

## Activated carbon from *Thapsia transtagana* stems: central composite design (CCD) optimization of the preparation conditions and efficient dyes removal

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### ABSTRACT

This study investigates the preparation of activated carbons from *Thapsia transtagana* stems using chemical H<sub>3</sub>PO<sub>4</sub> activation and their ability for cationic and anionic dyes removal from aqueous solution. Central composite design and response surface methodology (RSM) were used for the optimization of the preparation conditions and dyes removal efficiency. Five responses were targeted which are iodine number (IN), methylene blue index (MB index) and removal efficiency for methyl violet (MV), methyl orange (MO) and indigo carmine (IC). From the experimental results, the maximum iodine number and methylene blue index obtained were 1,082.22 and 397.54 mg g<sup>-1</sup>, respectively. The highest removal efficiency for methyl violet was obtained by activated carbon sample activated at 400°C for 145 min with an impregnation ratio of 2 g g<sup>-1</sup>. For methyl orange, the best conditions were activation temperature of 450°C, impregnation ratio of 1.5 g g<sup>-1</sup> and activation time of 155 min. For indigo carmine, activation temperature of 500°C, impregnation ratio of 2 g g<sup>-1</sup> and activation time of 145 min. Under these conditions, the maximum adsorption capacities were 358.68 mg g<sup>-1</sup> for methyl violet, 305.88 mg g<sup>-1</sup> for methyl orange and 196.06 mg g<sup>-1</sup> for indigo carmine. The best activated carbon samples were characterized by Fourier transform infrared spectroscopy, XRD and scanning electron microscopy–energy-dispersive X-ray. The functional groups were also determined by Boehm titration.

**Keywords:** Activated carbon; *Thapsia transtagana*; Dyes removal; Central composite design

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