PREPARATION AND CHARATERIZATION OF CuO/ZnO AND ZrO_2/ZnO PHOTOCATALYST FOR REMOVAL OF LEAD IONS by Hiba Abduladheem Shakir

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Hospital wastewater (HWW) poses a major risk to human health and the environment, making it one of

the most harmful wastewater types. Increasing HWW discharge worldwide, stricter effluent discharge

restrictions, and the continual effort to reuse treated wastewater all make wastewater treatment

necessary. To address the issue of heavy metals (HMs), particularly lead ions (Pb^{2+}), in the HWW,

this study was carried out using a photocatalysis method.

In this work, (CuO/ZnO and ZrO_2/ZnO) composites were synthesized from the Copper Oxide (CuO), Zinc

Oxide (ZnO), and Zirconium Dioxide (ZrO_2) using a physical mixing technique in ratio (1:1) as

photocatalysts for the degradation of Lead Ion Pb^{2+} in simulated wastewater, and their

physicochemical properties were studied by field emission scanning electron microscopy (FESEM),

energy dispersive X-ray spectroscopy (EDXS), Fourier transforms infrared (FTIR), and X-ray

diffraction (XRD). These studies proved that the two photocatalyst of nanosize particles CuO/ZnO

and ZrO_2/ZnO in size (14.18, and 22.19 nm) respectively. Response Surface Methodology

(RSM) was utilized to maximize the Pb^{2+} photocatalytic removal and its adsorption capacity over

CuO/ZnO and ZrO_2/ZnO in simulated wastewater. Based on a central composite design (CCD), the

experimental design included adjusting critical process parameters such as catalyst dosage, initial

Pb^{2+} concentration, pH, and distance of UV light in ranges 100-500 mg/L, 4-15 ppm, 4-10, and 10-23

cm respectively. Under

1.5 hr UV light irradiation, photocatalytic Pb^{2+} removal tests were carried out in a batch reactor.

The findings showed that a CuO/ZnO dose of 500 mg/L, a pH of 10, an initial Pb^{2+} content of 4 ppm,

and a UV light distance of 17.5 cm were the optimal conditions for maximal Pb^{2+} removal (100%),

while a ZrO_2/ZnO dose of 100 mg/L, a pH of 10, an initial Pb^{2+} content of 15 ppm, and a UV light

distance of 16.5 cm were the optimal conditions for highest Pb^{2+} removal (above 91.2%). The finding

proved that the maximal Pb^{2+} removal efficiency was by using CuO/ZnO compared to ZrO_2/ZnO.

Moreover, the maximum adsorption capacity of Pb ion by CuO/ZnO was 105.803 mg/g at the optimal

conditions (pH value of 10, initial concentration of 15 ppm, photocatalyst dose of 100 mg/l, and

distance of 23), while the adsorption capacity of Pb^{2+} by ZrO_2/ZnO was 131.656 mg/g at the same

preferable state of affairs. The actual Pb^{2+} removal obtained from the experimental runs was highly

correlated with that predicted using the RSM quadratic model. The reduction of Pb^{2+} to Pb^{o} using CuO/ZnO, ZrO_2/ZnO photocatalyst

follows pseudo-first order kinetics having a rate constant 0.01367,0.01197 min^{-1} with R^2 value of

0.9925,.09844 respectively.