

# Green Synthesis of Reduced Graphene Oxide/CoFe<sub>2</sub>O<sub>4</sub>/Fe Nanocomposite for the Photocatalytic and Fenton-Like Degradation of Glyphosate in Water

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Herbicide overuse is alarmingly high today, particularly those containing substantial amounts of Glyphosate, or GLP (C<sub>3</sub>H<sub>8</sub>NO<sub>5</sub>P). GLP, commonly used for weed control, poses significant risks due to its excessive solubility in water, far exceeding safe limits. This study introduces a ternary nanocomposite of reduced graphene oxide, cobalt ferrite, and zero-valent iron (rGO/CoFe<sub>2</sub>O<sub>4</sub>/Fe<sub>0</sub>), synthesized through an eco-friendly method. This composite serves as a catalyst to activate peroxymonosulfate (HSO<sub>5</sub>, PMS) for effective glyphosate removal from water. The rGO/CoFe<sub>2</sub>O<sub>4</sub>/Fe<sub>0</sub> nanocomposite underwent extensive characterization using techniques like FTIR, XRD, UV-Vis DRS, VSM, SEM, TEM, EDX, Raman, and BET. It was found to have densely packed CoFe<sub>2</sub>O<sub>4</sub> (25 nm) and Fe<sub>0</sub> (50 nm) nanoparticles on rGO sheets. Notable features of the nanocomposite include a high specific surface area (118.9 m<sup>2</sup>/g), high saturation magnetization (30.16 emu/g at 11 kOe), superparamagnetic properties, a narrow band gap energy (1.30 eV), and a remarkable GLP degradation efficiency of 99.62%. Detailed studies were conducted to explore how various environmental factors such as catalyst dosage, PMS concentration, and pH impact GLP degradation. The study identified a photocatalytic mechanism by which reactive oxygen species (ROS) degrade GLP, emphasizing the primary role of sulfate radicals (SO<sub>4</sub>•<sup>-</sup>), followed by holes (h<sup>+</sup>), superoxide radicals (O<sub>2</sub>•<sup>-</sup>), singlet oxygen (<sup>1</sup>O<sub>2</sub>), and hydroxyl radicals (HO•). The rGO/CoFe<sub>2</sub>O<sub>4</sub>/Fe<sub>0</sub> nanocomposite demonstrated excellent properties as a magnetic visible-light photo-Fenton-like catalyst, showing great promise for practical applications in wastewater treatment.