ABSTRACT

Humic substances are organic rich macromolecules commonly found in water tainted by peat swamp runoff. They cause undesirable colour and odour and pose significant impact on the treatability of water. The presence of humic substances in aquatic environment is a challenge to many water treatment authorities. They are the precursors to formation of carcinogenic compounds as they react with chlorine residues present in water after treatment processes. Conventional water treatment technique using coagulation and flocculation has good removal efficiency but the process generates resultant sludge which is discarded later. Often time, the amount of coagulant used is overdosed to affirm its removal efficiency, overlooking the potential hazards to human and environment health. On the other hand, humic substances have valuable agronomic values to farmers. Humic substances have been found to be soil enhancer and plant growth promoter. Hence, this study attempts to link the contradicting characteristics of humic substances to water treatment authorities and agriculture practitioners. Biosorption is gaining attention due to the abundance of agricultural biomasses, environmental friendly and economical sustainable, promoting green technology. Application of biosorbent serves to minimize the usage of alum in water treatment process. In this study, the potential of indigenous agricultural wastes in humic adsorption was evaluated. Coconut copra outperformed other biomasses studied; attaining 44.17% removal in its untreated state. It was further modified chemically to enhance its adsorption efficiency, where the chemical and morphological changes were confirmed using FTIR and SEM. Coconut copra was refluxed with distilled water and subsequently treated with citric acid. The treatment process is rather mild and environmental friendly. Upon modification, coconut copra experienced reduction in lignin content, glycosidic linkages and C–H stretching but enhanced C=O groups. Electrostatic, hydrophobic, hydrophilic and hydrogen bonding were anticipated in the adsorption of humic substances onto modified coconut copra. The chemical modification and water treatment condition were optimized at one-factor-at-a-time approach at laboratory setting. Coconut copra was refluxed using distilled water for 1 hour at 100 ºC, followed by agitation with 0.5 M citric acid for 1 hour at room temperature. A total of 1 g of modified coconut copra washed to pH 3 was agitated for 15

min recorded removal percentage above 95%. Adsorption isotherm studies were performed using Langmuir, Freundlich, Temkin and Dubinin-Radushkevich models with humic acid standard. The adsorption of humic acid using modified coconut copra is a favourable physical process with q_{max} of 232.56 mg/g. Response surface methodology was conducted based on inscribed central composite design to optimize the adsorption of humic substances for up scaling purpose. Experimental 86.54% humic removal was obtained when 4.56 g modified coconut copra is agitated in 100 mL peat swamp runoff at 56.8 ºC for 42.9 min. The experimental response acquired (based on the modelled optimum conditions. The recycling of humic fortified coconut copra to poultries feed is potentially viable. Humic solution was proven to be able to be germination promoter and plant growth enhancer with reference to mung beans.

Penjerapan Bahan Humik dari Air Paya Gambut dengan Hampas Santan Kelapa dan Aplikasinya

ABSTRAK

Bahan humik merupakan makromolekul yang kaya dengan bahan organik dan biasanya dijumpai dalam air paya gambut. Bahan humik adalah sumber kepada warna dan bau yang tidak diingini dan mempengaruhi keberkesanan proses rawatan air. Oleh itu, kehadiran bahan humik dalam air menjadi satu cabaran kepada loji rawatan air. Bahan humik adalah pendahulu kepada pembentukan sebatian karsinogenik setelah proses tindak balas dengan sisa klorin dalam air. Teknik konvensional menggunakan penggumpalan dan flokulasi dengan kadar penyingkiran yang baik tetapi proses ini menghasilkan kumbahan. Sering kali, bahan penggumpal digunakan secara berlebihan untuk memastikan kadar penyingkarannya. Namun begitu, bahan humik mempunyai nilai agronomi yang berharga kepada para petani. Bahan humik boleh menambah baik stuktur tanah dan menggalakan pertumbuhan tumbuh-tumbuhan. Justeru, kajian ini bertujuan untuk menghubungkan ciri-ciri bahan humik yang bercanggahan terhadap lembaga air dan sektor pertanian. Penjerapan dengan sisa pertanian semakin mendapat perhatian ramai kerana ianya boleh didapati dalam kuantiti besar, mesra alam, mampan dari segi ekonomi, dan menggalakkan teknologi hijau. Aplikasi penjerap bio berfungsi untuk mengurangkan penggunaan alum dalam proses rawatan air. Dalam kajian ini, potensi sisa pertanian pribumi untuk penjerapan bahan humik dinilai. Hampas santan kelapa dilaporkan mengatasi biomassa lain yang dikaji; mencapai kadar penyingkiran 44.17% tanpa sebarang pengubahsuaian. Ianya telah diubah suai dengan bahan kimia untuk meningkatkan kadar penjerapan, di mana perubahan struktur kimia dan morfologi telah disahkan dengan FTIR dan SEM. Hampas santan kelapa telah direfluks dengan air suling dan kemudiannya dirawat dengan asid sitrik. Proses rawatan ini agak ringan dan mesra alam. Selepas pengubahsuaian, hampas santan kelapa mengalami pengurangan dalam kandungan lignin, ikatan glikosidik dan peregangan C-H tetapi peningkatan dalam kumpulan C=O.

Hubungan elektrostatik, hidrofobik, hidrofilik dan ikatan hidrogen dijangka memainkan peranan dalam proses penjerapan bahan humik ke hampas santan kelapa yang diubah suai. Keadaan pengubahsuaian kimia dan rawatan air telah dioptimumkan melalui pendekatan satu faktor-pada-satu-masa dalam tetapan makmal. Hampas santan kelapa direfluks dengan air suling selama 1 jam pada 100 ° C, diikuti dengan kocakan dengan 0.5 M asid sitrik selama 1 jam dalam suhu bilik. Sebanyak 1 g hampas santan kelapa yang telah diubah suai ke pH 3 dikocakkan selama 15 min dengan air paya gambut mencatat kadar penyingkiran melebihi 95%. Kajian isoterma penjerapan telah dijalankan dengan menggunakan model Langmuir, Freundlich, Temkin dan Dubinin-Radushkevich atas piawai asid humik. Penjerapan asid humik dengan hampas santan kelapa yang diubah suai adalah satu proses fizikal dengan kapasiti penjerapan sebanyak 232.56 mg/g. Metodologi tindak balas permukaan telah dijalankan berdasarkan reka bentuk komposit berpusat untuk optimasi penjerapan bahan humik dalam skala besar. Kadar penyinkiran bahan humik sebanyak 86.54% diperolehi apabila 4.56 g hampas santan kelapa yang telah diubah suai dikocakkan dalam 100 mL air paya gambut pada 56.8 ° C selama 42.9 min. Hampas santan kelapa yang diperkaya dengan bahan humik berpotensi untuk dikitar semula sebagai makanan haiwan ternakan. Larutan humik telah terbukti boleh menggalakan percambahan dan pertumbuhan tumbuhan kacang hijau.