ISGC 2022

N°597 / OC
TOPIC(s) : Waste and side streams valorization / Chemical engineering

Facile fabrication of novel aerogel of electronic waste derived carbon for petrochemical refinery wastewater treatment

AUTHORS

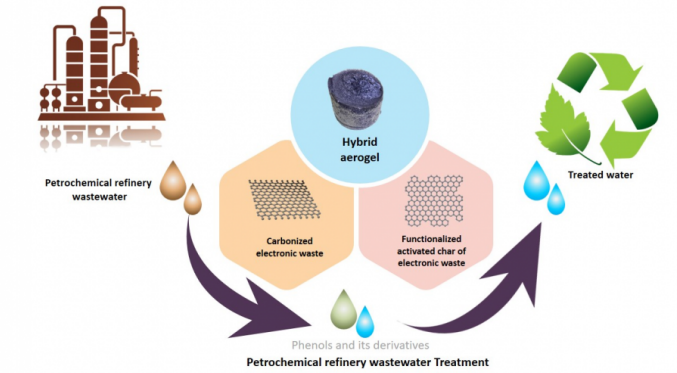
MARUT JAIN / INDIAN INSTITUTE OF TECHNOLOGY, INDIAN INSTITUTE OF TECHNOLOGY DELHI, DELHI
PRASHANT RAM JADHAO / INDIAN INSTITUTE OF TECHNOLOGY DELHI, DEPARTMENT OF CHEMICAL ENGINEERING IITD, DELHI
KAMAL KISHORE PANT / INDIAN INSTITUTE OF TECHNOLOGY DELHI, DEPARTMENT OF CHEMICAL ENGINEERING IITD, DELHI
ZYTA M. ZIORA / THE UNIVERSITY OF QUEENSLAND, ST LUCIA QLD 4072 AUSTRALIA, BRISBANE
MARK A. T. BLASKOVICH / THE UNIVERSITY OF QUEENSLAND, ST LUCIA QLD 4072 AUSTRALIA, BRISBANE

PURPOSE OF THE ABSTRACT

Petrochemical industries and refineries are considered the backbone of a developing nation's economy. However, growing environmental concern and stringent pollution control norms have affected their long-term sustainability. Thus, it is essential to find economical and affordable solutions to control pollutants generated from the industries and refineries. Phenol and its derivatives are the major pollutants present in the petrochemical refinery wastewater [1]. Electronic waste is increasing with a staggering annual rate of 4%?5% globally and electronic waste generated in 2019 was approximately 53.6 million metric tons [2]. Hence this waste material has been used for the treatment of wastewater.

In the present study, we have employed the novel, highly porous, and hydrophobic hybrid aerogel of the carbon derived from electronic waste using the freeze-drying process. The carbon material from the electronic waste was obtained using the pyrolysis and ultrasonication process and the methodology is reported in our published article [3]. The hybrid aerogel thus formed is utilized to remove phenol, and 2,4-dichlorophenol, one of the major pollutants in industrial effluents. The novel aerogel derived performed excellently for the removal of phenol, and 2,4-dichlorophenol with 92% and 95% removal efficiency respectively. The structure of aerogel is analyzed by field emission scanning electron microscope, transmission electron spectroscopy, Fourier transform infrared spectra, and N2 adsorption and desorption experiment. ANOVA analysis based on the central composite design-response surface methodology (CCD-RSM) showed a good fit between quadratic model predictions with experimental values, thus resulting in R2 of 0.9992 and 0.9997 for phenol and 2,4-DCP respectively. Furthermore, adsorption behavior, including kinetics, isotherms, and thermodynamics, are systematically investigated. The thermodynamic study also signifies a favorable and spontaneous removal process. Subsequently, the effect of adsorbent dosage, phenol concentration, contact time, and pH on phenol removal from the wastewater was studied. The adsorption mechanism of phenols with the synthesized aerogel is also well studied. The results obtained confirm that the synthesized aerogel is an effective medium to remove phenols from industrial wastewater effectively.

FIGURES



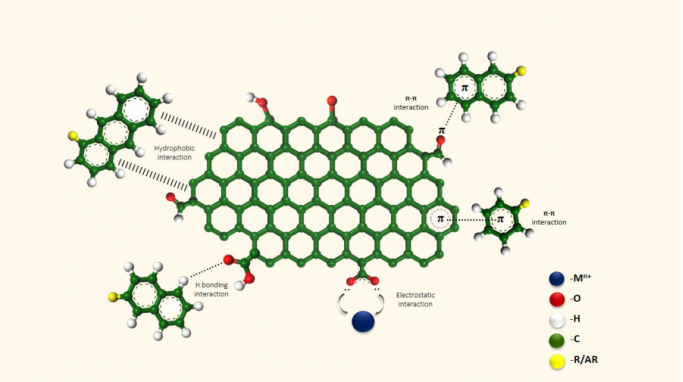


FIGURE 1
Novel aerogel of electronic waste derived carbon
Graphical Abstract

FIGURE 2
Interaction strategy of aerogel with pollutants
Modes of interactions of pollutants with the aerogel of carbon derived from electronic waste

KEYWORDS
Petrochemical refineries | Phenol | electronic waste | Wastewater treatment

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