

## **Esterification of high free fatty acids in supercritical methanol using sulfated angel wing shells as catalyst**

### **ABSTRACT**

In this research, shells of *Cyrtopleura costata*, commonly known as angel wing, were used to prepare sulfated calcined angel wing shell (CAWS) catalysts by a simple, low-cost method. The produced CAWS-SO<sub>4</sub> catalyst was characterized by using X-ray diffraction (XRD), Fourier transmission infrared spectroscopy (FTIR), temperature programmed desorption of CO<sub>2</sub> and NH<sub>3</sub> (CO<sub>2</sub>-TPD and NH<sub>3</sub>-TPD), BET surface area analysis and variable pressure scanning electron microscopy (VP-SEM). The esterification of palm fatty acid distillate (PFAD) by supercritical methanol was successfully performed to obtain the high fatty acid methyl esters (FAME) with yield of 98% at the optimum methanol/PFAD molar ratio of 6/1, 2 wt.% catalyst loading, 290 °C in 15 min. The catalyst could also be reused up to seven cycles with a FAME yield higher than 80% in the last cycle. The characterization of spent catalyst has been performed by using XRD, FTIR, TPD-NH<sub>3</sub> and SEM.

**Keyword:** Sulfated calcium oxide; Waste shell; Esterification; Biodiesel; Supercritical