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The Utilization of Activated Carbon/Lignin Biocomposite as Recyclable Sorbent For In-Situ Removal of High-Concentration BTX from Petroleum Wastewater

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Extended Abstract

Among varies petroleum pollutants of interest, BTX (i.e., benzene, toluene, and xylene of ortho, meta and para-positions) mono-aromatics has found to be the most environmental problem [1]. Environmental legalization policies are listed BTX as contaminants of emerging concerns (CECs) because of their potential toxic and/or carcinogenic properties for human health or animals and drinking water contamination, even in trace levels [2]. In this work, a facile one-pot co-precipitation process was developed to construct granule activated carbon (gAC)/Kraft lignin (KL) biocomposite (gAC/KL_x) as a new eco-friendly sorbent from recycling industrial wastes of both palm-date pits and pulping black liquor. The synthesized gAC/KL_x biocomposite with defined characteristics using ATR-FTIR, XRD, SEM, BET, TGA, DLS and Zeta potential analyses was utilized as an effective sorbent of environmentally toxic BTX compounds (benzene, toluene and xylene) from petroleum wastewater effluents. Sorption behavior of BTX over gAC/KL_x biocomposites with different ratios of Kraft lignin (x = 33, 50 and 67%) in batch experiments were evaluated using high performance liquid chromatography (HPLC). Interestingly, the gAC/KL showed the highest sorption capacity of BTX at lignin blended ratio of 50%, even from broad ranges of water salinity (up to 100,000 mg/L) and pH values (pH 4 - 9). The sorption behavior of BTX compounds were found to fit better to a type two pseudo-second kinetic (adsorption kinetic rate of BTX at 0.104 $g.mg^{-1}.min^{-1}$) and Langmuir isotherm models, as confirmed by the higher coefficient of $R^2 > 0.98$. The sorption affinities of the $gAC/KL_{0.5}$ biocomposite with respect to 250 mg/L BTX can be ordered in the sequence Xylene > Toluene ≥ benzene with highest monolayer capacities reached to 170.5, 160.5 and 159.7 mg/g, respectively after 6 h. The adsorption mechanism was found to follows the diffusion and hydrophobic sorption mechanisms. Particularly, the possibilities of BTX elution for $gAC/KL_{0.5}$ reuse were evaluated up to five cycles without high significant loss in sorption efficiencies during multiple wastewater treatment. As such, on the basis of batch BTX sorption studies, the $gAC/KL_{0.5}$ is expected to be a promising low cost and high performance new sorbent to be reutilize for real wastewater treatment process and petroleum hazardous decontamination with higher thermal stability (up to 350 °C) and aqueous stability (10% - 21% efficiency loss).

Keywords: Waste Management, Activated Carbon, Lignin-Based Biocomposite, BTX Hazardous, Petroleum Wastewater Treatment.

References

[1] R. Navarro Amador, L. Cirre, M. Carboni, D. Meyer, "BTEX removal from aqueous solution with hydrophobic Zr metal organic frameworks," *J. Environ. Manage*., vol. 214,pp. 17–22, 2018. DOI:10.1016/j.jenvman.2018.02.097.

[2] A. I. Stefanakis, J. A. Becker, "A review of emerging contaminants in water: Classification, sources and potential risks," Impact of Water Pollution on Human Health and Environmental Sustainability, 2015, pp. 57–82. DOI:10.4018/978-1-4666-9559-7.ch003.