Study of Operating Conditions for Biodiesel Production from Sludge Palm Oil using Chemical Reactor

Adeeb Hayyan[a], Md. Zahangir Alam[a], Mohamed E. S. Mirghani[a], Nassereldeen A. Kabbashi[a], Noor Irma Nazashida Mohd Hakimi[b], Yosri Mohd Siran[b] and Shawaluddin Tahiruddin[b]

[a]Bioenvironmental Engineering Research Unit (BERU), Department of Biotechnology Engineering, Faculty of Engineering, International Islamic University Malaysia, P.O. BOX 10, Kuala Lumpur, 50728, Malaysia
[b]Processing & Engineering, R&D Center - Downstream, Sime Darby Research Sdn Bhd., Lot 2664 Jalan Pulau Carey, 42960 Pulau Carey, Kuala Langat, Selangor, Malaysia
Email: zahangir@iium.edu.my , Tel: 03-61964571, Fax: 603-61964442

INTRODUCTION

Biodiesel is receiving an increased attention because of increases in crude oil prices, limited resources of fossil oil and environmental concerns. There has been renewed focus on using vegetable oils and animal fats to make biodiesel fuels. The main challenges in biodiesel industry are its production cost and limited availability of fats and oils resources. There are two aspects of the production cost of biodiesel, the costs of raw material and the cost of processing. The cost of raw materials accounts for 60 to 70% of the total cost of biodiesel production. However, there are large amounts of low grade oils from palm oil industry that could be converted to biodiesel such as sludge palm oil (SPO). SPO is a by-product of the palm oil milling process that contains high free fatty acids (FFA). The use of SPO can lower the cost of biodiesel production significantly. The problem in processing SPO to biodiesel is the high free fatty acid content in the oil restricts the conversion to biodiesel when using conventional transesterification process. This invention develops a process to treat the SPO and produce biodiesel within the standard specifications of biodiesel fuel.

Sludge Palm Oil

Reactor with Controller

Crude Biodiesel

Crude Glycerol

Pure Biodiesel

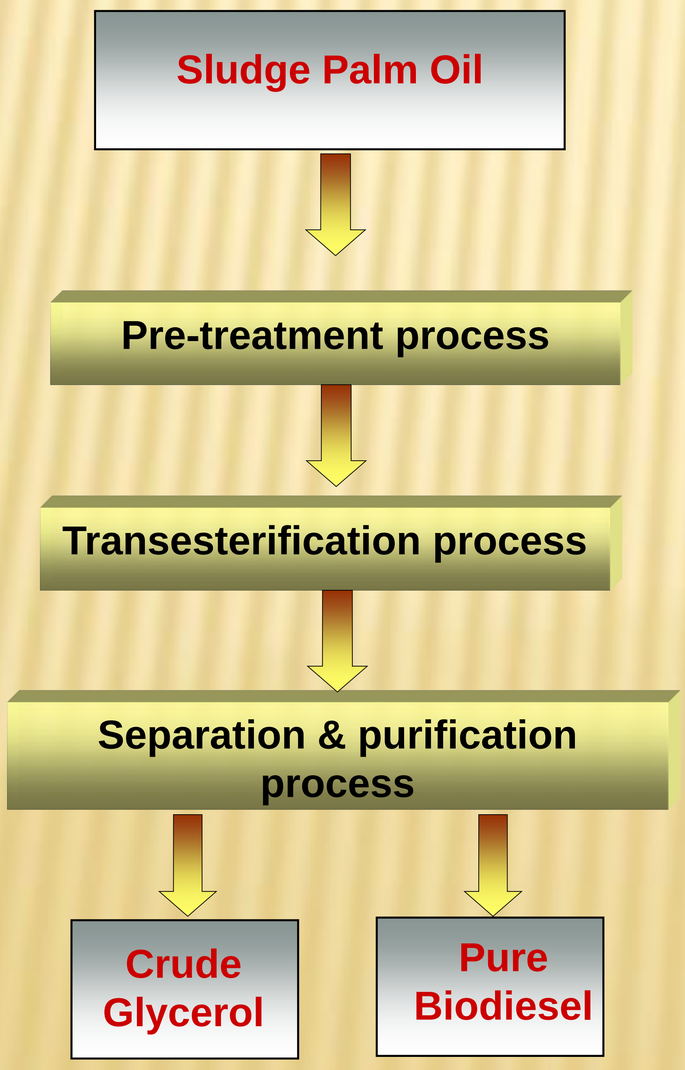
OBJECTIVE

- To investigate the potential of SPO as low cost feedstock in biodiesel production.
- To study the operating conditions for biodiesel production using chemical reactor.

NOVELTY

- ✓ Investigate new raw material for biodiesel production by using an economic process to process the SPO and to obtain high yield of biodiesel with high ester content.
- ✓ The results of preliminary investigation can lead to a novel potential process in the biodiesel manufacturing.

METHOD



RESULTS

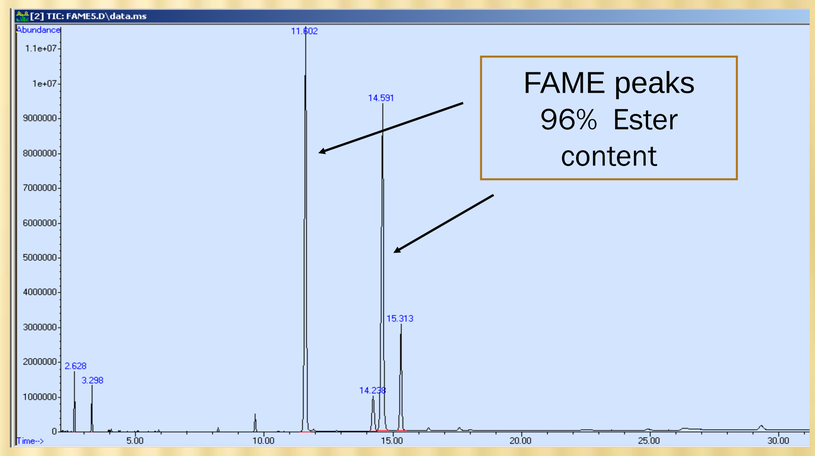


Figure 1: Fatty Acid Methyl Ester Composition using GC/MS.

➢**The study showed that the high FFA of SPO reduced from 50% FFA to less than 2% FFA by esterfication process and the yield of biodiesel after transesterification process was 80% with 0.25% FFA.**

TABLE 1: SPECIFICATIONS OF BIODIESEL FROM SPO ACCORDING TO EN 14214

Properties	Test Method	Units	Limits	Biodiesel from SPO
Ester content	EN 14103	% (mol mol^{-1})	96.5 min	96
Monoglycerides content	EN 14105	% (mol mol^{-1})	0.8 max	0.48
Diglycerides content	EN 14105	% (mol mol^{-1})	0.2 max	0.03
Triglycerides content	EN 14105	% (mol mol^{-1})	0.2 max	0.01
Free glycerol content	EN 14105	% (mol mol^{-1})	0.02 % max	<0.01
Total glycerol content	EN 14105	% (mol mol^{-1})	0.25 % max	0.16
Density (15 ˚C)	EN ISO 3675	kgm^{-3}	860 – 900	0.8779
Iodine value	EN 14111	g I2·100 g^{-1} max	120 max	52.7
Acid value	EN 14104	mg KOH g^{-1}	0.5 max	0.07
Flash point	EN ISO 3679	˚C	120 min	183.6
Saponification value	ISO 3657	mg KOH g^{-1}	312.5 max	192

APPLICATION & MARKETABILITY

- **Crude Biodiesel** is used as fuel in boiler, stationary engine.
- **Pure Biodiesel** is used as fuel in any vehicle diesel engine.
- **Pure Biodiesel** can be further refined to produce specific fatty acid esters (oleochemicals) .
- **Glycerol** is used in medical, pharmaceutical and cosmetics industries, chemical synthesis, soap industries, hydrogen generation.