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Application of Artificial Neural Network, Response Surface Methodology and Support Vector Regression Approaches for the Prediction of Heavy Metal Removal Capacities

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Water pollution stemmed from agricultural, industrial, and municipal activities has become a vital problem to humankind and the ecosystem. A wide variety of wastewater treatment techniques have to date proposed and implemented. Among the treatments, adsorption has come to the fore due its low cost, easiness to operate and maintain, and relatively simple design. Activated carbon employed in the adsorption process has been used for the removal of heavy metals in the industrial wastewater and the heart has gradually been shifted to developing and engineering low cost but efficient adsorbents. The current study was carried out with the following objectives: (1) to produce activated carbons from industrial waste as candidate adsorbents to remove Pb (II) heavy metals in the aqueous media (2) to analyze the batch-adsorption system data using empirical models versus theoretical models (3) to study the possibility of using Response Surface Methodology (RSM), Artificial Neural Network (ANN), and Support Vector Regression (SVR) to predict accurately the removal of heavy metal ions (4) to enlighten the adsorption mechanism through FTIR, SEM EDX-Mapping, TEM, and XRD analysis. The maximum heavy metal removal was reached up to 90% by the produced adsorbents. In addition, the ANN approach was found to be the best in data fitting and estimation, and generalization.

Keywords: Adsorption, Heavy Metal, Response Surface Methodology, Artificial Neural Network, Support Vector Regression