CHARACTERIZATION OF ACTIVATED CARBON PREPARED FROM LOCAL RAW MATERIALS (PALM SHELL) BY CHEMICAL ACTIVATION

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Abbreviations

KOH	Potassium Hydroxide
NaOH	Sodium Hydroxide
$ZnCl_2$	Zinc Chloride
H_3PO_4	Phosphoric Acid
K_2CO_3	Potassium Carbonate
BET	Brunauer, Emmett and Teller
pH	Hydrogen Concentration
CO_2	Carbon Dioxide
$AlCl_3$	Aluminium Chloride
$NaCO_3$	Sodium Carbonate
$MgCl_2$	Magnesium Chloride
H_2SO_4	Sulfuric Acid
C	Carbon
O	Oxygen
H	Hidrogen
BC	Before century
TGA	Thermal Gravimetric Analysis
FTIR	Fourier Transform Infrared Spectrometer
SEM	Scanning Electron Microscopy

IR	Infrared
IUPAC	International Union of Pure and Applied Chemistry
K	Potassium

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ABSTRACT

Activated carbon is a porous carbon material which possesses a high adsorption capacity and is widely used as adsorbent in the purification of liquids and gases. Malaysia is the largest producer of palm oil and produced palm shell as the by-product. Palm shells are generally utilize as fuels or building materials, all with relatively low value. Thus, it is an economical way to use palm shell as a raw material for the preparation of activated carbon. There are two categories for preparing an activated carbon which are physical activation and chemical activation. Chemical activation is known as a single step method of preparation of activated carbon in the presents of chemical agents while physical activation involves a carbonization of carbonaceous materials followed by activation of the resulting char in the presents of activating agents such as CO_2 or steam. Chemical activation presents a few advantages such as lower temperatures (500 to 800 ^{o}C) and low energy cost. Alkali hydroxide such as KOH and NaOH are hazardous, expensive and corrosive and $ZnCl_2$ would cause waste disposal problem. Hence, K_2CO_3 is preferable to be used as chemical activating reagent. The objectives of this study are to characterize the activated carbon prepared using different K_2CO_3 concentrations and to study the thermal stability of the activated carbon. The methods used in this study were preparation of activated carbon using K_2CO_3 at different concentrations as the activating reagent and carbonized at 600^{o}C. The characterizations of the activated carbon were performed using TGA, SEM, FTIR, and BET method. The results obtained showed that the optimum concentration is 30% K_2CO_3 as it produces the highest surface area at 769.9 m^2/g and are comparable to the commercial activated carbon. This is also shown by the pore development captured by SEM and the thermal stability of the activated carbon. Thus, it is concluded that higher concentration of K_2CO_3 produces better quality of activated carbon compared to activated carbon prepared by activation of low concentration K_2CO_3.

ABSTRAK

Karbon aktif adalah bahan karbon berongga yang mempunyai kebolehan menjerap yang tinggi dan digunakan sebagai penjerap di dalam pembersihan cecair dan gas. Malaysia ialah pengeluar kelapa sawit terbesar dan menghasilkan tempurung kelapa sawit sebagai bahan buangan. Tempurung kelapa digunakan sebagai bahan pembakar yang rendah nilainya. Maka, menghasilkan karbon aktif daripada tempurung kelapa sawit adalah cara yang sangat menjimatkan. Terdapat dua kategori untuk menghasilkan karbon aktif iaitu pengaktifan fizikal dan kimia. Pengaktifan kimia dikenali sebagai kaedah satu langkah dengan kehadiran agen kimia manakala pengaktifan fizikal pula melibatkan pembakaran sesuatu bahan diikuti dengan pengaktifannya dengan kehadiran agen pengaktif seperti CO_2 atau stim. Kelebihan pengaktifan kimia ialah penggunaan suhu dan kos tenaga yang rendah. Alkali hidroksida seperti KOH dan NaOH adalah merbahaya, mahal dan mengakis manakala $ZnCl_2$ akan menyebabkan masalah pengurusan sisa. Maka, K_2CO_3 adalah lebih sesuai digunakan sebagai agen pengaktifan kimia. Objektif kajian ini ialah untuk mengkaji ciri-ciri karbon aktif yang dihasilkan menggunakan kepekatan K_2CO_3 yang berlainan dan mengkaji kestabilan terma karbon aktif tersebut. Kaedah yang digunakan ialah penghasilan karbon aktif menggunakan K_2CO_3 pada kepekatan yang berbeza dan dipanaskan pada suhu 600°C. Pencirian karbon aktif dilakukan menggunakan TGA, SEM, FTIR, dan kaedah BET. Keputusan daripada kajian ini mendapati kepekatan optimum ialah pada 30% K_2CO_3 yang menghasilkan luas permukaan paling tinggi iaitu 769.9 m^2/g setanding dengan karbon aktif komersial. Ini juga ditunjukkan oleh pembentukan liang yang diambil menggunakan SEM dan kestabilan terma karbon aktif ini. Kesimpulannya, lebih tinggi kepekatan K_2CO_3 menghasilkan karbon aktif yang lebih baik kualitinya berbanding karbon aktif yang dihasilkan menggunakan kepekatan K_2CO_3 yang rendah.