

# Evaluation of Electrocoagulation Process for Hexavalent chromium Removal from Artificial Wastewater Using Box-Behnken Design

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**Abstract.** The proliferation of heavy metals in industrial effluents poses a significant threat to the environment and public health. Hexavalent chromium (Cr(VI)); is a particularly hazardous contaminant because of its high toxicity, mobility, and carcinogenicity. This study aims to determine the effectiveness of electrocoagulation (EC) process in removing Cr(VI) from synthetic wastewater. A Box-Behnken design (BBD) involving three factors and three levels along with Response Surface Methodology (RSM) was utilized to study and optimize the key operating parameters: initial pH (3.64-10.36), applied voltage (5.23-28.77 V), and electrolysis time (8–29.45 min). From the experimental results, it is apparent that EC is an effective approach for Cr(VI) remediation, the rate of which varies from 21.3% to 92.6%. The results of the statistical analysis showed that voltage and time were strongly positively correlated with removal efficiency, while pH showed of more complex but non-linear influence. The highest removal efficiency of 92.6% was achieved PH of 5, voltage of 24 V, and time of 24 min. An additional one-way analysis of variance (ANOVA) showed that the quadratic model developed was significant. Thus, it provides a good estimate of the removal of Cr(VI). This research highlights the interaction of the parameters, especially the synergism between voltage and time, which is essential for the increase in process efficiency. These results demonstrate the possibility of BBD-optimized electrocoagulation to operate durably and effectively in treating Cr(VI) contaminated wastewater.

**Keywords.** Hexavalent chromium, Cr (VI), Box-Behnken Design (BBD), Wastewater, Electrocoagulation.

## 1. Introduction

Industrialization has led to unprecedented economic growth but has also resulted in the widespread contamination of water resources with toxic pollutants [1]. Heavy metals are the most relevant because they do not decompose naturally in nature; and are found in nature for a long time, providing a chance for organisms to accumulate in their bodies, which are the primary sources of exposure to the environment and health [2-3]. Chromium in the form of hexavalent; Cr(VI); is the most dangerous heavy metal ion released by a number of industries, such as leather tanning, electroplating, dyeing

