USED FRYING OIL: RECOVERY and APPLICATIONS

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Vegetable oils including palm oil exhibit poor quality in terms of stability and high free fatty acids (FFA) content after exhaustive frying process. During frying, the oil darkens in the presence of phenolic minor components and is no longer good for health when polar compounds reach up to 25%-27%. These used frying oils are usually treated as waste and must be disposed of in an environment acceptable manner. The present technology shows that the used frying oil can be made into valuable raw materials via simple pre-treatment process. The pre-treated used frying oil can be refined or converted into useful derivatives for non-food and oleochemical industries including biofuels and lubricants.

PRODUCTION TECHNOLOGY

The used frying oil is subjected to pre-treatment. The pre-treated used frying oil is light yellow and the yield is 70%-75%. The characteristics of pre-treated used frying oil is tabulated in *Table 1*. The oil loss (25%-30%) during pre-treatment of used frying oil, may be impurities consisting of water, dimeric, polymeric compounds, polar compounds, protein, fat, carbohydrate and other macro particles and complexes.

The pre-treated used frying oil can be converted to its methyl esters. The esters yield is 80%. The compositions of the resulting methyl esters are shown in *Table 2*.

APPLICATIONS

Renewable Green Fuel

Vegetables oils (methyl and ethyl esters) have been use widely in Europe, Brazil, Canada, Austria, South Africa and USA, as fuel in diesel engines. The usage of used frying oil as diesel fuel, as a cheaper alternative was also initiated. This has prompted us to evaluate the fuel properties of the pre-treated used frying oil methyl esters.

TABLE 1. CHARACTERISTICS OF USED FRYING OIL AFTER PRE-TREATMENT*

Characteristics	Pre-treated used frying oil
Free fatty acids (FFA) (%)	4.9
Peroxide value (P.V.) (meq kg^{-1})	1.8
Glyceride components (MG, DG, TG) (%)	73.8
Others (non-glyceride components) (%)	20.0
Induction period (rancimat at 120°C) (hr)	1.45
Fatty acid composition (FAC) (wt% as methyl esters)	
C14:0	0.9
C16:0	39.2
C18:0	5.3
C18:1	46.4
C18:2	8.1

Note: *Only for this particular sample (batch).

TABLE 2. COMPOSITION OF PRE-TREATED USED FRYING OIL METHYL ESTERS*

Composition	Purity (%)
Esters	99.1
Monoglycerides	0.7
Diglycerides	0.2
Triglycerides	0.0
Fatty acid composition (FAC) (wt% as methyl esters)	
C14:0	0.8
C16:0	38.2
C18:0	5.6
C18:1	47.5
C18:2	7.8

The results are shown in *Table 3*.
It can be seen that the properties for methyl esters obtained are comparable to those of commercial petroleum diesel. Hence, it could substitute diesel.

Non-Food Applications

The pre-treated used frying oil has also other non-food applications. It can be refined into useful derivatives for making lubricants, grease, plasticizers, detergents, agricultural chemicals, emulsifiers, soap, candles and other oleochemicals.

TABLE 3. FUEL PROPERTIES OF PRE-TREATED USED FRYING OIL METHYL ESTERS

Properties	Used frying oil methyl esters	Petroleum diesel
Density @ 25°C (kg litre^{-1})	0.8863	0.8310
Viscosity @ 50°C ASTM D445 (cSt)	4.4	4.0
Sulphur content (wt%) IP 242	0.04	0.10
Pour point (°C) ASTM D97	15	15
Flash point (°C) ASTM D93	192	98
Gross heat of combustion (kJ kg^{-1}) ASTM D240	37365	45800

UFO BEFORE PRE-TREATMENT | PRE-TREATED UFO | PRE-TREATED UFO METHYL ESTERS

Note: * patent pending.

Figure 1. Samples of used frying oil (UFO) before and after recovery.*

CONCLUSION

The technology for recovery of used frying oil and subsequent process for the production of its methyl esters are available for commercial exploitation. The pre-treated used frying oil can be refined as intermediates for non-food applications. The methyl esters obtained has comparable fuel properties as the petroleum diesel and can be used for diesel substitute on unmodified diesel engines.

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