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Analysis of Waste Cooking Oil as Raw Material for Biofuel Production

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Abstract: The increase of virgin vegetable oil price has contributed the problems to the biofuel manufacturing industry. An option with great potential is used cooking oil recycling, which includes a variety of processes like pyrolysis and catalytic cracking, designed to transform waste cooking oil into hydrocarbon products for use in the preparation for refined chemicals or fuels. This research aims to determine some properties of used cooking for the production of biofuel. Preliminary analysis of used cooking oil properties via GCMS using capillary column shows n-Hexadecanoic acid and Oleic acid as the major compounds present in the used frying oil. The analysis for determination of volatile and moisture content with 3 replicates show an average of 0.02% moisture and volatile content, which the experimental procedure was based on MPOB Test Methods.

Key words: Used cooking oil · Pyrolysis · Catalytic

INTRODUCTION

Biofuel which is accepted as an attractive option fuel is prepared by various process namely transesterification, pyrolysis, fermentation and supercritical fluid extraction. However, the land use for production of edible oil for biodiesel feedstock competes with the use of land for food production. Furthermore, the price of edible plant and vegetable oils is usually higher than petrodiesel. The exploit of used cooking oil as biofuel feedstock reduces the cost of biofuel production since the feedstock costs constitutes approximately 70-95% of the overall cost of biofuel production. Hence, the use of waste cooking oils and non-edible oils should be given higher priority over the edible oils as biofuel feedstock.

EXPERIMENTAL

Raw Material: Used cooking oil was obtained from Faculty of Hotel and Catering, Universiti Teknologi MARA. The sample was first heated in the oven at 100-110°C for 10 minutes to remove the moisture. Meanwhile, other sample was heated in the furnace at temperature 550 °C for 4 hours to determine the ash content.

Analysis of Heavy Metal: The sample was analyzed using Atomic Absorption Spectrometer (Perkin Elmer) to determine the heavy metal content using Cadmium, Chromium, Nickel and Plumbum lamp. The level of detection is ppm range. The standard were prepared at 1ppm, 2ppm, 3ppm, 4ppm and 5ppm. The samples were prepared according to MPOB Test Method.[2]

Calorific Value: The samples was placed in the autosampler and analyzed by Bomb Calorimeter (IKA_Werke; Adibatic Mode for 25 minutes).

Analytical Method: The GCMS used to determine the compounds in a sample. Qualitative results of used cooking oil were obtained from Gas Chromatography-Mass Spectroscopy. Gas Chromatography-Mass Spectroscopy (GC-MS) serves to separate mixtures into specific components using Agilent HP5MS column (30.0m×250μm×0.25μm).

RESULTS AND DISCUSSION

Proximate Analysis

%Fixed carbon: 100-(%ash+%moisture+%volatile matter)

%volatile matter and moisture: 0.078 (MPOB p2.1)[2]

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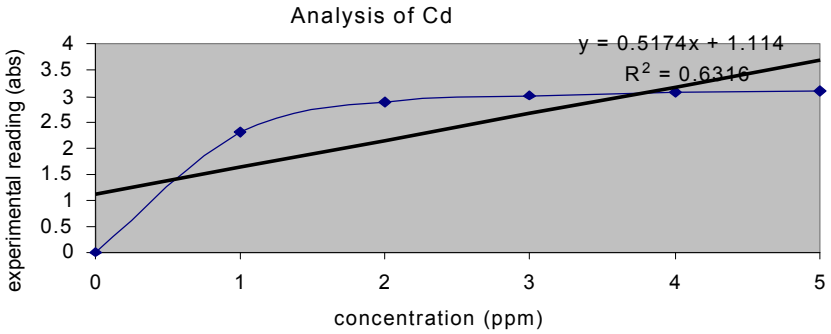


Fig. 1: Result of Cadmium analysis

%ash content: 0.003 (MPOB p3.5)[2]
%fixed carbon: 99.919

Low moisture and volatile content indicates the used cooking oil doesn't need pretreatment to remove the moisture prior processing and high fixed carbon indicates it rich with carbon content.

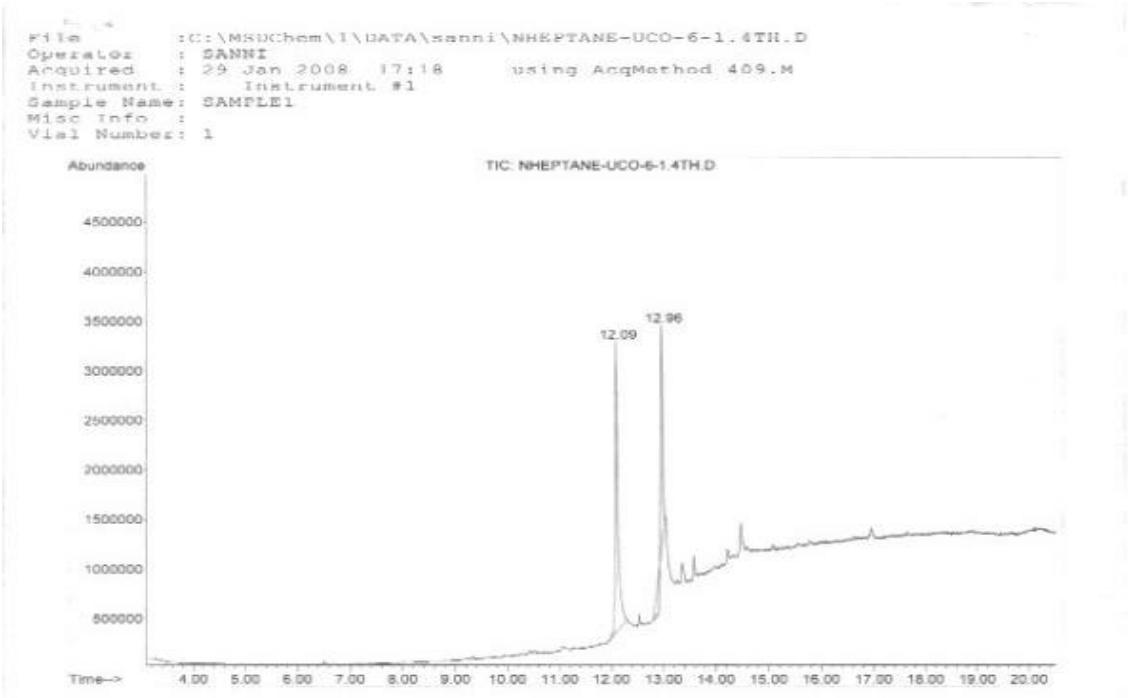
Calorific Value (CV): Calorific value for used cooking oil: 38.314MJ/kg. CV of UCO higher than MSW (~14 MJ/kg), biomass (~17MJ/kg), EFB/FFB (~23MJ/kg)[1]

AAS Analysis: Standard concentration: 1-5 ppm
Cr: absence
Ni: absence
Pb: absence
Cd: present (0.041ppm)

Further analysis need to be done to detect Cu, Ca, Hg, As and trace metals at ppb level using ICP.

From the Least-square fit procedure, the calibration graph was plotted. It was found that R2 is quite close to 1, indicating good correlation coefficient between the data point.

GCMS Analysis:



Library Search Report

Data Path : C:\MSDChem\1\DATA\sanni\
Data File : NHEPTANE-DCO-6-1.4TH.D
Acq On : 29 Jan 2008 17:18
Operator : SANNI
Sample : SAMPLE1
Misc :
ALS Vial : 1 Sample Multiplier: 1

Search Libraries: C:\Database\PCB\NIST02.L Minimum Quality: 0

Unknown Spectrum: Apex
Integration Events: ChemStation Integrator - autoint1.e

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			n-Hexadecanoic acid	92227	000057-10-3	94
			n-Hexadecanoic acid	92226	000057-10-3	93
2	12.96	27.95	C:\Database\PCB\NIST02.L			
			Oleic Acid	107517	000112-80-1	99
			Oleic Acid	107518	000112-80-1	93
			Octadec-9-enoic acid	107520	1000190-13-7	90

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CONCLUSION

Besides biomass, used cooking oil is a very potential feedstock for production of bio-oil via pyrolysis regardless on cost perspective. It has high calorific value, low heavy metal content and low moisture. With long chain of palmitic acid and oleic acid, it has the potential to be cracked by thermal cracking or catalytic cracking for possible formation of hydrocarbon chain.

REFERENCES

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