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Cathodes in Aluminium Electrolysis

I. MATERIALS PROPERTIES AND CATHODE CONSTRUCTION

INTRODUCTION

The fundamental assembly of the aluminium reduction cell cathode, a tray-shaped carbon vessel, has not changed in more than 100 years since Charles M. Hall and Paul L.T. Héroult independently of each other in 1886 conceived their idea of aluminium electrolysis in a molten fluoride electrolyte (Figure I-1). Today's industrial cathode lining construction is, however, far removed from the 1890'ies crude mix of pitch and coke filler [1]. The present cathode engineering is a product of high technology and knowledge both in materials and design, capable of achieving a service life of more than 10 years [2,3]. This, however, is not only dependent upon lining quality, but also on pre-heating, start-up and operational procedures.

Although the molten metal pad is the acting cathode in industrial aluminium electrolysis, the name “cathode” is used here, and throughout the industry, to describe the container of molten metal and electrolyte. This includes the electrically conducting carbon lining with current collector bars, refractories and insulation, all being encased in a supporting steel shell.

Hall and Héroult developed more than hundred years ago a lining of a monolithic carbon body rammed in place. This concept was kept fundamentally unchanged up to 1920 [5]. The ramming mixes consisted of metallurgical coke, anthracite or petroleum coke and a tar binder. In the early small cells, riveted steel tanks or cast iron vessels also served as the supporting shell.

Figure I-1. Pots designed by Héroult in 1892-93. a) Pot with six cylindrical anodes. b) Pot with four electrodes (from Peterson and Miller [4]).

VIII. TRENDS AND DEVELOPMENTS

GENERAL TRENDS

CA THODE CARBON MATERIALS

RAMMING PASTE

GLUING

SIDEWALL MATERIALS

REFRACTORIES

STEEL SHELL

WASTE PRODUCTS

MATHEMATICAL MODELS

WETTABLE CATHODE

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