

# Chapter 15: Electroplating & Electrorefining

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## Abstract

This chapter gives a detailed research on electroplating and electrorefining, their principles and processes, as well as their importance in industry. Electroplating is a process where a thin coating of a metal is deposited on a substrate, which entails the use of electric current and increases the substrate's properties that include corrosion, appearance, conductivity, and wear resistance. Industrial uses common to copper, nickel, silver, and gold are copper plating in electronics, nickel jewellery and automotive parts, and decorations. Electrorefining is defined as the technique of cleaning up the metals, including copper and aluminium, by taking away the impurities via controlled electrochemical actions, to attain a high level of purity which can be used by the industries. This chapter covers the design of cells, selection of electrolytes, choice of electrode materials and the operation parameters and how they influence the efficiency, rate of deposition and quality of the product. Industrial applicability is emphasized by large-scale uses in metal finishing, in electronic manufacturing, and in the recovery of precious metals. The issues of energy and waste management, and environmental policies are discussed, as well as sustainable and cost-effective solutions. The chapter provides students with the knowledge on how to analyze, optimize, and apply the electrochemical processes in industrial operations by illustrating them with theoretical principles and practical case studies. The knowledge of these processes is necessary in fields of work related to electrochemistry, materials engineering, metal processing, and industrial production.

**Keywords:** Electroplating, Electrorefining, Industrial applications, Metal purification, Corrosion resistance, Copper, Nickel.

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## 15.1. Introduction

Electrochemistry has been involved in the fabrication of contemporary science and industry, especially in metals extraction, purification, surface alteration, and corrosion prevention. The concept of electrochemistry was initially investigated in the late eighteenth and early nineteenth centuries, which established the basis of such technologies as electroplating and electrorefining. Scientists such as Luigi Galvani and Alessandro Volta in the early years showed a groundbreaking work by proving the connection between electricity and chemical activities. The voltaic pile invented by Volta in 1800 was an unending source of electric current, which allowed the use of electrochemical experiments and industry. Sir Humphry Davy recognized another development of the idea of electrolysis when he used electrical current to extract a number of metals, and was further formalized by Michael Faraday with his renowned laws of electrolysis (1834). The work of Faraday was able to determine the quantitative relationship between electric charge and change in chemical reaction and therefore electrochemical processes were predictable and scalable to industrial applications. Electroplating as an industrial process came up in the middle of the nineteenth century and was used as a decorative process like silver and gold plating on jewelry and home appliances. As time passed, it became an essential engineering procedure that was employed to enhance corrosion resistance, wear resistance, surface hardness, and electrical

