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Production and characterization of biodiesel obtained by transesterification catalyzed by the ionic liquid choline hydroxide

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BACKGROUND

➢BIODIESEL

Biodiesel is a mixture of alkyl esters derived from vegetable oils or animal fat, formed by triglycerides that can be converted into biofuels by different forms, being transesterification the most common used method. In the transesterification process, the most used alcohol is methanol and the byproduct of this reaction is glycerol.

➢IONIC LIQUIDS

The use of ionic liquids (ILs) in catalytic processes has been studied mainly in the ecological field, as it allows a high recycling efficiency. Choline cation-based IL (2-hydroxyethyl trimethylammonium) has been studied mainly for its biocompatibility characteristic and potential for various industrial applications, mainly choline hydroxide (ChOH) which shows good catalytic performance due to its basicity in methanol solution as well as its successful reuse.

METHODOLOGY

Choline Hydroxide Synthesis

Choline Chloride + Etanol

Potassium Hydroxide + Ethanol

→ REACTION → Thermal Bath → Vacuum Filtration → Potassium Chloride

Vacuum Filtration → Vacuum Evaporator → Vacuum Oven → Choline Hydroxide

Figure 1a. Choline Hydroxide after vacuum evaporator.

Figures 1b. Choline Hydroxide after vacuum evaporator.

Figure 1c. Choline Hydroxide after vacuum oven.

Biodiesel Synthesis

Choline Hydroxide + Oil + Methanol → REACTION → Thermal Bath → Separation funnel

Separation funnel → ChOH + Glycerol + Methanol exc. → Centrifuge → Drying Oven 110°C → ChOH + Glycerol

Separation funnel → Biodiesel + impurities → Centrifuge → Drying Oven 110°C → Biodiesel

Figure 2. Separation of biodiesel and aqueous phase.

EXPERIMENTAL RESULTS

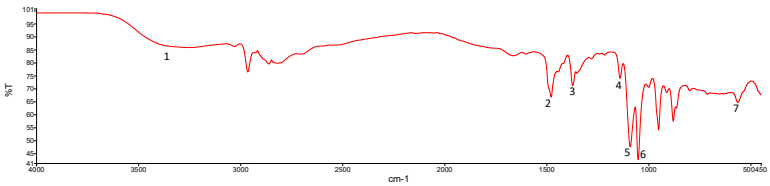

Figure 5. FTIR of synthesized Choline Hydroxide.

Acidity of waste oil: 6,14mg/g | Acidity of old sunflower oil: 5,22mg/g | Acidity of new sunflower oil: 0,41mg/g

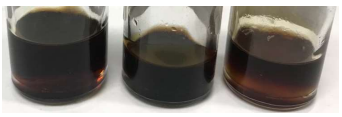

Figure 3. Aqueous phase obtained using as raw material oils with different acidity.

Acidity of waste oil: 6,14mg/g | Acidity of old sunflower oil: 5,22mg/g | Acidity of new sunflower oil: 0,41mg/g

Figure 4. Organic phase obtained using as raw material oils with different acidity.

Table 1. Reaction conditions of Biodiesel.

Temperature	60°C
oil/methanol	1:10
% of catalyst	10%

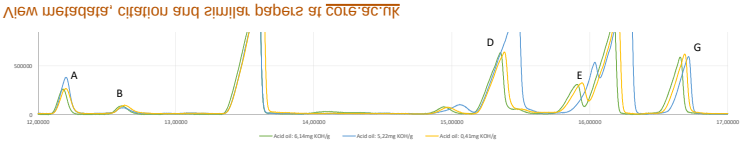

Figure 6. Chromatograms of biodiesel obtained with oils with diferent aciditys.

Table 2. Esters characterization of biodiesel samples from GC-FID analysis.

Reference	Compound Name	Structure	37 FAME MIX	Acid Oil 6,14mg KOH/g	Acid Oil 5,22mg KOH/g	Acid Oil 0,41mg KOH/g
			Time (min)			
A	Palmitic acid methyl ester	C16:0	12,172	12,181	12,181	12,202
B	Palmitoleic acid methyl ester	C16:1	12,514	12,605	12,605	12,629
C	Heptadecanoic acid methyl ester	C17:0	13,413	13,587	13,600	13,630
D	Stearic acid methyl ester	C18:0	14,872	14,945	14,939	14,970
E	Oleic acid methyl ester, Elaidic acid methyl ester	C18:1 (c+t)	15,232	15,365	15,351	15,380
F	Linoleic acid methyl ester, Linolelaidic acid methyl ester	C18:2 (c+t)	15,987	15,905	15,907	15,943
G	Gamma-Linolenic acid methyl ester	C18:3n6	16,521	16,662	16,654	16,687

CONCLUSIONS

ChOH was synthesized and characterized by [illegible] characteristic bands: 1, representing the OH (hydroxyl) group, bands 2 and 3, groups -CH2 and -CH3, bands 4, 5 and 6, amines and band 7, Cl- (chloride). Used as catalyst in the production of biodiesel, the preliminary results using the reaction conditions from Table 1 and a waste cooking oil (acid oil: 0,41 mgKOH/g) sample and two types of sunflower oil (acid oil: 6,41mgKOH/g and 5,22mgKOH/g), exhibited the occurrence of the transesterification reaction with the synthesis of fatty acid methyl esters (FAME), which was confirmed by Gas Chromatography (GC-FID) as can be seen in Table 2.

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