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Synthesis of $ZnFe_2O_4$-AC/CeMOF for Improvement Photodegradation of Textile Dyes Under Visible-light: Optimization and Statistical Study

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Abstract : A facile solvothermal procedure was applied to fabricate zinc ferrite nanoparticles ($ZnFe_2O_4$ NPs). Activated carbon (AC) derived from peanut shells is synthesized using a microwave through the chemical activation method. The $ZnFe_2O_4$-AC composite is then mixed with a cerium-based metal-organic framework (CeMOF) by solid-state adding to formulate $ZnFe_2O_4$-AC/CeMOF composite. The synthesized photo materials were tested by scanning/transmission electron microscope (SEM/TEM), Photoluminescence (PL), (XRD) X-Ray diffraction, (FTIR) Fourier transform infrared, (UV-Vis/DRS) ultraviolet-visible/diffuse reflectance spectroscopy. The prepared $ZnFe_2O_4$-AC/CeMOFphotomaterial shows significantly boosted efficiency for photodegradation of methyl orange /methylene blue (MO/MB) compared with the pristine $ZnFe_2O_4$ and $ZnFe_2O_4$-AC composite under the irradiation of visible-light. The favorable $ZnFe_2O_4$-AC/CeMOFphotocatalyst displays the highest photocatalytic degradation efficiency of MB/MO (R: 91.5-88.6%, consecutively) compared with the other as-prepared materials after 30 min of visible-light irradiation. The apparent reaction rate K: 1.94-1.31 min-1 is also calculated. The boosted photocatalytic proficiency is ascribed to the heterojunction at the interface of prepared photo material that assists the separation of the charge carriers. To reach optimization, statistical analysis using response surface methodology was applied. The effect of independent parameters (such as A (pH), B (irradiation time), and (c) initial pollutants concentration on the response function (%)photodegradation of MB/MO dyes (as examples of azodyes) was investigated via using central composite design. At the optimum condition, the photodegradation efficiency (%) of the MB/MO is 99.8-97.8%, respectively. $ZnFe2O_4$-AC/CeMOF hybrid reveals good stability over four consecutive cycles.

Keywords : azo-dyes, photo-catalysis, zinc ferrite, response surface methodology
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