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Use of artificial neural networks and genetic algorithms for prediction of sorption of an azo-metal complex dye onto lentil straw

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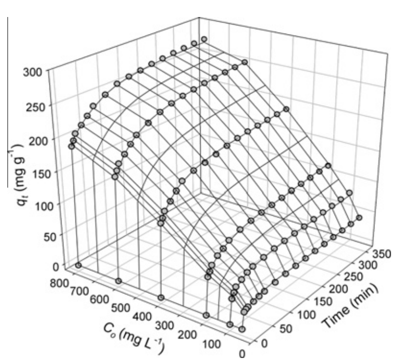
HIGHLIGHTS

- ▶ Predictive modeling of sorption of Lanaset Red (LR)G on lentil straw was studied.
- ▶ Artificial neural network (ANN) was found to be excellent model in representing the sorption kinetics data.
- ▶ The sorption at various operating factors in a single equation was described by gene expression programming (GEP).

GRAPHICAL ABSTRACT



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ABSTRACT

Artificial neural network (ANN), pseudo second-order kinetic, and gene expression programming (GEP) models were constructed to predict removal efficiency of Lanaset Red G (*LR G*) using lentil straw (*LS*) based on 1152 experimental sets. The sorption process was dependent on adsorbent particle size, pH, initial dye concentration, and contact time. These variables were used as input to construct a neural network for prediction of dye uptake as output. ANN was an excellent model because of the lowest error and the highest coefficient values. ANN indicated that initial dye concentration had the strongest effect on dye uptake, followed by pH. The GEP model successfully described the sorption kinetic process as function of adsorbent particle size, pH, initial dye concentration, and contact time in a single equation. Low cost adsorbent, *LS*, had a great potential to remove *LR G* as an eco-friendly process, which was well described by GEP and ANN.

1. Introduction

Various water treatment processes are used to remove undesired materials from industrial and domestic effluents. Sorption is an effective and eco-friendly process to remove color compounds from wastewaters due to its simplicity in operation and availability of a wide range of adsorbents (Srinivasan and Viraraghavan, 2010; Çelekli and Geyik, 2011). Sorption is highly dependent on various operating variables like adsorbent particle size, adsorbent dose, pH regime, dye concentration, temperature, ionic strength, and contact time. Operating factors consisted of multi-input variables (e.g., adsorbent dose, pH value, temperature, ionic strength, dye concentration, and contact time) and output(s) (e.g., percentage value of removal, dye adsorbed per unit of adsorbent at time *t* and at equilibrium), are closely related in sorption systems. To solve these types of complex issues, modeling of the sorption process can be achieved via artificial neural network (ANN) techniques (Khataee and Kasiri, 2010). This approach has been used to describe

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