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# Highly efficient and rapid removal of a toxic dye: Adsorption kinetics, isotherm, and mechanism studies on functionalized multiwalled carbon nanotubes

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## Abstract

In the present work, multiwalled carbon nanotubes functionalized with L-tyrosine (CNT-TYR) was used as a nanoadsorbent to remove a toxic dye, methylene blue (MB). To understand the adsorption behaviour of the MB dye on the nanoadsorbent, the adsorption mechanism, kinetics and isotherm were studied in detail. The factors that influence the adsorption process such as stirring speed (200–800rpm), contact time (0–150min), amount of nanoadsorbent (5–25mg), pH (2–10), temperature (25–65 °C), and initial dye concentration (10–300mg L<sup>-1</sup>) were optimized. It was observed that >95% adsorption occurred at pH 6, 25 °C temperature, and 7 min of contact time. The maximum adsorption capacity attained at the optimum conditions was 440mgg<sup>-1</sup>, which is higher in comparison to other reported nanoadsorbents. The kinetics study was done using pseudo first order, pseudo second order, intraparticle diffusion, and fractional power model, and the results indicated that the pseudo second order model was followed for the adsorption of MB dye on CNT-TYR. The study of adsorption isotherms was conducted for the Langmuir, Freundlich,