

**GREEN SYNTHESIS OF BiVO_4 USING COSMOS CAUDATUS
EXTRACT FOR DEGRADATION OF METHYLENE BLUE DYE**

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ABSTRACT

GREEN SYNTHESIS OF BiVO_4 USING *COSMOS CAUDATUS* EXTRACT FOR DEGRADATION OF METHYLENE BLUE DYE

Water pollution, particularly from industrial effluents containing synthetic dyes, poses a significant threat to both environmental and human health. In Malaysia, inefficient treatment of industrial wastewater has significantly deteriorated river water quality, with synthetic dyes such as methylene blue contributing to the persistence and toxicity of aquatic pollutants. Conventional wastewater treatment systems frequently exhibit limited efficiency in removing synthetic dyes due to their high chemical stability and resistance to biodegradation, thereby prompting the search for more effective and environmentally sustainable treatment alternatives. The study aims to analyze the effect of using *Cosmos caudatus* extract for green synthesis of BiVO_4 nanoparticles and to evaluate the effect of calcination temperature on the photocatalytic performance of the green synthesized BiVO_4 on the degradation of methylene blue dye under visible light irradiation. In this research, BiVO_4 photocatalyst was synthesized using a green synthesis approach using *Cosmos caudatus* extract as a natural reducing agent to support environmentally friendly material fabrication. The synthesized BiVO_4 samples were calcined at 450°C and 550°C to investigate the effect of calcination temperature on their structural and photocatalytic properties. Structural characterization was carried out using X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), and Fourier transform infrared spectroscopy (FTIR). XRD analysis confirmed the formation of monoclinic BiVO_4 with improved crystallinity after calcination, while FTIR spectra verified the presence of characteristic Bi-O and V-O bonding vibrations. FESEM analysis revealed the surface morphology and particle distribution of the synthesized BiVO_4 , showing improved particle definition and reduced agglomeration after calcination. The photocatalytic performance of the synthesized BiVO_4 was evaluated through the degradation of methylene blue dye under visible light irradiation. The BiVO_4 sample calcined at 450°C exhibited higher degradation efficiency (36%) compared to the sample calcined at 550°C (27%) after 120 minutes of irradiation. Kinetic analysis showed that the degradation followed a pseudo-first-order reaction model, with slightly higher rate constant for the sample calcined at 450°C .

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