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# Removal of 1-Butyl-3-methylimidazolium bromide from an aqueous solution by using a spongy chitosan-activated carbon composite

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ABSTRACT

This study reports the potential of chitosan-activated carbon composite (CH-AC) on the removal of hydrophilic imidazolium-based ionic liquid from aqueous solution. 1-Butyl-3-methylimidazolium bromide, [BMIM][Br] one of the mostly applied hydrophilic imidazolium-based ILs was selected for this study. The CH-AC was characterised using Scanning Electron Microscopy (SEM), Energy Dispersive X-ray spectroscopy (EDX), X-ray diffraction (XRD), Thermogravimetric analysis (TGA) and Fourier Transform Infrared Spectroscopy (FTIR). The effect of adsorption experimental conditions like initial concentration, pH, contact time and adsorbent dosage were examined, and the change in [BMIM][Br] concentration for the uptake process was monitored. The micrograph of CH-AC revealed an irregular shaped stone-like material held on rough surface which differ in surface morphology from the precursor used for preparing the composite. Distinct peaks were observed on XRD pattern of CH-AC at various 2Θ suggesting the intercalation of AC into chitosan. The disappearance of characteristic peak of chitosan at 10° on CH-AC was attributed to interruption of the crystalline region. The experimental data analysed using Langmuir and Freundlich isotherms fitted best into Langmuir model. The CH-AC applied on [BMIM][Br] removal give adsorption capacity of 12.17 mg/g (0.056 mmol/g) as calculated from Langmuir model. The adsorption kinetics fitted into pseudo-second order model.

## 1. Introduction

Recently, the use of ionic liquids (ILs) as a potential "green solvent" has gained attention in scientific environment [5,26,36,41]. This is connected with some important properties of ILs such as considerably negligible vapour pressure, good stability over a wide temperature range, good solvent capacity among others. Ionic liquids (ILs) are organic salts with melting temperature quite lower (below 100 °C) for their existence as liquid at room temperature [1,14]. Discharge of ILs as effluents into the aquatic environment may not be avoidable. Therefore, attention into their application as solvents with subsequent discharge into the environment is eventually leading to their consideration as emerging organic contaminants. Their good stability has also made some ILs to have low biodegradability characteristics in natural environment [8,45]. In addition, it has been revealed that some commonly applied ILs can be hazardous to aquatic organisms [25,37,48], specifying the necessity for its removal/recovery from aqueous wastes before the waste could be discharged into the environment's water bodies.

Meanwhile, various common techniques such as solvent extraction, thermal degradation, chemical oxidation, advanced oxidation processes [33,43,44], adsorption and biological treatment methods [13,22,23,32] have been utilised for removing different emerging organic pollutants including ILs from aqueous medium. Among these methods, adsorption has been considered as one of the non-destructive and cost effective methods for the purpose of ILs removal or recovery [8,12,20].

The adherence of hydrophilic and hydrophobic of ILs on solid adsorbents such as activated carbon (AC) and clay minerals had been investigated [20,25,28,30,40]. The uptake of ILs by activated carbon is a potential removal process for hydrophobic ILs from aqueous medium. Findings revealed a lower adsorption capacity for hydrophilic ILs removal but investigation have also revealed that the adsorption capacity could be enhanced through modification of surface chemistry of AC, featuring increasing the number of oxygen bearing group (e.g. OH) to facilitate hydrogen bonding with the basic species of hydrophilic ILs [25]. There is a need to intensify research on the removal process of hydrophilic ionic liquids, most especially the imidazolium based that were mostly studied and applied.

Chitosan is biodegradable and nontoxic biopolymer which is

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