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Removal of color from real textile dyeing effluent utilizing tannin immobilized jute fiber as biosorbent: optimization with response surface methodology

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Abstract

The present study explored an efficient technoeconomic method for treating intensely colored dyeing effluents from a commercial source. Firstly, the adsorption efficacy of jute fiber (JF) was enhanced through grafting with tannin, a natural polyphenol, via incorporation of active epoxy groups by epichlorohydrin onto fiber surface. The effect of different experimental parameters (e.g., initial pH, adsorbent dose, temperature, and contact time) on extent of color removal was evaluated performing batch studies. A full factorial central composite design (CCD) in response surface methodology (RSM) was applied to optimize the decolorization process for achieving maximum color removal (99.5%) at pH 4.9, adsorbent dose 11.8 g/L, temperature 30 °C, and time of contact 117.8 min. The isotherm and kinetic studies of the process revealed that Langmuir model and pseudo-second-order model provided best fit, yielding high correlation coefficients ($R^2 > 0.997$). Significant desorption (76%) of the spent adsorbent by 0.1 M NaOH solution suggested that this tannin-modified JF can find a prospective practical application as a novel, inexpensive, and potential bioadsorbent to treat the dyeing effluent.

Keywords:
Jute Fibre; Bioadsorption, Textile Waterwaste, Response surface methodology, Chemical modification.

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