Biodiesel Production From Neem Oil Using KOH Supported With Activated Carbon

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Abstract

Fossil fuel reduction and environmental degradation are the two crises that the world threatened by generally and UAE specifically. Biodiesel is a fuel produced through chemical reaction of animal fat or vegetable oil with alcohol, and is a potential alternative of diesel engines. However, this reaction needs a catalyst to success. In this project, potassium hydroxide catalyst supported with activated carbon (KOH/AC) will be applied for transesterificaion of neem oil. The Response Surface Methodology (RSM) software was used to determine the optimum conditions of reaction time, amount of catalyst and methanol to oil ratio in order to obtain the highest yield of biodiesel. The optimum conditions obtained were 60 min of reaction time, 6:1 methanol to oil ratio and 1wt% of catalyst, which lead to the highest yield of biodiesel (100% w/w). Furthermore, the main properties of the biodiesel were measured and they met the ASTM standards. Moreover, the biodiesel was tested in the engine in order to get the brake power. The maximum brake power of the biodiesel obtained from the engine testing was 993.5 W. This study will include both simulation and experimental work by applying KOH/AC as an effective catalyst for transesterification of local neem oil.

Objectives

•Enhance the biodiesel yield
•limiting the disadvantages of biodiesel production
•There is need to produce biodiesel based on the available biomass locally.

Methodology

1 - Preparing the solution of KOH dissolved in deionised water.
2- Titration.
3- Preparing the catalyst (KOH/AC).
4- Preparing the amount of methanol and oil .
5- Add the catalyst into methanol and oil in one beaker.
6 - Heat up the mixture at 55^0C with 200 rpm and keep the stirring for the required time.
7- Keeping the mixture 24 h in the separation funnel.
8- Separate the biodiesel from the crude glycerol.

Figure 1: Heating up and stirring the mixture

Figure 2: Mixture before Separation

Figure 3: Mixture After 24 h

Conclusion

•The highest yield was achieved (100% w/w) by using 0.5 wt% of the catalyst, 60 minutes reaction time and 6:1 methanol to oil ratio.
• All properties of our biodiesel fell within the ASTM standards for biodiesel fuel.
• The maximum brake power we obtained was 993 W at 3720 rpm.

Reference

[1] Capareda, S. C. (2014). Introduction to biomass energy conversions. Boca Raton: CRC Press.

[2] Khola, G., & Ghazala, B. (2012). Biodiesel production from algae. Pak. J. Bot, 44(1), 379-381.

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Introduction

The world energy consumption has been rising over the years. In 2017, the UAE energy plan was announced, with a 50% target for power generation from clean energy by 2050. In addition, petroleum is constantly decreasing and will run out in the near future. Although it is a useful resource but it caused emissions to the environment and effected global warming so badly. The best renewable alternative for petroleum, which is biodiesel. Biodiesel is a fuel produced through chemical reaction from animal fat or vegetable oil with alcohol. The best feature about this fuel is that, it's friendly to the environment and doesn't cause emissions.

Result and Discussion

Number of experiment	Amount of oil (mL)	Amount of Activated Carbon (g)	Amount of methanol (mL)	Amount of KOH solution (mL)	Reaction time (min)	Biodiesel yield (%)
1	100	0.35	22	5.25	45	74
2	100	0.35	29	5.25	45	84
3	100	0.52	29	7.8	30	64.8
4	100	0.52	14.6	7.8	30	60
5	100	0.17	22	2.6	45	85
6	**100**	**0.17**	**29**	**2.6**	**60**	**100**
7	100	0.17	29	2.6	30	94.5
8	100	0.17	14.6	2.6	30	88.7
9	100	0.52	29	7.8	60	70
10	100	0.52	22	7.8	45	63.5
11	100	0.35	22	5.25	45	74
12	100	0.35	22	5.25	45	74
13	100	0.35	22	5.25	45	74
14	100	0.35	22	5.25	45	74
15	100	0.17	14.6	2.6	60	84.5
16	100	0.52	14.6	7.8	60	59
17	100	0.35	22	5.25	45	74
18	100	0.35	14.6	5.25	45	84.5
19	100	0.35	22	5.25	30	85.5
20	100	0.35	22	5.25	60	82.5

Table 1: RSM data for the small scale of biodiesel production

This table shows the RSM results. It can be seen that the maximum yield of biodiesel is 100%.

Property	ASTM Standard	Experimental
Viscosity (cSt)	5.213	4.8
Density (kg/m^3)	868	888
HHV (MJ/kg)	39.81	36.15

Table 2: Properties of biodiesel

The main properties of the optimum biodiesel sample were measured experimentally and then compared with the standard ones.

Figure 4: Maximum biodiesel yield

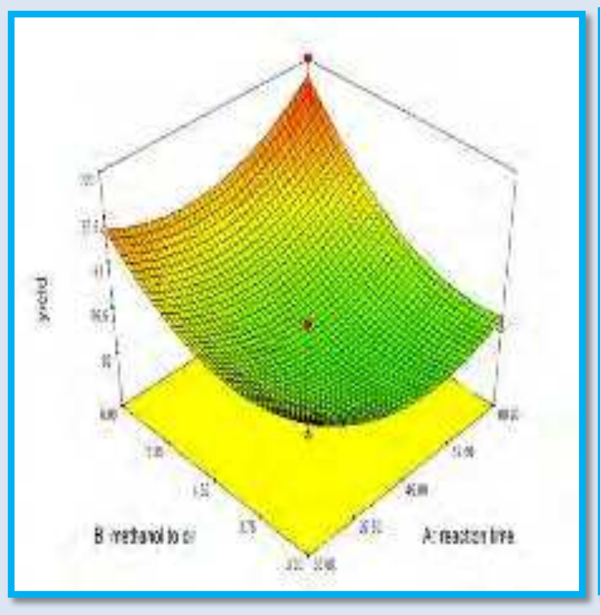

Figure 5: yield vs reaction time and methanol to oil ratio at 0.5wt% of catalyst

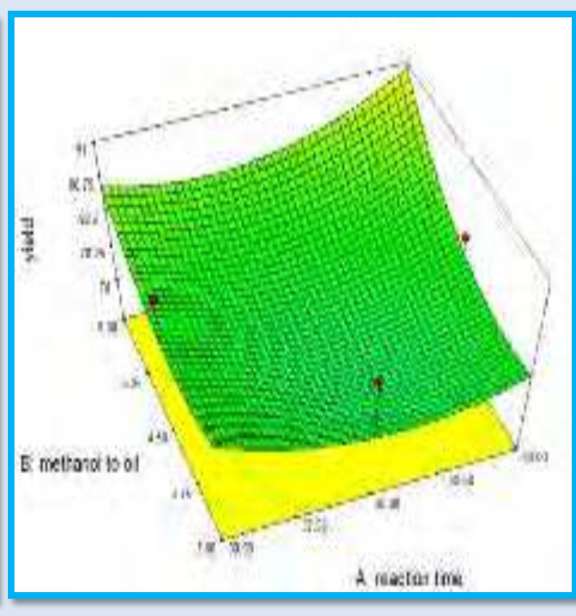

Figure 6: yield vs reaction time and methanol to oil ratio at 1wt% of catalyst

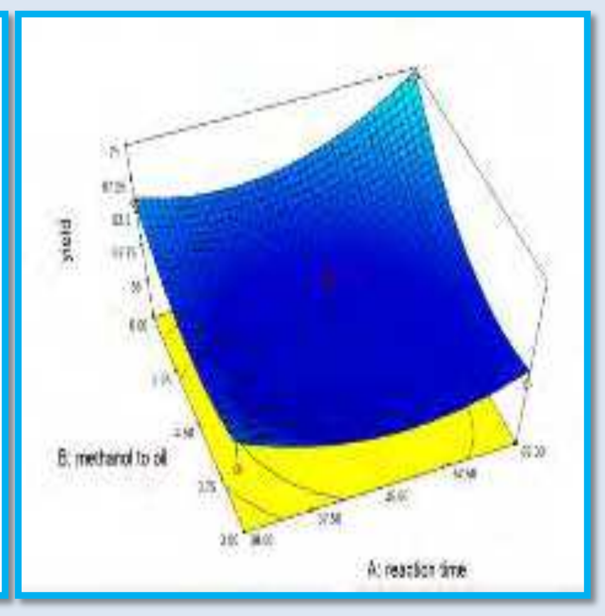

Figure 7: yield vs reaction time and methanol to oil ratio at 1.5wt% of catalyst

Figure 5 , 6 and 7 shows the relationship between the yield , reaction time , methanol to oil ratio with different amount of catalyst. It can be seen that at the intersect point of 6:1 methanol to oil ratio and 60 minutes reaction time, using 0.5wt% of catalyst gave a higher yield of biodiesel compared to 1% and 1.5wt% of catalyst.

In Figure 8 , it shows that as the engine speed increases the brake power increases (maximum power was 993W at 3720 RPM)

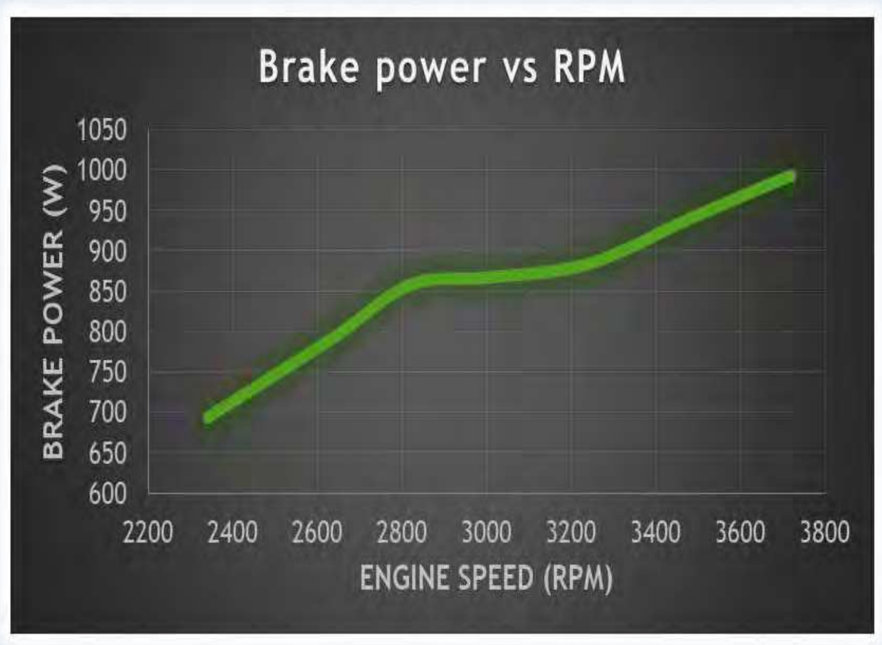

Figure 8: The relationship between BP and RPM