

Study of Producing Biodiesel from Waste Oils with Immobilized *Candida* Lipase

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Abstract: The transesterification of waste oils and methanol to biodiesel catalyzed by immobilized *Candida* lipase in three stages fixed bed reactors was studied. Saponification value, acid value of waste oils and water content were tested. The influence of velocity of reaction liquid, solvent and water content in the reaction was also researched. The yield of biodiesel was 94% in the condition of $n(\text{oil}:\text{methanol}) = 1:1$ in every stage of fixed bed, 20% hexane as solvent, 20% water content, 40°C.

Key words: waste oils; biodiesel; transesterification; immobilized lipase

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Recently biodiesel has drawn much more attention because of its almost zero emissions of sulfates and a small net contribution of CO_2 . Many researchers were carried out using immobilized lipase as catalyst^[1-5]. In this paper, Fatty acid methyl esters (FAME) which was usually called biodiesel was produced by transesterification reaction of waste oils and methanol in the condition of immobilized *Candida* lipase.

1 Experiments

Waste oils were filtrated and decolored. Acid value and saponification value of waste oils was tested. The experiment was carried in three stages fixed bed reactor. A mixture of waste oils, methanol, solvent and water was added into the top of reactors. The temperature of water bath is 40°C. The molar ratio of waste oils and methanol was 1:1 in every stage. The weight ratio of solvent to waste oils was 20%. The weight ratio of enzyme to waste oils was also 20%. The content of fatty acid methyl ester in the product liquid was analyzed by Japan gas chromatogram GC 2010 with FID detector.

2 Results and discussion

2.1 Characteristic of biodiesel

Acid value of waste oils was 144 and saponification value was 299.

2.2 Transesterification of waste oils and methanol to biodiesel

2.2.1 Effect of flow velocity of feed on reaction

In this test, waste oils feed was added by a syringe pump. Flow velocity of feed was controlled by rotate speed of syringe pump.

The concentration of FAME was increased with increasing flow velocity of feed then decreased. The largest value was occurred at 3.30 r/min. Enzymatic transesterification reaction is pervasion controlling reaction. Increasing flow velocity of feed accelerated substrate molar pervasion, so concentration of FAME increased. But too fast flow velocity of feed lead contact time of reactant and enzyme active site too short, concentration of FAME decreased.

2.2.2 Comparison of n-hexane and biodiesel being solvent respectively

Adding solvent dilutes substrate that conduce to transesterification reaction. For comparison, n-hexane and biodiesel being solvent respectively, fig 1 shows the result. The influence of n-hexane and biodiesel is similar.

2.2.3 Effect of water amount on transesterification

Transesterification includes many ordinal hydrolysis reaction and esterification^[6]. There was no higher than 0.05% water in waste oils after purification. Water is good for hydrolysis reaction. In the experiment

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water content of 5%, 10%, 15%, 20% and 25% of waste oils were added to the reactant to research the effect of water amount on transesterification. With the water content increased, conversion rate of biodiesel increased. When the water rate reached 20%, conversion rate of biodiesel reached the highest point 94%. Water content increased continuously, conversion rate of biodiesel decreased, because concentration of reactant was too low.

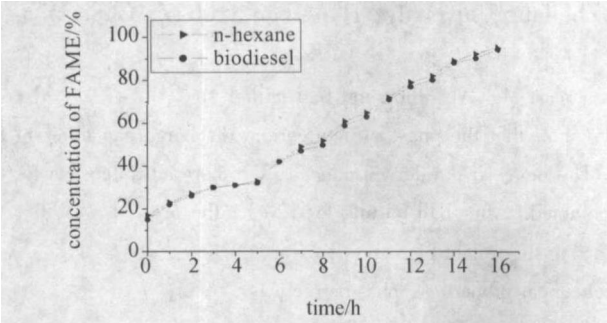


Fig 1 Comparison of n-hexane and biodiesel being solvent respective

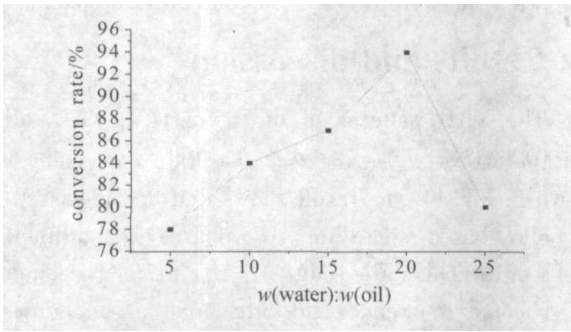


Fig2 Effect of water amount on transesterification

3 Conclusion

The highest yield of biodiesel was 94% in the condition of n (oil) : n (methanol) = 1 : 1 in every stage of fixed bed, 20% hexane as solvent, 20% water content, 40°C.

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地沟油固定化脂肪酶生产生物柴油

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摘 要: 研究了地沟油和甲醇在三段式反应器中固定化脂肪酶上合成生物柴油。对地沟油的酸值、皂化值以及水含量进行了检测。考察了进料流速、溶剂、水含量对反映的影响。在 40℃, 正己烷作溶剂, 添加水含量为地沟油质量的 20%, 每一段反应器中添加的甲醇与地沟油的摩尔比为 1:1 时, 生物柴油产率为 94%。

关键词: 地沟油; 生物柴油; 转酯化; 固定化脂肪酶

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