KAJIAN POTENSI TANAH LIAT, ZEOLIT DAN KARBON TERAKTIF SEBAGAI PENJERAP KOMPOSIT UNTUK MERAWAT LARUT RESAPAN

MOHD BAHARUDIN BIN RIDZUAN

Tesis ini dikemukakan sebagai
memenuhi syarat penganugerahan
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ABSTRAK

Larut resap domestik mengandungi kepekatan bahancemar NH3-N dan COD yang sangat tinggi. Kajian ini menggunakan campuran bahan penjerap semulajadi terdiri daripada tanah liat, zeolit dan karbon teraktif bagi menjerap bahancemar tersebut. Ujian pencirian penjerap komposit telah dilakukan dengan menggunakan pendarkilau sinar-x (XRF), mikroskop imbasan elektron (SEM), luas permukaan Brunauer Emmett Teller (BET), titratan Boehm, pH di caj titik sifar (pHzpc) kelajuan goncangan, masa sentuhan, saiz partikel dan dos penjerap. Kelajuan goncangan adalah pada 200 rpm, masa sentuhan 120 minit, pH 7 dan saiz partikel 2.36-3.35 mm. Sementara ujian nisbah optimum dijalankan melalui penjerapan kelompok. Keputusan analisa kajian mendapati, tanah liat dan zeolit bleh dikategorikan sebagai penjerap hidrofilik dan karbon teraktif pula penjerap hidrofobik dengan nisbah optimum pada nisbah 5:3 sesuai dengan tingkah laku penjerapan NH3-N dan COD ke atas penjerap. Keputusan ujian XRF komposit penjerap menunjukkan kehadiran kalsium oksida dan silika oksida yang tinggi sebagai sebatian utama. Ujian SEM pula menunjukkan penjerap komposit mempunyai permukaan liang yang heterogen dan kasar. Kajian perbandingan menunjukkan kapasiti penjerapan penjerap komposit terhadap NH3-N dan COD adalah lebih baik daripada zeolit dan karbon teraktif. Kajian kinetik penjerapan mendapati penjerap komposit mengikut hampir kesemua model yang dikaji namun model pseudo-tertib kedua adalah paling dominan untuk keseluruhan parameter.

ABSTRACT

Domestic leachate contains very high concentrations of NH3-N and COD contaminants. This study uses a mixture of natural adsorbents consisting of clay, zeolite and activated carbon to adsorb the pollutants. Composite adsorbent characterization tests were performed using x-ray fluorescence (XRF), scanning electron microscope (SEM), Brunauer Emmett Teller surface area (BET), Boehm titration, pH at zero-point charge (pHzpc) shake speed, contact time, size particles and adsorbent dose. While the optimum ratio test is carried out through batch adsorption. Shake speed was at 200 rpm, contact time 120 minutes, pH 7 and particle size ranging from 2.36mm-3.35 mm. The results of the study analysis found that clay and zeolite can be categorized as hydrophilic adsorbents and activated carbon is a hydrophobic adsorbent with an optimum ratio of 5: 3 in accordance with the adsorption behavior of NH3-N and COD on the adsorbent. The XRF test results of the adsorbent composite showed the presence of high levels of calcium oxide and silica oxide as the main compounds. SEM test showed that the composite adsorbent has a heterogeneous and rough pore surface. Comparative studies showed that the adsorption capacity of composite adsorbents against NH3-N and COD was better than that of zeolite and activated carbon. The adsorption kinetic study found that composite adsorbents according to almost all models studied however second-order pseudo-models were the most dominant for the overall parameters.

KANDUNGAN

SENARAI JADUAL

SENARAI RAJAH

SENARAI SINGKATAN

AC	-	Activated Carbon
APHA	-	American Public Health Association
ASTM	-	American Society for Testing and Materials
ATR	-	Attenuated Total Reflection
AWWA	-	American Water Works Association
BET	-	Brunauer, Emmet, Teller
BOD	-	Permintaan Oksigen Biokimia
BS	-	British Standards
CCD	-	Charge-Coupled Device
COD	-	Permintaan Oksigen Kimia
EBCT	-	Empty Bed Contact Time
FA	-	Asid Fulvik
Fe	-	Ferum
FKAAS	-	Fakulti Kejuruteraan Awam dan Alam Sekitar
FTIR	-	Spektroskopi Inframerah Transformasi Fourier
GAC	-	Granular Activated Carbon
HA	-	Asid Humik
HCl	-	Asid Hidroklorik
JAS	-	Jabatan Alam Sekitar
KPK	-	Kapasiti Pertukaran Kation
KT	-	Karbon Teraktif
LOI	-	Loss of Ignition
MPRC	-	Pusat Penyelidikan Pencemar Mikro
MSW	-	Municipal Solid Waste
MTZ	-	Mass Transfer Zone
NaCl	-	Natrium Klorida
NaOH	-	Natrium Hidroksida

NH_3-N	-	Ammonia-Nitrogen
OPC	-	Simen Portland Biasa
PAC		Powdered Activated Carbon
pH_{ZPC}	-	pH Caj Titik Sifar
Pt.Co	-	Platinum Cobalt
RBC	-	Penyentuh Biologi Berputar
RECESS	-	Pusat Penyelidikan Tanah Lembut
RPM	-	Pusingan Per Minit
SEM	-	Mikroskop Imbasan Elektron
SS	-	Pepejal Terampai
TL	-	Tanah Liat
TPSR	-	Tapak Pelupusan Simpang Renggam
UTHM	-	Universiti Tun Hussein Onn Malaysia
VFA	-	Asid Lemak Meruap
WCAT	-	Water Contact Angle Test
WDPT	-	Water Drop Penetration Test
WEF	-	Water Environment Federation
XRF	-	Analisis Pendarkilau Sinar-X
ZEO	-	Zeolit

SENARAI SIMBOL

C_b	-	Kepekatan efluen atau kepekatan bulus	mg/L
C_e	-	Kepekatan pada keseimbangan	mg/L
C_L	-	Had kepekatan	mg/L
C_o	-	Kepekatan awal	mg/L
C_t	-	Kepekatan bulus pada masa *t*	mg/L
H	-	Ketinggian bahan penjerap penjerap dalam turus	mg/L
k_1	-	Pemalar kadar pseudo-tertib pertama	cm atau m
k_2	-	Pemalar kadar pseudo-tertib kedua	(min^{-1})
k_{AB}	-	Pemalar Adams-Bohart	(g/mg min)
K_F	-	Pemalar Freundlich	(L/mg-min)
k_{TH}	-	Pemalar Thomas	$mgg^{-1}(gm^{-3})^n$
k_{YN}	-	Pemalar Yoon-Nelson	(mL/min-mg)
k_i	-	Pemalar kadar pembauran intra-partikel	(min^{-1})
K_L	-	Pemalar Langmuir	(mg/g $min^{0.5}$)
n	-	Pekali dalam persamaan Freundlich	m^3g^{-1}
N_o	-	Kapasiti penjerapan atau kapasiti bulus	-
Q	-	Kadar aliran volumetrik	mg/L
q_e	-	Amaun penjerapan pada keseimbangan	mL/min
q_m	-	Amaun penjerapan maksimum	mg/g
q_t	-	Amaun penjerapan pada masa *t*	mg/g
t_b	-	Masa bulus	mg/g
t_e	-	Masa tepu	minit
V_e	-	Isipadu turus kosong	minit
V_0	-	Halaju linear	cm^3 atau m^3
X	-	Jisim penjerap yang digunakan	cm/min
Z	-	Kedalaman lapisan katil turus	cm atau m

BAB 1

PENGENALAN

1.1 Pendahuluan

Malaysia menuju ke arah negara maju dan melalui fasa pembangunan yang pesat dengan kewujudan pelbagai sektor seperti sektor perindustrian, pertanian, perkhidmatan dan pembinaan. Dengan perkembangan pelbagai industri tersebut, populasi serta kawasan perbandaran akan meningkat berikutan daripada migrasi penduduk luar bandar ke kawasan bandar. Seiring dengan perkembangan ekonomi yang pesat dan peningkatan jumlah populasi setempat, Malaysia berdepan dengan cabaran dalam pengurusan sisa pepejal domestik dan industri. Peningkatan bahan sisa pepejal, kekurangan tanah untuk tapak pelupusan, kos tanah untuk tapak pelupusan dan kos pengangkutan sisa pepejal ke tapak pelupusan adalah antara cabaran yang perlu ditangani oleh Pihak Berkuasa Tempatan (PBT) atau mana-mana pihak pengendali sisa pepejal di sesuatu kawasan.

Pengurusan sisa pepejal merupakan suatu cabaran baru dan berterusan di Malaysia dalam usaha membangunkan Malaysia sebagai negara maju menjelang abad ke-21. Pengurusan yang efektif perlu selari dengan komitmen Malaysia dalam Deklarasi Rio pada tahun 1992 yang menekankan tahap kesihatan awam yang baik, kehidupan manusia yang selesa dan seimbang serta bebas daripada masalah alam sekitar. Sementara deklarasi Rio, 2012-pula dipetik sebagai “Mengawal dan menguruskan sisa pepejal merupakan tunjang kemajuan dalam pembangunan sesebuah negara maju”.

Pengurusan sisa pepejal memerlukan kemudahan yang secukupnya untuk mengatasi masalah pelupusan sisa pepejal. Perancangan sistem pengurusan sisa pepejal bagi suatu kawasan perlu mengambil kira rancangan pembangunan, kadar

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