ABSTRACT

A more environmentally friendly alternative to aviation fuel is sustainable aviation fuel (SAF) from coconut oil. The production of SAF from coconut oil requires NiMoS catalyst supported by mesoporous silica because it can facilitate hydrogenation, hydrodeoxygenation, and deoxygenation reactions. Nickel metal is used because it can facilitate hydrogenation and hydrodeoxygenation reactions, while molybdate metal is used to enhance the deoxygenation reaction. Sulfidation is performed to control the reaction rate and increase selectivity. The mesoporous silica support can prevent the agglomeration of active metals, thereby improving catalyst performance. In this study, sonication was added to the synthesis of mesoporous silica to increase the silica formation reaction rate and improve the pore uniformity of the mesoporous silica. The purpose of this study was to determine the effect of sonication time on the resulting pore characteristics and its implications for the activity and selectivity of the bioavtur fraction product from coconut oil.

The method used in the synthesis of mesoporous silica was a sol-gel method, developed using sonication and reflux method of aging. The silica to CTAB template ratio was 4:1 (w/w). Three variations of sonication time were carried out to determine their effect on pore characteristics, namely 1 hour, 2 hours, and 3 hours, with a frequency of 40 kHz, while the reflux time was kept constant for 2 hours at 80 °C. The synthesized mesoporous silica was then impregnated with Ni-Mo metal using a wet impregnation technique. The total metal loading was 5% with a nickel and molybdenum ratio of 3:1. The catalyst was then calcined at 500 °C for 5 hours, reduced at 350 °C for 3 hours, accompanied by H_2 gas flowing at 20 mL/min, then sulfidized using H_2S gas from the decomposition of thiourea at 190 °C and activated at 400 °C for 3 hours. The characteristics of the NiMoS catalyst supported by mesoporous silica were then analyzed by XRF, XRD, GSA-BET, gravimetric acidity test, and FT-IR. Meanwhile, to determine the catalyst activity and selectivity, a catalyst activity test was conducted in a reactor at 350°C for 2 hours with 20 mL/min of H_2 gas flowing through it. The product from the catalyst activity test was characterized using GC-MS to determine the type of compounds contained.

The results showed that the mesoporous silica-supported NiMoS catalyst is an amorphous material, identified by the appearance of a shallow 2θ angle of 22–26° in the XRD diffractogram. The most optimal pore characteristics were achieved with a 3-hour sonication time variation due to the widest average pore diameter of 5.2 nm, with the largest number of pores in the 5-50 nm range, at 75.2%. In line with porosity, the best catalyst activity and selectivity were obtained at 63.44% and 12.52%, respectively, with the most ideal acidity value of 8.5 mmol/gram. It is concluded that the most significant catalyst characteristic for the catalytic reaction of coconut oil into bioavtur is the pore diameter, where the greater the number of pores in the pore range of 5–50 nm, the easier it is for the coconut oil reactant to access the active site so that activity and selectivity can be maximized.

***Keywords**: Sonication, Silica Mesopore, NiMoS, Sustainable Aviation Fuel, Rice Husk*