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Mesoporous Functionalized g-C_3N_4 with Magnetic Properties for Adsorption of Tetracycline from Water

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Abstract

Tetracycline (TC) antibiotic with high water solubility and a long environmental half-life is extensively used in human and veterinary medicine. In this study, graphitic carbon nitride (g-C_3N_4) was functionalized with hydrophobic 1H, 1H, 2H, 2H-perfluorooctyltriethoxysilane and was used for the adsorption of TC antibiotic. The synthesized adsorbent was characterized by using, XRD, SEM and VSM. The perfluorinated and magnetic g-C_3N_4 (PMCN) with hydrophobic property floated on the surface of solution and separated easily by using magnetic force. The adsorption capacity of PMCN towards TC was enhanced by about ten times compared to bare g-C_3N_4, and reached 222.2 mg/g. In the equilibrium adsorption test, three adsorption isotherm models, namely the Freundlich, Langmuir and BET were investigated, and data for the adsorption of TC on bare g-C_3N_4 and PMCN showed the best fit to the BET model. Three models, including, pseudo-first-order, pseudo-second-order and intra-particle diffusion were used to explain the adsorption kinetics. The adsorption of TC on both adsorbents followed the pseudo-second-order kinetic model. As a result of potential photocatalytic activity of g-C_3N_4, the developed modified bifunctional adsorbent/photocatalyst can be used for the adsorption and subsequent photocatalytic degradation of hazardous organic contaminates such as TC.

Key words: Adsorption, g-C_3N_4, Tetracycline, Magnetic, Antibiotic, Functionalized adsorbent

1. Introduction

The extensive use of pharmaceutical antibiotics in human therapy and the farming industry has led to the detection of these hazardous compounds in the aquatic environment [1]. This is because large fractions of most antibiotics are excreted through urine and feces as a result of the slow rate of metabolism, and end up in the surrounding aquatic environment via runoff [2, 3]. The presence of these compounds in water bodies is a growing concern due to their impact on the enhancement of antibiotic resistant microorganisms, potential risks to the ecosystem and disruption of indigenous microbial populations even at low concentrations [2, 4]. Tetracycline (TC) is the most widely used antibiotics in the