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Sustainable synthesis and characterization of copper-modified zeolite Y (Kaolin-CuY) from purified Meetiyagoda kaolin

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Sustainable synthesis of zeolite is important since zeolites are employed in many industrial and environmental applications. However, the use of pure chemicals on large scale is not sustainable due to the high cost and production of hazardous chemical waste. To avoid these negative impacts natural aluminosilicate materials can be used. Among various raw materials, it has been investigated that kaolin is very suitable as a starting material which has an uncharged layer with a silica tetrahedral sheet and alumina octahedral sheet. Kaolin is naturally available but needs to purify before the synthesis process to remove impurities. The main objectives of this study are the synthesis of faujasite type Zeolite-Y from kaolin which was mined from Meetiyagoda, Sri Lanka, and modification by copper cation. Copper-modified zeolites can be used as a catalyst in many applications. To synthesize gel precursors, known ratios of purified metakaolin, silica, NaOH and water were mixed. An environmentally friendly hydrothermal seed-assisted method was used for the crystallization process. Synthesized zeolite was labelled as Kaolin-Y and it was modified with copper(II) cation (Kaolin-CuY). These materials were characterized by PXRD, FTIR and Raman spectroscopy by comparing the structure of Zeolite-Y. The availability of characteristic diffraction of Zeolite-Y in Kaolin-Y data representing zeolite synthesis becomes successful. In FTIR spectra a small band is appearing around 612 cm^{-1} representing the loading of cation (M-O bond) with internal deformation vibration modes of T-O-T bridging bonds. A small peak that appears in the Kaolin-CuY Raman spectrum around 129 cm^{-1} represents the formed M-O bond that affects the O-Si-O bond and a peak at 202 cm^{-1} in Kaolin-CuY also proves cation loading. According to these results, in this study synthesis and modification of Kaolin Y have been successfully achieved. The application of copper-modified kaolin in the catalytic reaction will be studied.

Keywords: *Characterization, copper modification, metakaolin, zeolite Y*

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