Practical Use of Online Chemical Analyser for Spent Anodes Quality Control

Edouard G. M. Mofor[1], Rajwinder Kaur[2], Anand Dev Pandey[3], Mahesh Bitra[4], Petra Muhlen[5], Najeeba Al Jabri[6], Amer Al Marzouqi[7] and Ahmed Al Marzouqi[8]

1. Manager, Carbon Process Efficiency, Technical
2. Area Engineer, Carbon Process Efficiency, Technical
3. Area Engineer, Carbon Process Efficiency, Technical
4. Engineer, Carbon Process Efficiency, Technical
5. CEO, SpectraFlow Analytics, CH-8957 Spreitenbach, Switzerland
6. Vice President, Technical
7. Vice President Carbon & Port
8. Senior Manager, Carbon & Port

Emirates Global Aluminium (EGA), United Arab Emirates
Corresponding Author: emofor@ega.ae

Abstract

This technical paper examines the practical application of an online chemical analyser for spent anodes in the aluminium industry, focusing on improving quality control and addressing challenges related to delayed laboratory analyses. The significance of spent anode quality control is discussed, highlighting the need for real-time monitoring of their chemical composition. Traditional lab-based analysis methods are compared with online analysers, identifying the latter's advantages in enhancing process efficiency and control. Feasibility studies are presented for equipment selection, and the working principle of the online-inline chemical analyser is explained.

This first-time installation of the near-infra-red (NIR) Online Chemical Analyser includes installation, performance testing, and data utilisation for effective control and events analysis. The paper also covers change management, equipment enhancements, and lessons learned. Finally, the value captured through improved anode quality is assessed, and a way forward is proposed, involving the roll-out of the online chemical analyser to other rodding rooms in Emirates Global Aluminium (EGA) to optimise operations further and ensure consistent product quality.

Keywords: Spent anode, Online analyser, Quality control, NIR, Process control

1. Introduction

EGA is a globally recognised aluminium smelting company that has maintained its competitive edge by adopting cutting-edge technologies to preserve its status as the world's largest 'premium aluminium' producer. One such initiative by EGA is the implementation of an Online Chemical Analyser, a first-of-its-kind technology in the aluminium industry. This analyser is a key initiative to EGA's vision for the "Smelter of the Future."

The Online Chemical Analyser (OCA) is an intelligent automation system with NIR technology installed on equipment to provide real-time quality data on spent anodes. This data is then stored and analysed, and any deviations from standard patterns are flagged with alerts. This paper will delve into the practical applications of the evolving Online Chemical Analyser for spent anode control, including its benefits, drawbacks, and potential applications.

2. Background on Spent Anodes Quality Control and the Importance of Monitoring

The smelting industry has been working to reduce the carbon consumption involved in the production of aluminium by optimising various factors, including potroom design, efficiency, and anode quality (specifically anode reactivity and conductivity). Anode reactivity, influenced by Na, Ca, V, and Ni, is critical in determining anode performance. Improved Na levels in the butts (Figure 1) reduce anode reactivity. This leads to reduced carbon dusting in pots, lower carbon consumption, improved cell productivity and enhanced customer satisfaction.

As EGA had continuously increased its capacity and operated above design limits, focusing on balancing energy prices and LME, the strenuous requirements of anode quality, including resistivity, reactivity, density, and baking levels. These factors had become increasingly important.

Raw materials typically consisted of 60 % coke, 14 % pitch, and 26 % recycled butts, with butts contributing the highest percentage to sodium contamination. However, there were limitations regarding the capability of dynamically responding to changes in sodium. The past process of adjusting the butts cleaning process relied on delayed sample collection and analysis, sometimes culminating in up to a few 8-hour shifts and the challenge of taking representative samples due to the heterogeneity of the material and its impurities. Such variability in the anode quality became a significant challenge while operating with very low anode-cathode distance (ACD) pots due to ever-increasing amperages in the potrooms. Efforts had to be made at the source of the variability through proper control [1, 2, 3, 6].

Given the feasibility of controlling Na levels in recycled butts by improving internal processes, implementing an Online Chemical Analyser has become a priority for EGA.

Figure 1. Anode butt picture.

3. Challenge Faced without the Analyser

To enhance the performance of anode butts, monitoring their composition, including the Na content level, was crucial. At EGA smelter Phase 1 (potlines 1 and 2), located at Al Taweelah, approximately 340 tonnes of spent anodes are recycled daily through a crushing circuit, and the quality assessment was based on random samples. However, the sample results were released

13. Acknowledgement

The authors extend our heartfelt appreciation and gratitude to all those who provided their support and assistance during the preparation of this OCA technical paper. The contributions from the Management, Rodding Operations, and SpectraFlow Analytics teams have been invaluable in ensuring the successful completion of this endeavour.

14. References

1. S.M. Hume, Anode Reactivity*, Influence of Raw Material Properties*, 2nd edition, by R&D Carbon*,* 1999.
2. Y.K. Hoang, B. Vitchus, Laboratory studies on the impact of vanadium and sodium on the air reactivity of coke and anodes, *Fifth Australasian Aluminium Smelter Technology Workshop*, October 1995, 430-446.
3. Les Edwards, Quality and process performance of rotary kilns and shaft calciners, *Light Metals* 2011, 895-900.
4. B. Coste and J.P. Schneider, Influence of coke real density on anode reactivity consequence on anode baking, *Light Metals* 1994, 583-592.
5. Werner K. Fischer, Felix Keller and Raymond Perruchoud, Interdependence between anode net consumption and pot design, pot operating parameters and anode properties, *Light Metals* 1991, 681-686.
6. Edouard Mofor, Impact of anode top cover composition on anode butt quality, *The 7th International Conference on Electrodes for Primary Aluminium Smelters*, Reykjavik, Iceland, 25-27 April 2017.
7. K. Fassbender et al., Cleaning of spent anodes of the aluminium process, *Light Metals* 1987, 541-552.