Biodiesel Acid Water Washing

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Abstract

Water washing is a technique that is used to separate the dispersed contaminants (such as, potassium salt, glycerin, and methanol) in biodiesel. During the process water is sprayed onto the biodiesel, polarity of water separates contaminants from biodiesel. The contaminants are denser than the biodiesel so after separation, the contaminants sink leaving a purified biodiesel. Some biodiesel can be lost during this process. The goal of this project is to add an acidic solution to the wash water before it is sprayed on the biodiesel. The acidic wash water should enable the water washing to preserve and reduce the amount of biodiesel lost in the process of water washing. The wastewater will be drained from the processor. The biodiesel production should then be increased.

Question and Purpose

The purpose of this project is to increase the efficiency of biodiesel water washing with the addition of acid. The goal is to have a high volume of biodiesel after the acid water washing. After the acid water washing, the biodiesel should have a low soap content and a low acid number. The goal of the experiment is to determine which acid solution creates the most efficient results. In the experiment, acid type, acid water volume, acid concentration, and steady state time would be tested.

Method/Procedure One

1. Nineteen cylinders were set up with 75mL of biodiesel in each
2. Acid water, acid types, and concentration were then added to the cylinders with biodiesel.
3. Between the times 30min-90min, the cylinders were left to sit.
4. The yields of biodiesel production, soap content, and acid number were then measured.

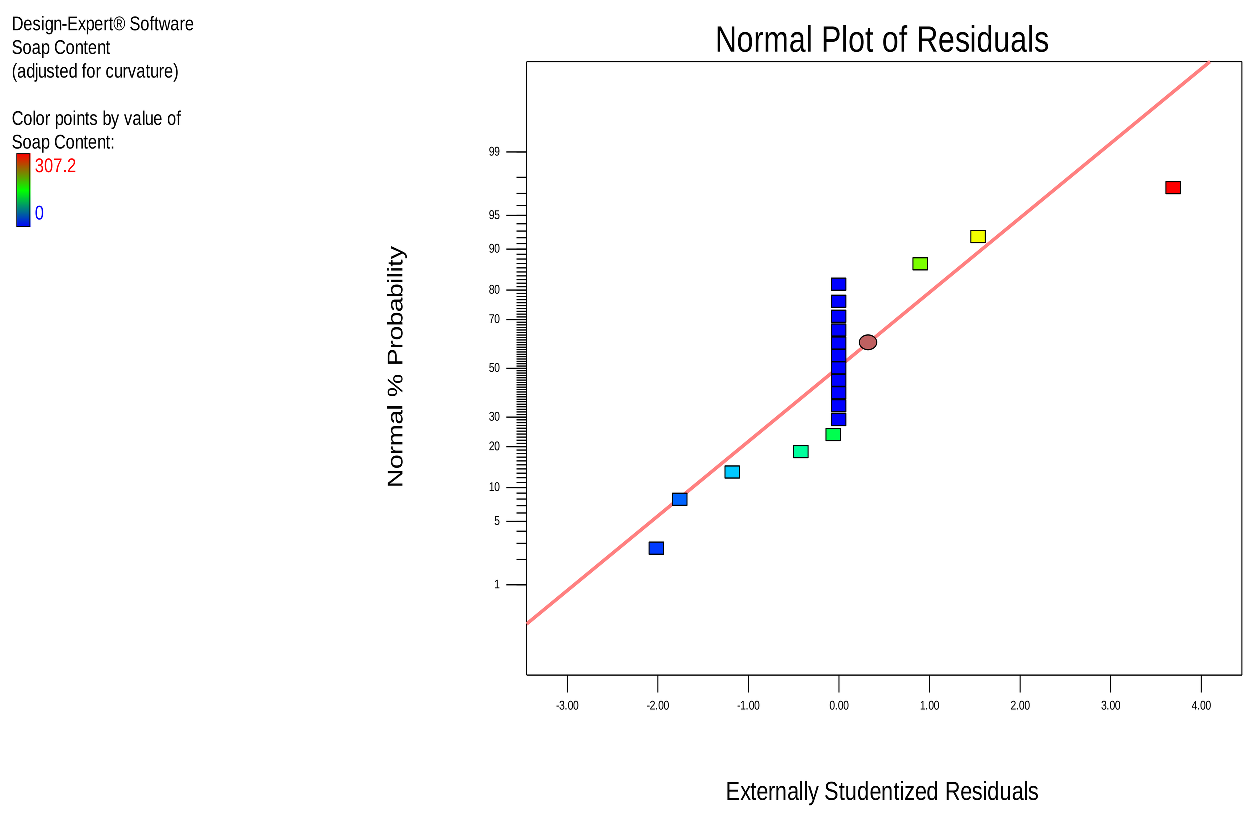
Method/Procedure Two

1. Eleven cylinders were set up with 75mL of biodiesel in each
2. Acid water, acid types, and concentration were then added to the cylinders with biodiesel.
3. Between the times 30min-90min, the cylinders were left to sit.
4. The yields of biodiesel production, soap content, and acid number were then measured.

Data Tables/Graphs/Observations

	Variables				*Measurements*		
Runs	Acid Type	Acid Concentration (%)	Volume of Acidic Water (%)	Steady State Time (min)	Biodiesel Volume (mL)	Soap Content (ppm)	Acid Number
#1	Phosphoric (1)	0	10	90	78	307.2	0.640
#2	Nitric (0)	2.5	15	60	76	0	1.80
#3	Nitric (0)	2.5	15	60	77	0	1.138
#4	Phosphoric (1)	0	20	30	75.5	129.92	0.625
#5	Phosphoric (1)	0	20	30	80	0	1.451
#6	Phosphoric (1)	0	20	90	72	30.08	0.703
#7	Nitric (-1)	5	20	30	76.5	0	1.945
#8	Nitric (-1)	0	10	30	79	190.72	0.601
#9	Nitric (-1)	0	20	30	74	106.88	0.624
#10	Phosphoric (1)	5	20	30	76.5	0	1.80
#11	Nitric (-1)	5	10	90	77	0	1.686
#12	Nitric (-1)	5	10	30	78	0	1.910
#13	Nitric (-1)	0	20	90	72	17.92	.637
#14	Nitric (0)	2.5	10	60	76	0	1.165
#15	Phosphoric (1)	5	20	90	73	0	1.253
#16	Nitric (-1)	5	20	90	76	0	1.661
#17	Phosphoric (1)	5	20	90	76	0	1.256
#18	Nitric (-1)	0	10	30	79	226.56	0.604
#19	Phosphoric (1)	0	10	30	73.5	60.8	0.634

	Variables			*Measurements*		
Runs	Acid Type	Acid Concentration (%)	Volume of Acidic Water (mL)	Biodiesel Volume (mL)	Soap Content (ppm)	Acid Number
#1	Nitric (-1)	1	5	75.5 mL	0	0.956
#2	Phosphoric (1)	1	5	76	1145.6	0.956
#3	Phosphoric (1)	0.25	10	73	147.84	0.797
#4	Phosphoric (1)	0.25	5	76	526.08	0.895
#5	Nitric (0)	0.5	7.5	76	37.76	-
#6	Phosphoric (1)	1	10	75	0	0.948
#7	Nitric (-1)	1	10	74	0	1.045
#8	Nitric (-1)	0.25	10	74	78.72	0.692
#9	Nitric (0)	0.5	7.5	75.5	83.84	0.847
#10	Nitric (0)	0.5	7.5	76	78.08	0.880
#11	Nitric (-1)	0.25	5	77	60.16	0.807



Results

The tests showed that acid type had no significant effect on biodiesel volume, soap content, or the acid number. The tests also showed that lower volumes of acid water solutions produced more biodiesel, lower acid concentrations reduced the acid number of the final solution, and the addition of acid reduced soap content in the biodiesel. The run that best adhered to our constraints was the eleventh run in the second experiment of our solution testing. The eleventh run consisted of Nitric acid and a low acid concentration of 0.25% with 5mL of acidic water. The result was a 77mL of biodiesel, 60.16PPm and an acid number that is 0.807. In both experiments, the Normal Plot of Residuals have p-values significantly below 0.05.

Discussion

The addition of any type or amount of acid in the acid water solution stripped the biodiesel of all soap resulting in 0 PPM. The second round of experiments did not have any run with 0% acid solution because the addition of acid efficiently removes soap from the biodiesel. However, the results did not explicitly show which acid type was more efficient. The final product can only contain one acid type so further testing can conclude which acid type works best. Almost all volumes of acid water that contained 2.5% or 5% of either acid type produced biodiesel that was within the goal. All runs resulted in an acid number that was higher than the goal of 0.5. Lower concentrations of acid were tested in the second experiment for a clearer result in biodiesel production. Higher volumes of acid water solutions produce less biodiesel, but this also includes the runs that have 0% acid. Based on the experiment, the run that adhered to our constraints was the eleventh run. The eleventh run consisted of a Nitric acid and a low amount of acid of .25% with 5mL of acidic water. The result was a 77mL of biodiesel, 60.16PPm and an acid number that is .807. The results of the biodiesel volume and soap content met our requirement specifications. However, the acid number did not meet this requirement and was 0.307 higher than wanted.

References

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