



**Master's Program in BioChemical Engineering  
of the Department of Chemical Engineering  
Master Thesis**

**Liquid Lipase Catalyzed Esterification for Biodiesel  
Production in The Presence of Superabsorbent  
Polymer**

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# 明志科技大學碩（博）士學位論文

## 指導教授推薦書

生化工程 研究所 林美香 君所提之論文

超吸水樹脂應用於生質柴油生產之研究 (題目) 係由本人指導撰述，  
同意提付審查。

指導教授 謝彥弘 (簽名)

107 年 7 月 24 日

# 明志科技大學碩士學位論文

## 口試委員審定書

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超吸水樹脂應用於生質柴油生產之研究

Liquid Lipase Catalyzed Esterification for Biodiesel  
Production in The Presence of Superabsorbent Polymer (題  
目)係本委員會審議，認為符合碩士資格標準。

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## ABSTRACT

Biodiesel, a renewable and environmental friendly energy has replaced for diesel in the engine vehicles. Mostly biodiesel on the world is produced by alkaline catalyzed transesterification of edible oils, which causes the high price of biodiesel and the competition in the food supplement. None-edible oils and waste cooking oils are the potential feedstocks because of their cheap price. The esterification of fatty acids with methanol seems to be a suitable process for biodiesel production from these feedstocks. In this study, the esterification of Oleic acid with Methanol by liquid lipase catalyst was investigated. However, water by-product from this process favors the reverse reaction, thus reducing the reaction yield. To address this, superabsorbent polymer (SAP) was added to remove water in the esterification. The result showed that SAP significantly enhanced the conversion yield compared with the reaction without SAP. The lipase-catalyzed esterification in the presence of SAP was then optimized using response surface methodology to maximize the reaction conversion. A maximum conversion of 96.73% was obtained at a temperature of 35.25 °C, methanol to oleic acid molar ratio of 3.44:1, SAP loading of 10.55%, and enzyme loading of 11.98%. Under these conditions, Eversa Transform lipase reusability was investigated, the conversion reduced to lower 96.73% after 5 time cycles. This study suggests that the liquid lipase-catalyzed esterification of fatty acids using SAP as a water-removal agent is an efficient process for producing biodiesel.

**Keywords:** Biodiesel, esterification, liquid enzyme, oleic acid, methanol, superabsorbent polymer.

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## ABBRAVIATION

AV	Acid value
CCD	Central composite design
DDGS	Distiller dried grains with solubles
EU	European Union
FAME	Fatty acid methyl ester
FFA	Free fatty acid
FFAs	Free fatty acids
GHG	Greenhouse gases
ME	Methyl ester
RSM	Response surface methodology
SAP	Superabsorbent polymer
SS-HAOO	Soapstock-High acid acid oil
WCO	Waste cooking oil
WCOME	Waste cooking oil methyl ester
WEO	Waste edible oil



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