Research Grant Report

PREPARATION AND STUDY OF MEDICAL GRADE ACTIVATED CARBON PREPARED FROM LOCALLY AVAILABLE FRUITS (UMS GRANT No. B-0901-01-ER/U131)

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ABSTRACT

Activated carbons were prepared using papaya seeds as raw materials. The present study aims to demonstrate and illustrate the following aspects: first the development of activated carbon; second the impact of different thermal treatment condition on the physical and chemical characteristic of the activated carbon; third the corresponding liquid phase adsorption test as evaluated by iodine and methylene blue as adsorbates. The dried papaya seeds were subjected to semi carbonized at 200°C for 15 minutes and activation at elevated temperature of 400°C, 500°C and 600°C under self generated atmosphere. Different activation durations were attempted to activate the semi charred samples. All heating process proceeded in preset temperature to neglect the effect of different progressing heating rate, and also for the cost and time effective perspective. Developed activated carbons were characterized by BET surface area analysis, SEM and FTIR. Increasing burn-off of the samples raised the BET surface area, iodine uptake and methylene blue removal efficiency. These were clearly illustrated by SEM micrographs that porous structures were progressively developed. However, the surface chemistry of the activated carbon under different thermal treatment had neglected variance due to the pH controlled during the preparation process. Activated carbon prepared at 600°C and 45 minutes had the highest BET surface area, iodine number and methylene blue removal efficiency. The BET surface area was 219.056 m^2/g and the iodine number was 196.85 mg/g. The methylene blue adsorption results were well fitted in the Langmuir isotherm, with the highest removal efficiency recorded at 62%. Higher activation temperature tends to produce optimum result than longer activation time, suggested that papaya seeds derived activated carbon with higher surface area and better adsorption capacity can be developed by considering higher activation temperature.

ABSTRAK

Karbon teraktif telah disediakan dengan menggunakan biji betik. Kajian ini mengkaji aspek berikut : pertama, penyediaan karbon teraktif; kedua, kesan keadaan terma yang berbeza ke atas sifat fizikal dan kimia karbon teraktif yang disediakan; ketiga, mengkaji keberkesanan penjerapan dalam fasa cecair dengan iodine dan metilena biru sebagai molekul terjerap Biji betik yang kering melalui pengkarbonan separa pada suhu 200°C selama 15 minit dan diaktifkan pada suhu tinggi 400°C, 500°C dan 600°C dibawah atmosfera pembakaran yang terdiri daripada campuran udara atmosfera asal dan komposisi terbebas daripada pembakaran. Tempoh pengaktifan yang berlainan digunakan untuk mengaktifkan sampel yang telah menjadi separa arang. Semua proses pemanasan dijalankan di bawah suhu yang telah tetap untuk mengabaikan kesan akibat menggunakan kadar pemanasan yang berbeza dan juga untuk faktor keefisien ekonomi dan masa. Produk akhir diuji dengan analisis luas permukaan BET, SEM dan FTIR. Peningkatan dalam kadar pembakaran sampel meningkatkan luas permukaan BET, nombor iodine dan kerbesanan dalam kecekapan penyingkiran metilena biru. Ini dapat dijelaskan lagi dengan mikrograf SEM yang menunjukkan struktur liang terbentuk secara progresif Namun, sifat kimia di permukaan karbon teraktif yang disedia di bawah keadaan terma berbeza, tidak menunjukkan perubahan yang banyak akibat daripada keadaan pH yang dikawal semasa proses penyediaan. Karbon teraktif yang disediakan pada suhu 600°C dan 45 minit mempunyai luas permukaan BET, nombor iodine dan kecekapan penyingkiran metilena biru yang tertinggi. Luas permukaan BET ialah 219.056 m^2/g dan nombor iodine bersamaan 196.85 mg/g. Keputusan penjerapan metilena biru terpadan dengan baik dalam isoterma Langmuir, dengan kecekapan penyingkiran tertinggi 62%. Suhu pengaktifan yang tinggi menghasilkan keputusan yang lebih baik daripada masa pengaktifan yang lama,maka karbon teraktif yang mempunyai luas permukaan dan kecekapan penjerapan yang tinggi boleh disediakan dengan mengambil suhu pengaktifan yang tinggi.

*Adsorption analysis was done using UV-Vis (Methylene Blue). This was due to the breakdown of AAS (Arsenic not used).
* TiO_2 doping onto Activated Carbon – Preliminary experiments (trial/error) done, indicated the possibility and the viability of this research project. This research proposal has been drafted and submitted for e-science research grant.
* Adsorption of fluids (liquid/gas) were done using carbon nanotubes. Fluid dynamics and fluid thermodynamics experimental data indicated the feasibility of this research project. Research proposal is currently being drafted for a research grant submission.