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**PROCESSING IN RECYCLING PROCESS OF WASTE COOKING OILS –  
SELECTED ASPECTS OF AUTOMATED REACTORS, WITH ANALYTICAL  
CAPABILITIES AND MATERIAL CHARACTERIZATION – DIFFERENTIAL  
SCANNING CALORIMETRY DSC AND SIMULTANEOUS THERMAL ANALYSIS  
STA**

**Słowa kluczowe:**

Przetwarzanie olejów, reaktory, zużyte oleje, automatyzacja, transestryfikacja, recykling, reaktory ciśnieniowe,

**Streszczenie**

W ramach prac badawczych przeanalizowano procesy przetwarzania niezdatnych do spożycia olejów spożywczych oraz opracowano indywidualne rozwiązania technologiczne do zweryfikowania wykorzystania reaktorów w rzeczywistych warunkach pracy dla przeprowadzenia procesu wybranego rodzaju transestryfikacji. Przedmiotem badań było m.in. opracowanie systemu kontroli temperatury procesu, możliwości pracy w kontrolowanych ciśnieniach w układach niezależnych reaktorów i układach kaskad reaktorów oraz możliwości szybkiej charakterystyki materiałowej DSC, TGA, STA.

**Piśmiennictwo**

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**Abstract**

There were researches on processing waste cooking oils conducted using chemical reactors system. Transesterification process was selected to be examined as it is a chemical process widely used to convert waste cooking oils into biodiesel, a renewable energy source. This process involves reacting the triglycerides in the oils with an alcohol, typically methanol or ethanol, in the presence of a catalyst such as sodium or potassium hydroxide. The reaction breaks down the triglycerides into fatty acid methyl esters (biodiesel) and glycerol as a byproduct. By converting waste cooking oils into biodiesel, the transesterification process helps reduce waste, lowers environmental impact, and provides a sustainable alternative to fossil fuels.

The project aimed to develop an automated system for processing waste cooking oils into biodiesel using the transesterification process. For this purpose, a system of interconnected pressurized reactors was developed, making it possible to conduct the entire process.



Figure 1. Oils before (left) and after transesterification process (right)

The project developed the steps for processing waste cooking oils of the selected type of transesterification. The transesterification process was conducted as a process with the potential demand for the industry in a refined formula using a system of chemical reactors. Tests were conducted for the selected type of transesterification, the complex process of which was conducted in a dedicated system of chemical reactors (Figure 1).

Material characterization using thermal analysis DSC, TGA, and STA might be implemented for additional information (Figure 2 left).

A system of interconnected reactors was created, serving from 1 to 9 pressure vessels, in which parallel or multi-stage reactions can be conducted. The system allows for the control of heating/cooling, stirring, and dosing from the level of a user-friendly graphical interface (Figure 2). Further material characterization might expand the product characterization data, using thermal analysis systems: differential scanning calorimetry DSC, thermogravimetry TGA, simultaneous thermal analysis STA (Figure 2 right).

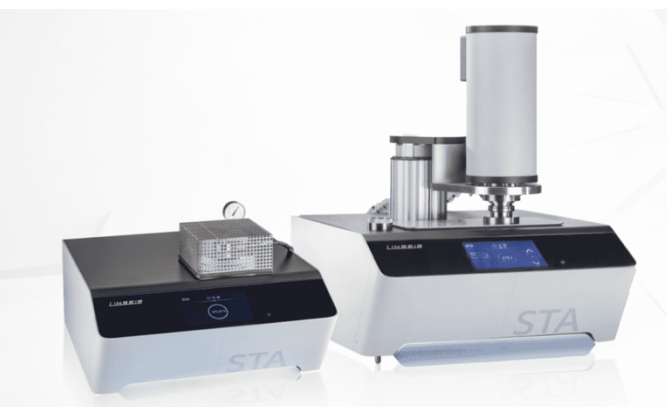


Figure 2. Reactor for transesterification process (left); DSC and STA used for samples characterization (right)

## Informacja

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