INTISARI

Pengolahan limbah uranium dengan metode adsorpsi menggunakan adsorben $Mg(OH)_2$ *impregnated activated carbon* telah dilakukan. Tujuan penelitian ini adalah untuk mengetahui nilai kapasitas adsorpsi maksimum adsorben dari model isoterm adsorpsi, persamaan matematis laju adsorpsi uranium (VI) menggunakan adsorben, dan pengaruh rasio impregnasi adsorben terhadap persen pemungutan uranium dalam limbah cair. Adsorben disintesis dari bahan baku tempurung kelapa melalui beberapa tahapan, yakni pirolisis (150 menit dan suhu 400±10^oC), proses aktivasi kimia menggunakan 150 mL NaOH 1 N (24 jam), proses impregnasi menggunakan variasi larutan $MgCl_2$ (30 menit dan suhu 600^oC) dan terakhir dilakukan karakterisasi menggunakan FTIR, BET, XRF, dan XRD. Parameter adsorpsi yang digunakan pada penelitian ini adalah suhu operasi (T), ukuran butir adsorben (d), rasio massa adsorben per massa larutan (r), dan rasio impregnasi. Hasil penelitian menunjukkan bahwa model isoterm adsorpsi yang mewakili kesetimbangan adsorpsi uranium menggunakan adsorben adalah model isoterm Langmuir dengan nilai kapasitas adsorpsi maksimum pada suhu 303 K sebesar 85,4701 mg/g dan nilai R_L sebesar 0,6969 yang menunjukkan proses adsorpsi berjalan dengan baik (*favourable*). Hasil penelitian juga menunjukkan bahwa laju adsorpsi meningkat dengan meningkatnya suhu operasi, rasio massa adsorben per massa larutan, dan berkurangnya ukuran butir adsorben dengan persamaan matematis laju adsorpsi yang dinyatakan sebagai berikut:

$$\ln\frac{C}{C_0} = -\left[85032{,}11\exp\left(-\frac{41981{,}03}{RT}\right)d^{-0{,}2176}r^{0{,}1925}\right]t^2$$

Persamaan berlaku untuk kisaran suhu (T) 303-323 K, ukuran butir adsorben (d) 767-1194 µm, dan rasio massa adsorben per massa larutan (r) 0,001-0,003 (gr/mL) dengan kesalahan relatif 12,6156%. Selain itu, hasil penelitian juga menunjukkan bahwa meningkatnya rasio impregnasi dari 0,3 hingga 1,0 dapat meningkatkan persen pemungutan uranium dalam limbah.

Kata kunci: adsorpsi, isoterm adsorpsi, karbon aktif, laju adsorpsi, limbah uranium.

ABSTRACT

Uranium wastewater treatment has been done by adsorption method using $Mg(OH)_2$ impregnated activated carbon. Research purposes are to determine the adsorbent maximum capacity of the adsorption isotherm model, the mathematical equation of the uranium (VI) adsorption rate, and the effect of the impregnation ratio of adsorbent to uranium removal efficiency. Adsorbent was synthesized from coconut shell through several stages, those are pyrolysis (150 minutes and 400±10^oC), chemical activation using 150 mL NaOH 1 N (24 hours), impregnation process using varied solutions of $MgCl_2$ (30 minutes and 600^oC temperature), and characterized using FTIR, BET, XRF, and XRD. The parameters studied in this research were adsorption temperature (T), particle diameter of adsorbent (d), mass ratio of adsorbent to wastewater solution (r), and impregnation ratio. The result show that equilibrium data agreed very well with the Langmuir isotherm model with the maximum adsorption capacity at 303 K about 85.4701 mg/g and RL value about 0.6969 which indicates that the adsorption process is favourable process. The adsorption rate was increased by increasing the adsorption temperature (T), mass ratio of adsorbent to wastewater solution (r), and the decrease of particle diameter of adsorbent (d) with mathematical equation of the uranium (VI) adsorption rate as:

$$\ln\frac{C}{C_0} = -\left[85032{,}11\exp\left(-\frac{41981{,}03}{RT}\right)d^{-0{,}2176}r^{0{,}1925}\right]t^2$$

This equation is valid for the range of T from 303 K to 323 K, d from 767 µm to 1194 µm, and r from 0.001 to 0.003 with the relative mean error about 12.6156%. In addition, the results also shown that increasing the impregnation ratio from 0.3 to 1.0 can increase the uranium removal efficiency.

Keywords: activated carbon, adsorption, adsorption isotherm, adsorption rate, uranium wastewater