

**PREPARATION OF β -CYCLODEXTRIN BASED
ADSORBENTS AND THEIR BEHAVIOUR TOWARDS
CHROMIUM(VI)-DIPHENYLCARBAZIDE COMPLEX
REMOVAL FROM AQUEOUS SOLUTION**

NURUL HUDA BT MOHD YUSOF

**FACULTY OF SCIENCE
UNIVERSITY OF MALAYA
KUALA LUMPUR**

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REMOVAL FROM AQUEOUS SOLUTION**

NURUL HUDA BT MOHD YUSOF

**DISSERTATION SUBMITTED IN FULFILMENT OF
THE REQUIREMENT FOR THE DEGREE OF
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ABSTRACT

The adsorption of Cr(VI) ions from aqueous solution by β -cyclodextrin (β -CD) based polymer as an adsorbent was studied in a batch adsorptions experiments. Three types of adsorbent were synthesized, namely, β -CDCP-HMDI, β -CDCP-TDI and Si-TDI- β CD. The method was based on the complex reaction of Cr(VI) with 1,5-diphenylcarbazide (DPC) in acidic solution loaded on β -CDCP-HMDI and β -CDCP-TDI and Si-TDI- β CD.

The adsorption isotherm and kinetics of the three adsorbent were studied. Equilibrium isotherm was analyzed according to classic Langmuir and Freundlich model. It shows that the Langmuir isotherm is better in describing the adsorption process for adsorbent β -CDCP-HMDI, while Freundlich isotherm is better for β -CDCP-TDI and Si-TDI- β CD. In order to analyze the kinetics data, two kinetic model, pseudo-first order and pseudo-second order were applied. It was found that the adsorption processes for all types of adsorbents followed second order kinetic. The thermodynamic parameters for the sorption have been evaluated. The thermodynamic study shows that the enthalpy (ΔH°) value is positive suggesting an endothermic nature of the adsorption and the negative value of free energy (ΔG°) indicated the spontaneous nature of adsorption.

ABSTRAK

Penjerapan ion Cr(VI) daripada cecair akues dengan menggunakan rantaian polimer β -cyclodextrin sebagai penjerap telah dikaji di dalam satu set eksperimen. Tiga jenis penjerap telah disintesis iaitu, β -CDP-HMDI, β -CDP-TDI, dan Si-TDI- β -CD. Kaedah yang digunakan adalah berdasarkan kepada tindak balas kompleks Cr(VI) dengan 1,5-diphenylcarbazine (DPC) di dalam larutan yang berasid. Kompleks Cr(VI)-DPC mengisi ruangan di dalam β -CDP-HMDI, β -CDP-TDI, Si-TDI- β -CD.

Isoterm penjerapan dan kinetik untuk ketiga-tiga penjerap telah di kaji. Keseimbangan isoterm telah dianalisa dengan menggunakan model klasik Langmuir dan Freundlich. Kajian ini menunjukkan keputusan yang sesuai bagi model klasik Langmuir semasa proses penjerapan untuk penjerap β -CDP-HMDI dan model Freundlich lebih sesuai digunakan untuk penjerap β -CDP-TDI dan Si-TDI- β -CD. Di dalam menganalisa tentang data-data kinetik, terdapat dua jenis model kinetik yang di gunakan iaitu tertib pertama dan tertib kedua. Ini menunjukkan bahawa proses penjerapan untuk semua penjerap telah mengikut tertib kedua. Ciri-ciri untuk menerangkan termodinamik bagi proses penjerapan ini telah di kaji. Kajian termodinamik terhadap nilai entalpi adalah positif dan ini menunjukkan kejadian endotermik terhadap proses penjerapan dan nilai negatif bagi tenaga bebas telah menandakan kejadian spontan semasa proses penjerapan.

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LIST OF ABBREVIATIONS

Short term

Cr(VI)	Chromium (VI)
Cr(III)	Chromium(III)
β -CD	β -cyclodextrin
CD	cyclodextrin
β -CDP	β -cyclodextrin-cross-linked polymer
HMDI	1,6-hexamethylene diisocyanate
TDI	toluene-2,4-diisocyanate
SiO ₂	Silica
DPC	1,5-diphenylcarbazide
ΔH°	Enthalpy
ΔG°	Gibbs Free Energy
ΔS°	Entropy
°C	degree Celsius
mL	milliliter
cm ³	centimeter cube