Using SPC Method to Design an Aluminum Fluoride Addition Strategy for Aluminium Electrolysis

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Abstract

A 400 kA aluminum reduction potline suffers from extensive cathode damage due to defects in the refractories materials. The aluminum level was raised in order to reduce a further damage of the pots. However, it caused increased heat dissipation from the sidewall, which increased the energy consumption and formed long ledge toe that caused frequent cathode problems such as cracking. An optimization plan was carried out on six test pots over a year which included, among other measures, a new cryolite ratio (CR) and bath temperature control regime. These were necessary as reduction of CR and bath temperatures variations were a precondition for pot performance optimization. A new AlF₃ feeding strategy which is based on Statistical Process Control (SPC) method, was implemented on the test pots and compared to a group of reference pots. This strategy aimed to reduce the variations of AlF₃ feed leading to a reduction of variations in cryolite ratio (CR), and the bath temperature. After 4 months of operation, the variation of AlF₃ additions was reduced by 35 % and thereby reducing variation in CR by 37 % and bath temperature variations by 14 % compared to a group of reference pots. This control method ensured a more stable operation which allows optimization of metal level and voltage.

Keywords: Bath chemistry control; SPC method; aluminium fluoride feeding strategy.

1. Introduction

A 400 kA series electrolytic cells potline suffers from extensive cathode damage due to defects in refractories materials. The cathode damage is mostly transverse cracks in the carbon block upper surface, which leads to high concentrations of Fe and Si in the molten aluminium metal. Most of the pots that were built during the initiation of the potline show signs of cathode damage, hence they all carry the risk of cathode damage. In order to reduce further damage of the pots, the metal level on all pots had been previously raised to 30 – 34 cm. This reduces the cathode temperature and reduced pot failure. However, operating at high metal level leads to many disadvantages: (1) higher energy consumption as more heat is dissipated out from the sidewall and extra voltage is needed to compensate for that heat loss and (2) reduced bath level due to the need to accommodate higher metal level in the cavity. This leads to a decrease of alumina dissolution in the bath and increase of sludge, resulting in an increase of cathode voltage drop (CVD).