analyses of these different settings to obtain the most profitable process conditions

This project is performed by a chemical engineering student and thereby the client was Universidade federal de Vicosa

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Method

Steps:
- Design (shown below in process diagram)
- Different simulations
- Economic analyses by Aspen
- Processing data of economic analyses
- Economic analyses by Peters, Timmerhaus & West Methology
- Processing results

For the different simulations, seven parameters were used. To find the optimal settings, an increasing and decreasing was applied on the standard settings. For each parameter this is shown in the table.

Parameter	Decreasing	Increasing
Feed oil	-10%	+10%
T Glycelorysis	-10%	+10%
T transesterification	-10%	-10%
t Glycerolysis	-20%	+20%
t Transesterification	-20%	+20%
Biodiesel price	-25%	+10%
Oil price	-25%	+25%

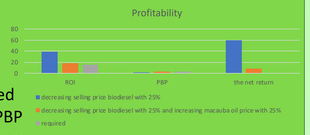
Results

The final results obtained by the economic analyses were the ROI, PBP and the net return. The ROI is the return on investment in %/year, the PBP is the payback period in years and the net return in 10^6 $. The obtain results are divided in three different graphs, one for the optimal temperatures, one for the optimal reaction times and one with an increasing of the oil price and decreasing of the biodiesel price. All these simulations were executed on the most profitable feed of oil which was 70.000 kg/h.

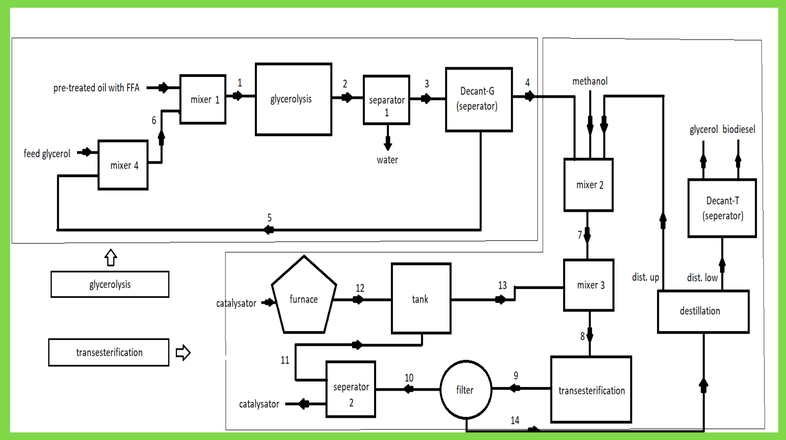
The profitability graph of the temperatures shows the profitability of three different temperature combinations compared with the required results. Which are a ROI of 15 %/year a PBP under 3,6 years and A net return above zero.

The profitability graph of the reaction times shows the profitability of three different reaction time combinations compared with the required results. Which are a ROI of 15 %/year a PBP under 3,6 years and a net return above zero.

The profitability graph of the biodiesel and oil price shows the profitability of two different price combinations compared with the required results. Which are a ROI of 15 %/year a PBP under 3,6 years and a net return above zero.



Process Diagram



Conclusion

First simulations:

Parameter	Optimal setting
Feed oil	70.000 kg/h
T Glycerolysis	207 °C
T Transesterification	58,5 °C
t Glycerolysis	4 hours
t Tranesterification	2,4 hours

Second Simulations:

Parameter	Optimal conditions
Feed oil	70.000 kg/h
Temperatures	207 °C and 58,5 °C
Reaction times	4 hours and 2,4 hours

End conclusion:

After the second simulations the ROI was 106,5 %/year, the PBP was 0,7 year and the net return was 194,66*10^6 $. After an increasing of the oil price and decreasing of the biodiesel price the ROI was 18,2 %/year, the PBP was 3,2 years and a net return of 7,95*10^6 $.

When compared with required outcome it shows to be still profitable when the oil price was raised and the biodiesel price was decreased. Which means that this process is profitable and can have negative price changes.

However, the pre-treatment is not included in the process and thereby, there was not much information about the pre-treatment price which made it neccessary to do an asumption on the oil price. When this would be included, it could change the profitability.

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