10 th International Conference on Innovation and Research in Engineering Sciences
GEORGIAN INTERNATIONAL ACADEMY OF SCIENCES AND STUDIES
11 November 2021 -TBILISI GEORGIA
www.icires.ir
info@icires.ir

Scallop shell coated Fe_2O_3 nanocomposite as an eco-friendly adsorbent for tetracycline removal

Dariush Naghipour[1]
School of Health, Guilan University of Medical Sciences
Rasht, Iran

Kamran Taghavi[3]
School of Health, Guilan University of Medical Sciences
Rasht, Iran

Fatemeh Javan Mahjoub Doust[2]
School of Health, Guilan University of Medical Sciences
Rasht, Iran

Jalil Jaafari[4]
School of Health, Guilan University of Medical Sciences
Rasht, Iran

Abstract— The present study focused on the usability of scallop shell coated Fe_2O_3 nanoparticles as an eco-friendly new absorbent in the treatment of tetracycline (TC). The process performance in terms of TC removal was investigated at different operating conditions i.e. at solution pH of 7-11, Fe_2O_3-scallop dosage of 0.4- 2.4 g L^{-1}, initial TC content of 20-120 mg L^{-1}, and temperature of 25- 55 ℃. Solution pH of 7 yielded the highest TC removal efficiency (99%). At this pH value, almost complete TC removal was achieved at a Fe_2O_3-scallop shell nanocomposite dose of 1.6 g L^{-1}, and 25 °C. The responsible TC removal mechanism suggested as the non-electrical π-π dispersion interaction between the bulk π system on the absorbent surface and TC molecules bearing both benzene rings and double bonds at this solution pH. TC removal efficiency appreciably enhanced up to the Fe_2O_3-scallop dosage of 1.6 g L^{-1} being an optimum. Adsorption rate found to be fast at lower initial TC concentrations than 40 mg L^{-1}. The effect of temperature on TC removal efficiency was insignificant. Adsorption followed the pseudo-second order kinetic model. Experimental data perfectly fitted by the Langmuir equation. The maximum adsorption capacity was calculated as 49.26 mg g^{-1}. Thermodynamic analysis demonstrated that adsorption process was a spontaneous process and endothermic. The results obtained from present study proved the excellent performance of scallop shell coated Fe_2O_3 nanoparticles as an eco-friendly adsorbent in TC treatment.

I. INTRODUCTION

Tetracyclines (TCs) are the most commonly used antibiotics as human and veterinary medicines owing to their broad spectrum activities and low costs [1, 2] [3] [4]. Around 25 to 75% of tetracyclines are excreted in unchanged form and released into the environment via sewage networks [1, 4]. Such pharmaceutically active substances have the potential of bioaccumulation due to their resistances or pseudo-resistances, toxicities, and resistances to biodegradation [4, 5, 6, 7, 8]. The entrance of these substances into the water bodies has prompted world public health concern owing to their long-term unfavorable impacts such as inhibition the growth and development of aquatic species and nephropathy, endocrine disruption, central nervous system defect, and mutagenicity [1, 9].

Recent data demonstrated that classical municipal wastewater treatment plants are not able sufficiently and completely to treat TCs and these insufficiently treated antibiotic residues introduce into environment [1]. Therefore, to protect environment, particularly aquatic media, huge and remarkable efforts have been made to find out and develop the most efficient and suitable TCs treatment technologies for the minimization of entrance of TCs into the environment. Until now, many effective and cost-effective treatment technologies such as adsorption, membrane processes, advanced treatment processes and electrochemical processes [10, 11] have been employed for elimination of tetracycline from water and wastewater. Among these treatment technologies, adsorption methods have been widely employed for TCs treatment because of its high efficiency, lack of byproducts and other characteristics. Actually, adsorption process seems to be a promising TCs treatment method when utilized a proper and efficient adsorbent. To date, several adsorbents such as activated carbon derived from KOH activation of tyre