SYNTHESIS OF C-4-FURYLCALIX[4]RESORCINARENE SUPRAMOLECULE BASED ON BAGGASE AS TOXIC METALS ADSORBENT FOR Pb(II) AND Cd(II)

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ABSTRACT

The aim of this research is to synthesize supra molecular compound in the form of C-4-furylcalix[4]resorcinarene by using bagasse that abundantly available as a starting material. The target compound is classified into a group of macro cyclic molecules, such as crown ether and cyclodextrin. These class of compounds have several active functional groups which are arranged in a unique molecular geometry, which is shaped like a vase or crown making it possible to be used as a host molecule for the cation, anion and neutral molecule. It is well known that some heavy metal cation such as Pb^{2+} and Cd^{2+} has its high toxicity that adversely affect human health. Based on this phenomena, the study has been conducted to synthesize an adsorbent for toxic metals Pb(II) and Cd(II) in the form of C-4-furylcalix[4]resorcinarene by using 2-furfuraldehyde based on bagasse. Synthesis of C-4-furylcalix[4]resorcinarene has been done through several stages as follows: (1) isolation of penthosan from bagasse by continuous extraction using toluene-ethanol solvent, (2) synthesis of 2-furfuraldehyde from penthosan by involving process of hydrolysis and dehydration in the presence of acid catalyst, (3) purification of 2-furfuraldehyde via solvent extraction techniques and vacuum distillation, and (4) acid catalyzed of condensation and cyclisation of 2-furfuraldehyde with resorcinol to produce C-4-furylcalix[4]resorcinarene. The product of 2-furfuraldehyde was obtained in the yield of 11.47% which gave a positive reaction to aniline acetate reagent, whereas C-4-furylcalix[4]resorcinarene was gained as dark brown solids in 73.25% with melting point of 375-377 °C. Based on an analysis using ^{1}H-NMR spectrometer, the compound of C-4-furylcalix[4]resorcinarene tend to exits in the crown conformation.

The result indicated that C-4-furylcalix[4]resorcinarene is a good host for metal ions, where Cd(II) sorption capacity was higher than that of Pb(II). Effect of pH on batch experiments for the mentioned ions indicated that the optimum pH for metal binding were 5 for both of lead(II) and cadmium(II). In order to investigate the mechanism of adsorption, the 1st-order, pseudo 1st-order, and pseudo 2nd-order kinetic models were used. The adsorption model of metal ions on the resorcinarene followed pseudo second order of Ho & McKay expression. The equilibrium adsorption isotherm have been analyzed by Langmuir and Freundlich equations. Langmuir model had the higher correlation coefficient than that of Freundlich model.

Keyword: baggase, 2-furfuraldehyde, C-4-furylcalix[4]resorcinarene, crown conformation