

## **The effects of different sonication times of nickel oxide and zirconium oxide catalysts in syngas production**

### **ABSTRACT**

Heterogeneous catalytic cracking is currently one of the most effective ways for both reducing tar content and enhancing hydrogen (H<sub>2</sub>) content in syngas at relatively low temperature, besides being environmental friendly. Sonochemical treatment has also been shown to lower reaction times with enhanced reaction rate and enables production of particles with high surface area. In this study, two different types of metal oxides, which are Nickel oxide (NiO) and Zirconium oxide (ZrO<sub>2</sub>) at a combination of 1:1 ratio with Zeolite as the supporter are synthesized via sonochemical treatment in durations of 30, 60 and 90 minutes. The catalysts are then characterized using X-Ray Diffraction (XRD), Temperature Programmed Reduction (TPR-H<sub>2</sub>), Brunauer-Emmett-Teller surface measurement (BET), Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). From SEM and TEM analysis, Nickel tends to agglomerate and form sizable globular shapes, Zirconium forms coral-like branching structure and Zeolite forms stacks of cubic clumps. The most promising sonication treatment duration for the catalysts is 30 minutes because it removes decent amount of reactive oxygen at a rate of  $0.83 \times 10^{21}$  atoms/g during hydrogen reduction, possesses the highest surface area of 506.52 m<sup>2</sup>/g as well as smallest average crystallite size of 56.9 nm compared to other durations. Generally sonochemical treatment also increases the catalysts surface area and oxygen removal as well as lowers the reduction temperature which is favourable in term of production cost. Catalysts with sonochemical treatment duration of 30 and 60 minutes generally show higher reactive oxygen removal and surface area compared to catalysts with 90 minute treatments.

**Keyword:** Heterogeneous catalysts; Nickel oxide; Zirconium oxide; Biomass; Gasification