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Biodiesel Made Easy

Tech ID: 33503 / UC Case 2024-792-0

BACKGROUND

Conventional biodiesel production methods from vegetable oils come with significant drawbacks, which include unwanted soap production, low yields and/or difficulty in purification. Currently, homogenous base catalysts have received the most attention for biodiesel production due to their availability and low price. Common base catalysts utilize hydroxide in the form of sodium hydroxide (NaOH) or potassium hydroxide (KOH) for the transesterification of vegetable oils in methanol (MeOH). The role of hydroxyl group (-OH) is to deprotonate the mildly acidic proton of MeOH, forming $[\text{O}^-\text{Me}]$ ions for the transesterification reaction. Both NaOH and KOH show excellent catalytic activity towards biodiesel production but come with the major drawback of producing water. This reduces biodiesel yield and adds complications for purification of the desired biodiesel from the alkali-metal fatty acid carboxylate (i.e. soap) as a side product. Sodium methoxide (NaOMe) and potassium methoxide (KOMe) have also been used in biodiesel production since they are a direct source of $[\text{O}^-\text{Me}]$ ions. However, these reagents result in a more complex separation of biodiesel from the byproduct. Mostly notable, fatty acid methyl esters (also called FAMES) containing double bonds are not suitable for use in diesel engines since the alkenes react with hydroxyl radicals present during combustion. These radicals polymerize diesel fuel during combustion, resulting in premature aging of the engine. Thus, a new approach to the transesterification of vegetable oils is desired.

TECHNOLOGY DESCRIPTION

A team at UC Santa Cruz has developed a method of producing biodiesel that overcomes the limitations of currently known methods of producing biodiesel from vegetable oils. This reaction does not require a hydroxide base, is free of solvents, and does not require extreme chemical conditions.

These new methods may be used to produce biodiesel fatty acid methyl esters from commercial waste oils and/or virgin cooking oils. The method involves reacting **sodium borohydride (NaBH_4)** with **methanol (MeOH)**. NaBH_4 is a source of hydride and reacts with MeOH to produce $[\text{O}^-\text{Me}]$ ions for transesterification of vegetable oils to form FAMES. The reaction of NaBH_4 with MeOH may be performed either in a neat environment or in a solvent, e.g., toluene, and produces sodium tetramethoxyborate $[\text{NaB}(\text{OMe})_4]$. Hydrogen gas is also produced as a byproduct of the reaction and can be used to hydrogenate the fatty acid chains of the newly formed biodiesel. In some embodiments, $\text{NaB}(\text{OMe})_4$ can also be produced using trimethoxyborate $[\text{B}(\text{OMe})_3]$ and NaOMe in methanol to produce the biodiesel

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OTHER INFORMATION

KEYWORDS

biodiesel, fatty acid methyl esters,
sodium borohydride, methanol

CATEGORIZED AS

- ▶ **Energy**
- ▶ Hydrocarbon

RELATED CASES

2024-792-0

fatty acid methyl esters.

FAME's could be produced at an average yield of 85% at 80 degrees C in one hour using this reaction.

APPLICATIONS

- ▶ Biodiesel production from organic sources (e.g. waste vegetable oil).
- ▶ Simple enough reaction to be performed on-site

ADVANTAGES

- ▶ Transesterification reaction that reduces the number of double bonds in the fatty acide methyl esters of biodiesel, resulting in a biodiesel that extends engine life.
- ▶ Avoids the use of hydroxide bases as catalyst, reducing the amount of soap produced as a byproduct.
- ▶ Main byproducts are glycerol-borate compunds that form a solid at the bottom of the reaction vessel and are readily decanted away.
- ▶ Reaction is efficient (85% yield), fast (~1 hour), and without harsh conditions (80 degrees C).
- ▶ Reaction involves cheap commodity chemicals

INTELLECTUAL PROPERTY INFORMATION

Patent Pending

RELATED MATERIALS

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ [Simple and Rapid Method for the Quantification of Halogenated Dissaccharides \(i.e. Sucralose\) in an Aqueous Media](#)
- ▶ [Rapid and accurate detection of sucralose in solution](#)
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