

# Electrochemical Preparation of Ultrafine Zinc Powder

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In this research work, statistical analysis and optimization of the electrolytic preparation of zinc powder from an alkaline solution containing zinc oxide were carried out using Taguchi methodology. The analysis considered the effect of ZnO concentration (20-80 g L<sup>-1</sup>), electrolyte temperature (30-70 °C), and current density (150 - 450 mAcm<sup>-2</sup>) on the specific surface area of zinc powder. The effect of organic additives such as D-sorbitol and sucrose on the morphological structure of zinc powder was studied based on the optimum operating conditions of Taguchi design. XRD-diffraction, atomic force microscopy (AFM), BET, and SEM were used to characterize the zinc powder. The results indicate that ZnO concentration has the major effect on the specific surface area of zinc powder followed by current density while the temperature has no significant effect on the specific surface area. The optimum conditions for preparing zinc powder at a higher specific surface area and a nanostructure were a current density of 450 mAcm<sup>-2</sup>, an electrolyte temperature of 30 °C, ZnO at a concentration of 20 g L<sup>-1</sup>, and D-sorbitol at a concentration of 4 g L<sup>-1</sup>. The current efficiency and energy consumption were 91.3 %, and 3.0 KWh kg<sup>-1</sup> respectively. The produced powder has a specific surface area of 6.218 m<sup>2</sup> g<sup>-1</sup> and an average particle size of 67 nm.

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**Keywords:** Taguchi method, zinc powder, specific surface area, electrodeposition, D-sorbitol, sucrose.

## 1. INTRODUCTION

In view of valuable features such as its low cost, abundance, and low equilibrium potential, zinc powder has been widely used in various industrial applications [1]. It can be used in both chemical industries such as preparation of benzidine, rongalite, and hydrosulphite, and in metallurgical industries such as production of precious metals like gold and silver by using a cementation process. Moreover, it was used for the preparation of amalgam alloy which is used in dental fillings [2]. Zinc powder can also be used as a paint for a heavy-duty coating for large-scale structures such as sea containers, bridges, and other marine equipment. The most important application of zinc powder is as