



## Ultrasound-assisted removal of methylene blue from aqueous solution by milk thistle seed

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### ABSTRACT

The milk thistle seeds were tested as a possible adsorbent for the removal of methylene blue (MB) from aqueous solutions in the absence and presence of ultrasound. Batch adsorption studies were conducted to study the effects of different parameters such as adsorbent dose, initial dye concentration and ultrasonic power on MB dye adsorption. The simultaneous association of ultrasound and stirring leads to an intensification of the adsorption process. The amount of MB dye adsorption with the assistance of ultrasound was improved with the increase of adsorbate initial concentration and with the decrease of adsorbent dosage. The acoustic power was an important factor for the enhancement of the removal of MB dye. Adsorption isothermal data could be well simulated by Freundlich model, and then Langmuir and Temkin models. Langmuir simulation showed that the monolayer adsorption capacities of milk thistle seed were 44.25 and 181.49 mg g<sup>-1</sup> for the conventional method and for the combined method, respectively. The combination of ultrasound and stirring for the adsorption process was shown to be of interest for the treatment of wastewaters contaminated with MB.

*Keywords:* Ultrasound; Adsorption; Methylene blue; Milk thistle seed

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