

Synthesis of glycerol carbonate from industrial by-products by alcoholysis of urea : Crude glycerol and red gypsum

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ABSTRACT

In this study, a heterogeneous catalyst was developed from red gypsum for the synthesis of glycerol carbonate through a glycerolysis reaction with urea. Under optimum reaction conditions, a simple heat treatment on bare red gypsum in a static air environment produces an 87% yield of the targeted glycerol carbonate product. The higher catalytic activity of the calcined catalyst is due to its basic characteristics and the presence of different phases of anhydrite CaSO_4 with additional elements, especially an active hematite (Fe_2O_3) phase. The catalytic process was also found to be insensitive to the type of flowing gas that was used to remove the evolved ammonia gas, whereby, either inert nitrogen gas or reactive air containing oxygen did not significantly impact the glycerol carbonate yield. Indeed, with a promising yield, the developed catalytic system was able to directly synthesise glycerol carbonate from industrial crude glycerol from a biodiesel plant. The red gypsum-based catalytic system seems resistant to the presence of a certain level of moisture and other impurities in crude glycerol. The catalyst efficiency is being retained for consecutive reaction cycles, which are subsequently reused for the next batch reaction without requiring any pre-treatment.

KEYWORDS

Crude glycerol; Glycerol carbonate; Heterogeneous catalyst; Industrial by-product; Red gypsum

ACKNOWLEDGEMENT

The authors would like to thank Ministry of Higher Education for Fundamental Research Grants Scheme (FRGS/1/2018/STG01/UMP/02/1) and Universiti Malaysia Pahang, for Internal Grants Scheme (RDU1703277).