

**REMOVAL OF BISPHENOL A FROM AQUEOUS SOLUTION BY  
ADSORBING ONTO AN ACTIVATED CARBON OF THE  
AGRICULTURAL WASTE**

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WASTE

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This thesis specially dedicated to my beloved mother, father and brothers

Thank you very much for the endless love, support and prayer.

I love you all.

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## ABSTRACT

Adsorption of bisphenol A (BPA), an endocrine disrupting compound, from aqueous media was studied using activated carbon derived from oil palm empty fruit bunch (EFB) waste. Oil palm EFB waste is a readily available biomass in Malaysia. Annually, Malaysia palm oil mill generates millions tonnes of oil palm EFB waste which is not effectively utilized. In this work, activated carbon was prepared by impregnating EFB for 24 hours in 10% of zinc chloride solution. The impregnated EFB was heated in a horizontal tube furnace under nitrogen flow at 500°C for 1 hour. The samples were characterized by means of Fourier Transform Infrared Spectrometry, Brunauer-Emmett-Teller, and Field Emission Scanning Electron Microscopy. The proximate analysis including moisture content, ash content, bulk density, pH, conductivity and pH at zero charge was conducted to identify the physicochemical properties of the adsorbent. Batch adsorption test was carried out by varying contact time, activated carbon dose, agitation speed, initial BPA concentration, temperature and pH of the solution. The analyses showed that the oval-shaped micro pores were developed in carbon surface causing increase in surface area from 4.29 m<sup>2</sup>/g to 86.62 m<sup>2</sup>/g. The highest adsorption removal of BPA achieved up to 96.1% for 48 hours. The equilibrium data were perfectly represented by Langmuir isotherm with maximum monolayer adsorption capacity of 41.98 mg/g. Kinetic studies indicated that the adsorption process followed the pseudo-second-order kinetic with a rate constant of 0.3 x10<sup>-3</sup> mg/g min. The thermodynamic studies showed that the adsorption capacity increased by the increase in temperature. The results indicate that the activated carbon prepared from EFB has potential as a low cost bio-adsorbent for the removal of BPA from aqueous solution.

## ABSTRAK

Penjerapan Bisphenol A (BPA), salah satu daripada bahan pengganggu endokrin, dari media akueus telah dikaji menggunakan karbon teraktif yang diperolehi daripada sisa tandan buah kosong kelapa sawit (EFB). Sisa EFB kelapa sawit merupakan biojisim sedia ada di Malaysia. Setiap tahun, kilang minyak sawit di Malaysia menjana jutaan tan sisa EFB kelapa sawit yang belum dimanfaatkan secara berkesan. Dalam kajian ini, karbon teraktif telah dihasilkan dengan mengimpregnasi EFB selama 24 jam dalam 10% larutan zink klorida. Sampel terimpregnasi telah dipanaskan di bawah aliran gas nitrogen dalam relau tiub mendatar pada 500°C selama 1 jam. Pencirian sampel dilakukan dengan kaedah Spektroskopi Inframerah Transformasi Fourier, Brunauer-Emmett-Teller dan Mikroskopi Imbasan Elektron Pancaran Medan. Analisis yang lain termasuk kandungan lembapan, kandungan abu, ketumpatan pukal, pH, konduktiviti dan pH pada cas kosong telah dijalankan untuk mengenal pasti ciri-ciri kimia fizik bahan penjerap. Ujian penjerapan berkelompok telah dijalankan dengan mengubah masa sentuhan, jumlah karbon teraktif, kelajuan pengacauan, kepekatan awal BPA, suhu dan pH larutan. Analisis menunjukkan bahawa liang mikro berbentuk bujur terbentuk pada permukaan karbon menyebabkan luas permukaan meningkat dari 4.29 m<sup>2</sup>/g ke 86,62 m<sup>2</sup>/g. Penyingkiran penjerapan BPA tertinggi telah dicapai sehingga 96.1% selama 48 jam. Data keseimbangan mengikut isoterma Langmuir dengan kapasiti penjerapan lapisan tunggal maksimum sebanyak 41.98 mg/g. Kajian kinetik menunjukkan proses penjerapan mengikut kinetik tertib-pseudo-kedua dengan pemalar kadar 0.3 x10<sup>-3</sup> mg/g min. Kajian termodinamik menunjukkan kapasiti penjerapan bertambah dengan peningkatan suhu. Keputusan kajian ini menunjukkan bahawa karbon teraktif yang dihasilkan daripada EFB berpotensi sebagai penjerap-bio kos rendah untuk penyingkiran BPA daripada larutan akueus.