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Removal of recalcitrant organic pollutants from bio-treated coking wastewater using coal-based carbonaceous materials

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ABSTRACT

Low-cost coal-based carbonaceous material has attracted special attention for treatment of recalcitrant industrial wastewater. In this study, adsorption of recalcitrant organic pollutants from bio-treated coking wastewater using powder coke, lignite-based activated coke and tar-based activated carbon were investigated. The results showed that the adsorption followed Freundlich isotherm, indicating a heterogeneous adsorption for these substances. The activated coke exerted the best removal of COD (55%) and colority (77%) at 30 $g \cdot L^{-1}$, pH = 4 and 25ºC with contact time of 120 min, nearly 20% and 80% higher than activated carbon and powder coke at their respective optimum conditions. This is attributed to the abundant oxygen-containing functional groups in its structure in spite of the apparently lower surface area than activated carbon. The lowest adsorption demonstrated by powder coke is correlated to the smallest surface area (0.81 $m^2 \cdot g^{-1}$). In addition, the adsorption behavior over time was followed the pseudo-second-order kinetic model very well. The time to reach equilibrium is short for activated carbon and intraparticle diffusion seems to be the rate controlling step. However, the adsorption on activated coke and powder coke is slower than activated carbon and the surface diffusion is more important in these processes. It is expected the study will provide a technical insight into the above said carbonaceous adsorbent and also identifying the low-cost adsorbent for bio-treated coking waste water treatment.

Keywords: Recalcitrant organic pollutants; Bio-treated coking wastewater; Adsorption; Coal-based carbonaceous materials

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