ADSORPTION CHARACTERISTICS OF Pb(II) ONTO C-4-HYDROXY-3-METHOXYPHENYLCALIX[4]RESORCINARENE IN BATCH AND FIXED BED COLUMN SYSTEMS

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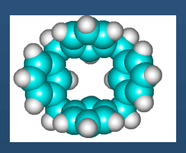
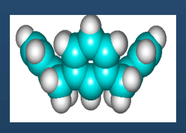
Introduction

SIGNIFICANT CONTENT OF Pb(II) ON STREAM AND INDUSTRIAL EFFLUENTMUST BE REMOVED

CYCLIC OLIGOMER CALIXARENES HAVE POTENT AS ADSORBENT

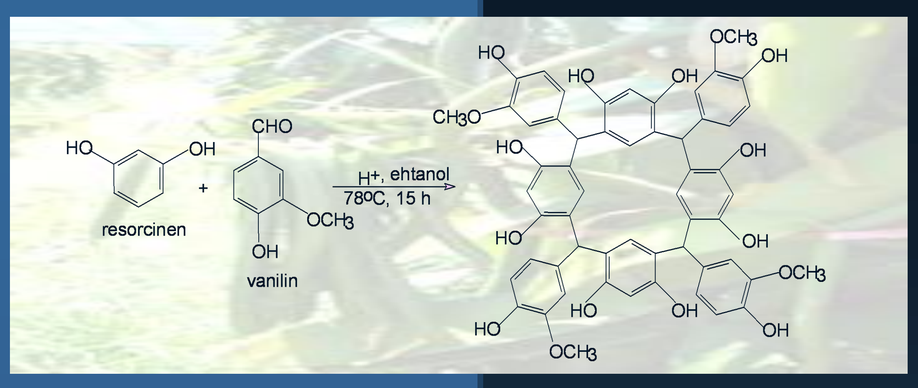
ADSORPTION IS ONE OF THE FEW PROMISING TECHNOLOGY TO TREAT INDUSTRIAL WASTE





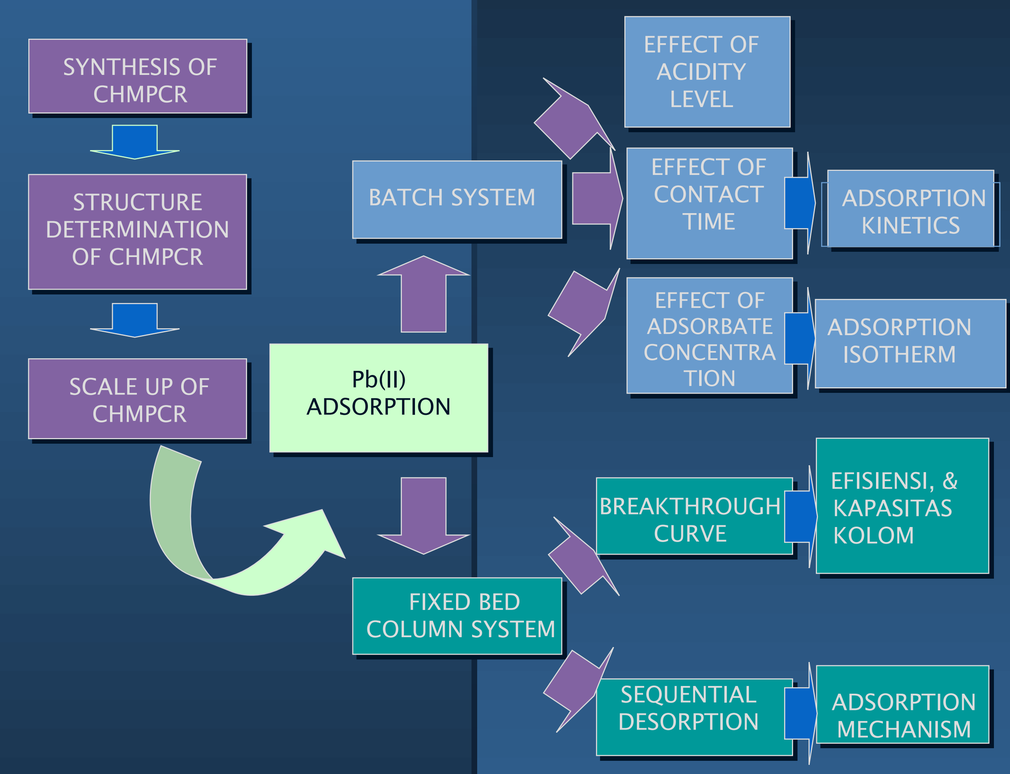
Calixarenes are synthetic cyclic oligomers of aromatic residues linked by a bridge. This macromolecule has almost unlimited possibilities of modification, including the modification of type and number of aromatic residues, functional groups, and bridges. This family represents an interesting geometry that exhibits characteristic of cavity or basket shape. This shape allows calixarenes application in host-guest system. The family of calixarene has been used for various utilities, namely as an additive in capillary electrophoresis, liquid membrane, extraction, chemical sensing and HPLC stationary phase. However, the usage of calixarenes as heavy metal, especially Pb(II) adsorbent was rare.

One member of calixarenes was 4-hydroxy-3-methoxy-phenil calix[4]resorsinarena (CHMPCR) which synthesized by resorcine and vanillin.



CHMPCR
98,36%

Methods



Reference

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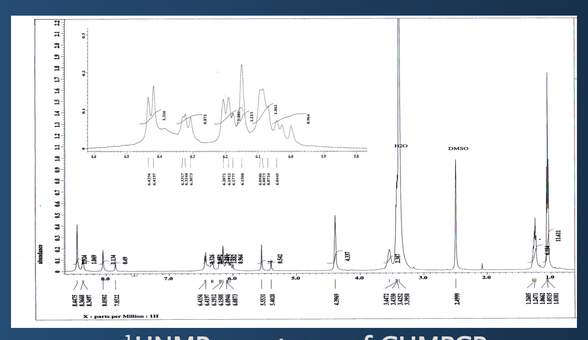
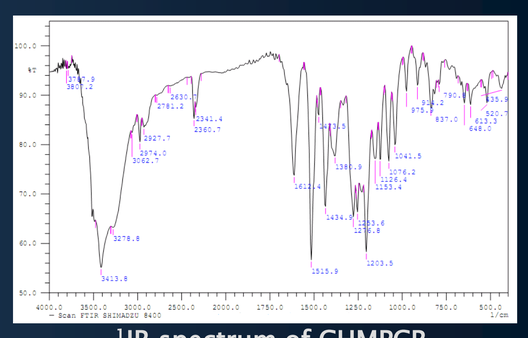
Results

Synthesis CHMPCR

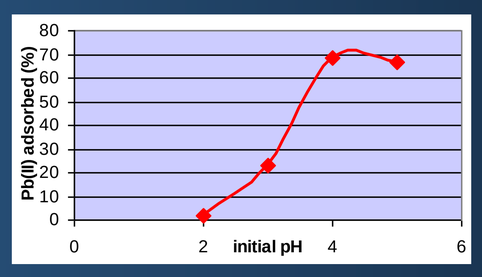


^{1}HNMR spectrum of CHMPCR

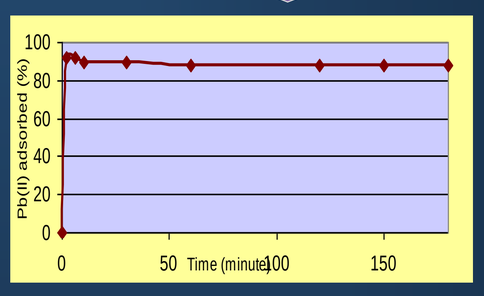


^{1}IR spectrum of CHMPCR

Pb(II) Adsorption in batch system

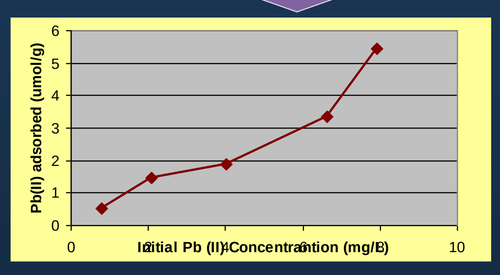


Effect of acidity level experiment shows that optimum adsorption value (4.64 μmol/g or 68.42 % in percentage) reached at initial pH value of 4



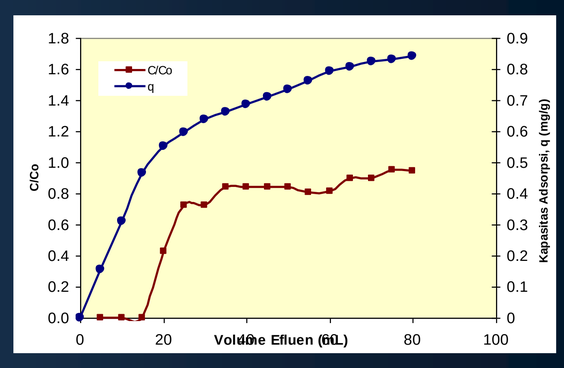
Effect of contact time experiment shows the kinetics of Pb(II) adsorptions onto CHMPCR could be described well by

pseudo 2nd order equation

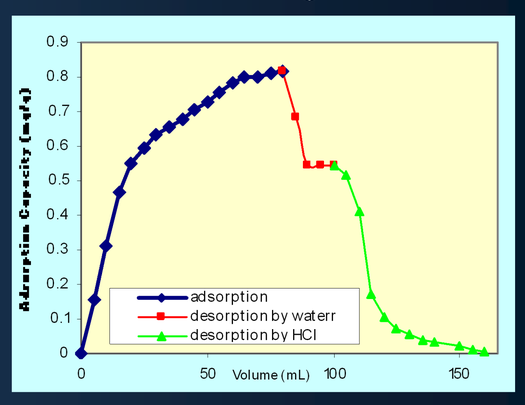


Effect of Pb(II) concentration experiment gave the adsorption equilibrium isotherm of Pb(II) adsorption in batch system followed Freundlich isotherm. Adsorption capacities of Pb(II) were 5.44 μmol/g (91,84%) in batch system

Pb(II) Adsorption in fixed bed column system



The fixed bed column test showed that the total uptake of Pb(II) (qe) was 3.95 μmol/g atau 0.46 mg Pb(II) per g of CHMPCR



The results of desorption test showed that Pb(II) adsorption by CHMPCR was dominated by chemisorption (more than 66%), but physisorption ruled adsorption mechanism in moderate portion (about 33%).

Conclusions

- CHMPCR was produced by one step synthesis from resorcine, vanillin (4-hydroxy-3-methoxybenzaldehyde), and HCl. The synthesis was carried out at 78oC for 24 hours, and afforded the adsorbent in 96,9 % as a 2:1 mixture of C4v: C2v isomer.
- Most parameters in batch and fixed bed column systems confirm that CHMPCR is a good adsorbent for Pb(II). The adsorption kinetic of Pb(II) adsorptions in batch and fixed bed column systems followed pseudo 2nd order kinetics model. In addition, the adsorption equilibrium isotherm of Pb(II) adsorption in batch system followed freundlich isotherm.
- Adsorption capacities of Pb(II) were 5.55 μmol/g (91.84%) in batch system and 3.95 μmol/g in fixed bed column system.
- Desorption studies showed that the adsorption was dominated by chemisorption.