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Biodiesel Production from High Free Fatty Acid Mixed Crude Palm Oil in a 150 Litre Batch System

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Background

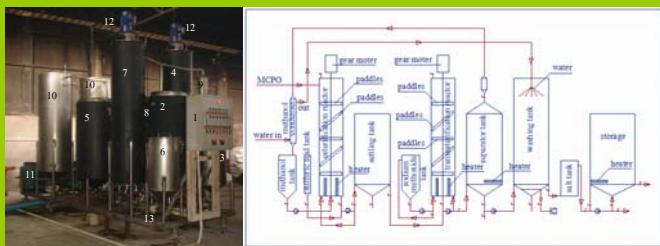
Mixed crude palm oil (MCPO) is normally produced from small scale industry or small community and contains high free fatty acid of 8-20 wt% depending on the quality of palm fruit.

It is usually used in the animal feed industry.

To be used as the raw material to produce biodiesel, the two stage (ester-transesterification) process is necessary.

A 150 litre batchwise ester-transesterification system is designed and fabricated and tested.

150 litre ester-transesterification system



control box (1), raw material tank(2), methanol tank (3), first stage (esterification) reactor(4), first stage product setting tank (5), sodium hydroxide+methanol mixing tank(6), second stage (transesterification) reactor(7), separator tank(8), methanol recovering condenser(9), washing tanks(10), biodiesel storage tank(11), gear motors(12), magnetic pump(13), pump(14), solid salt tanks(15)

Acid esterification

Variation of methanol at 13, 14 and 15 v/v% and the variation of sulfuric acid at 1.2, 1.25, 1.3 and 1.4 v/v% were used.

Reaction temperature was controlled at 60 °C.

Samples were taken every 5 minutes for checking with TLC.

Speed of reactor was controlled at 150 rpm.

Acid and water formed in the reaction were drained out after 2.5 hours of setting.

Alkaline Transesterifications

20 v/v% of methanol was used for all tests.

Results

Acid esterification
conditions:

Methanol 13 %v/v

H₂SO₄ 1.25 %v/v

Methanol 14 %v/v

H₂SO₄ 1.25 %v/v

Methanol 15 %v/v

H₂SO₄ 1.2 %v/v

Methanol 15 %v/v

H₂SO₄ 1.25 %v/v

Methanol 15 %v/v

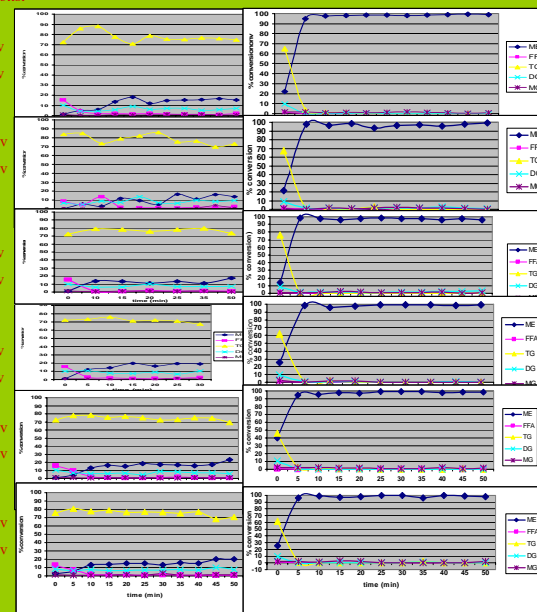
H₂SO₄ 1.3 %v/v

Methanol 15 %v/v

H₂SO₄ 1.4 %v/v

Alkaline transesterification

conditions: Methanol 20% v/v



Conclusions

A 150 litre batch-wise biodiesel production system using high free fatty acid mixed crude palm oil as raw material was designed and fabricated.

Free fatty acid of oil can be reduced to 1 wt% within 25-30 minutes by using 13 %v/v of methanol to oil and 1.25 %v/v of sulfuric acid to oil in the acid esterification process.

Transesterification process with 20 %v/v of methanol to oil was used to produce methyl ester from the first stage product with the conversion of >98 %.

All methyl ester properties meet the biodiesel standard of Thailand.