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種別(和文)	論文要旨
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（博士課程）
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論 文 要 旨

THESIS SUMMARY

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要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

The objective of this work is to study the effects of additional solid particles under ultrasonic irradiation on the lipid extraction and the biodiesel production from microalgae. We proposed to use the additional solid particles under ultrasonic irradiation as a method to enhance the lipid extraction and the biodiesel production from microalgae simultaneously. Calcium oxide (CaO) was selected as an alkaline solid catalyst for the biodiesel production in this study due to its low cost, low toxicity, high availability, great basic strength, and easy handling. In this study, we first confirmed the effectiveness of the additional solid particles under ultrasonic irradiation on both the lipid extraction and the biodiesel production. Then, the effects of the variation of the solid particles were investigated, including the number of the particles, the size of the particles, and the type of the particles. Lastly, the enhancement mechanism was proposed.

Chapter 1: Introduction

The background of biodiesel as a promising alternative energy, as well as its production method (transesterification), was briefly explained. The use of microalgae as a potential source of biodiesel was introduced. The process of the lipid extraction and the transesterification from microalgae was briefly explained for basic understanding. The advantages and disadvantages of each process were discussed, as well as the problem of the biodiesel production from microalgae. The applications of ultrasonic irradiation and the addition of solid particles with various processes were described. Based on the background, the use of the additional solid particles under ultrasonic irradiation on the lipid extraction and the biodiesel production from microalgae was proposed. The objective of this study was set, and the structure of this thesis was presented.

Chapter 2: Effect of alumina particles under ultrasonic irradiation

The effect of alumina particles on the simultaneous process of the lipid extraction and the biodiesel production was investigated. The experimental setup, experimental procedure, analysis method, and calculation method of FAME conversion were explained. Chlorella was

used as a model of microalgae. Three experimental variables were studied to find the proper condition for the study of the additional solid particles, including ultrasonic power, catalyst concentration, and reaction time. Alumina was selected as a solid particle to add in the process. The two-step process of the lipid extraction followed by the biodiesel production was also performed to investigate and clarify the effect of alumina particles under ultrasonic irradiation on FAME conversion. The results indicated that both the processes were accelerated by the addition of alumina particles. The effect was more remarkable on the transesterification than on the lipid extraction.

Chapter 3: Variation of solid particles

The variations of the solid particles were conducted including, the number of the particles, the size of the particles, and the type of the particles to investigate their effects on the lipid extraction and the biodiesel production from microalgae. The results indicated that a higher number of the particles and larger size of the particles tended to give higher FAME conversion. Among four types of the particles, zirconia gave the highest FAME conversion when the same number and size of the particles were applied. The two-step process was also performed with three types of the particles. All the three types showed the same result that the solid particles showed high enhancement on the transesterification with slight enhancement at the lipid extraction step. The transesterification of triolein was preliminary performed to confirm the effect of the addition of the solid particles under ultrasonic irradiation. The results showed the same tendency that the experiment with the particles gave higher FAME conversion than without the particles.

Chapter 4: Mechanism

The effects of each parameter from the variations of the solid particles were verified. Several factors that had an impact on FAME conversion, including, surface area, movement index, density, hardness, acoustic impedance, and temperature increase were explained. The large surface area would contribute to high interaction between the solid particles and ultrasonic irradiation that could create more microjets and cavitation bubbles, resulting in the enhancement of the process. The large difference of the acoustic impedance between two media could lead to more energy reflection which caused high movement of the particles. By reviewing the phenomena governing the lipid extraction and the transesterification obtained in the experiments, the overall enhancement mechanism by the additional solid particles under ultrasonic irradiation on the process was illustrated.

Chapter 5: Conclusion

The findings obtained from this study were summarized and future prospects were suggested.

The additional solid particles under ultrasonic irradiation were proven to be effective on the simultaneous process of the lipid extraction and the biodiesel production from microalgae. The enhancement was shown to be more effective on the transesterification with a slight impact on the lipid extraction. Higher number and bigger size of solid particles tended to yield higher FAME conversion due to larger surface area on solid particles with higher interaction with ultrasonic irradiation. Zirconia showed higher FAME conversion than other solid particles due to its higher acoustic impedance that had more energy reflection than energy transmission which resulted in higher movement and higher enhancement on the process. The overall mechanism was proposed to be the effect by the solid particles under ultrasonic irradiation that could enhance the process from the increase in surface area with greater cavitations and microjets.