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# Solar photocatalytic Degradation of 2- Chlorophenol with ZnO Nanoparticles: Optimisation with D-optimal Design and Study of Intermediate Mechanisms

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**Abstract:** In this study, the photocatalytic degradation of toxic pollutant (2-chlorophenol) in the presence of ZnO nanoparticles (ZnO NPs) was investigated under solar radiation. The three main factors, namely pH of solution, solar intensity and calcination temperature, were selected in order to examine their effects on the efficiency of the degradation process. The response surface methodology (RSM) technique based on D-optimal design was applied to optimise the process. ANOVA analysis showed that solar intensity and calcination temperature were the two significant factors for degradation efficiency. The optimum conditions in the model were solar intensity at 19.8 W/m2, calcination temperature at 404 °C and pH of 6.0. The maximum degradation efficiency was predicted to be 90.5% which was in good agreement with the actual experimental value of 93.5%. The fit of the Doptimal design correlated very well with the experimental results with higher values of R2 and R2adj correlation coefficients of 0.9847 and 0.9676, respectively. The intermediate mechanism behaviour of the 2-chlorophenol degradation process was determined by gas chromatography-mass spectrometry (GC-MS). The results confirmed that 2-chlorophenol was converted to acetic acid, a non-toxic compound.

**Keywords:**
2-chlorophenol, photocatalytic, ZnO NPs, D-optimal design

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