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Experimental Design Technique on Removal of Hydrogen Sulfide using CaO-eggshells Dispersed onto Palm Kernel Shell Activated Carbon: Experiment, Optimization, Equilibrium and Kinetic Studies

OMAR Abed Habeeb[1], RAMESH Kanthasamy[1], GOMAA A. M. Ali[2,3,4], ROSLI bin Mohd Yunus[1]

(1. Faculty of Chemical & Natural Resources Engineering, Universiti Malaysia Pahang, Gambang, 26300, Kuantan, Malaysia; 2. Faculty of Industrial Sciences and Technology, Universiti Malaysia Pahang, Gambang, 26300 Kuantan, Malaysia; 3. Chemistry Department, Faculty of Science, Al-Azhar University, Assiut, 71524, Egypt; 4. Al-Azhar Center of Nanoscience and Applications (ACNA), Al-Azhar University, Assiut, 71524, Egypt.)

Abstract: This study presents the use of chicken eggshells waste utilizing palm kernel shell based activated carbon (PKSAC) through the modification of their surface to enhance the adsorption capacity of H_2S. Response surface methodology technique was used to optimize the process conditions and they were found to be: 500 mg/L for H_2S initial concentration, 540 min for contact time and 1 g for adsorbent mass. The impacts of three arrangement factors (calcination temperature of impregnated activated carbon (IAC), the calcium solution concentration and contact time of calcination) on the H_2S removal efficiency and impregnated AC yield were investigated. Both responses IAC yield (IACY, %) and removal efficiency (RE, %) were maximized to optimize the IAC preparation conditions. The optimum preparation conditions for IACY and RE were found as follows: calcination temperature of IAC of 880 ℃, calcium solution concentration of 49.3% and calcination contact time of 57.6 min, which resulted in 35.8% of IACY and 98.2% RE. In addition, the equilibrium and kinetics of the process were investigated. The adsorbent was characterized using TGA, XRD, FTIR, SEM/EDX, and BET. The maximum monolayer adsorption capacity was found to be 543.47 mg/g. The results recommended that the composite of PKSAC and CaO could be a useful material for H_2S containing wastewater treatment.

Key words: water treatment; hydrogen sulfide; response surface methodology; optimization; activated carbon; adsorption isotherm; kinetics; calcium oxide

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RAMESH Kanthasamy: Ph D; E-mail: ramesh@ump.edu.my

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