Light Metals 2011 *Edited by: Stephen J. Lindsay*
TMS (The Minerals, Metals & Materials Society), 2011

REDUCTION OF PFC EMISSIONS AT POT LINE 70 KA OF COMPANHIA BRASILEIRA DE ALUMÍNIO

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Keywords: PFC, Anode Effect, Energy Consumption

Abstract

Following world tendency the Primary Aluminum Industry has been committed to the reduction of PFC emissions in order to reduce the greenhouse effect. Anode Effects is a significant source for such emissions.

The Companhia Brasileira de Alumínio (CBA) pot line is equipped with 70 kA VSS Montecatini technology from the end of 60's with side feed pots, has been making efforts and developing actions to improve work practices and the operating process with the aim of reducing both the duration and frequency of anode effects.

The anode effect, which was used for decades to assess the process behavior, ensuring their performance and preventing future problems, has been replaced by indicators supported by technological developments and the process computer improvement. Projects were developed and implemented as follow: Liquids control, Resistance control, Feed control, Anode/Cathode control and mainly by team work practices through operating training.

This paper shows achievements for projects cited, that caused significant impacts by reducing the duration and frequency of anode effects inline with world best practices for VSS technology. A reduction of 66 % of PFC emissions was achieved, from 1.2 t CO_2e per t Al in 1998 to 0.41 t CO_s e per t Al in 2009 calculated by Slope Method.

Introduction

The Companhia Brasileira de Alumínio, a company of Votorantim Metais, has an installed capacity to produce 475,000 tons of primary aluminum per year, with nine reduction lines totaling 1,508 electrolytic cells of VSS technology operating at 70 kA, 90 kA and 127 kA.

Figure 1. The Companhia Brasileira de Alumínio

This paper was based on investigations and testing conducted at the 70 kA Pot Room that has 174 electrolytic cells with side feeding and went through the process of increasing current from 65 kA to 70 kA, from 2002 to 2005.

Figure 2. Pot Room 70 kA form CBA

The anode effect, previously considered essential for evaluating the operational performance of the pot line, has been losing its importance over the years as a best practice for pot operation. The systematic suppression of the anode effect was modified in order to reduce the duration from 1.86 min per cell day to 0.63 min per cell day (Figure 3), and the frequency of anode effect from 1.2 AE per cell day to 0.3 AE per cell day (Figure 4). The logic of feeding, which is held at intervals of four hours, has been changed to reach 39 consecutive feeds. But for these reductions were possible, actions were necessary to reduce the number of anode problems, improve the liquid level control and operating procedures.

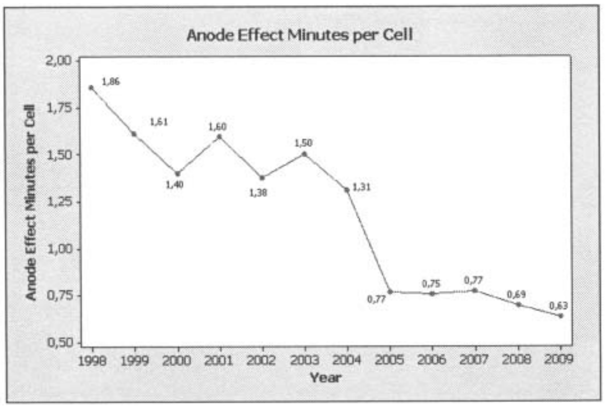

Figure 3. Average Anode Effect Minutes per Cell Day

Development

Deployment of the reduction control system

Up to 1998 the voltage control system was manual hampering an accentuated reduction of anode effects. The implementation of the resistance control system was the first step that led to a significant reduction of anode effect going from 1.1 AE/cell day to 0.7 AE/cell day in 2 years as shown in figure 4.

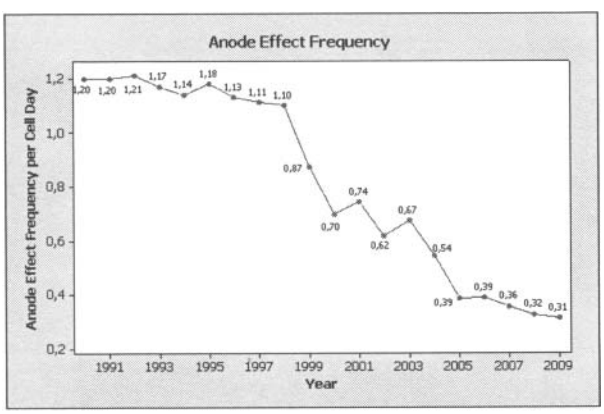

Figure 4. Evolution of anode effect frequency at Pot Room 70 kA

This result is mainly due to the development of control parameters that became effective in the prediction of anode effects, providing an effective method that would allow reducing the number of anode effects to the levels achieved.

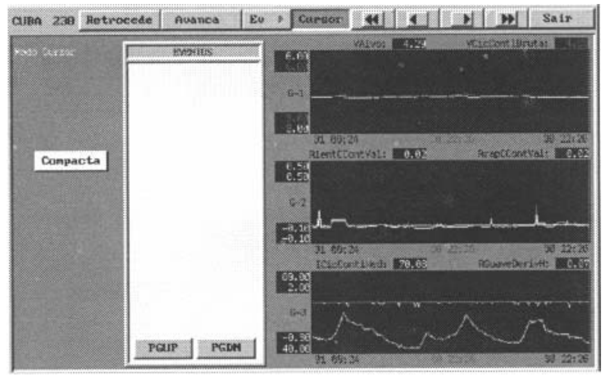

Figure 5. The Resistance Control System

The next steps for achieving further reductions targeted r improvement of routine operational and process control, because it was necessary to reduce the number of operational problems associated with anode quality.

Reducing the number of anode problems

The high number of operations related to problems with the anode was a hindrance to continue reducing the number of AEs to the levels proposed. In this, actions were taken in order to obtain an anode quality and stable operation. (See Table I and Figure 6)

Table I. Table of anode improvement actions

Problem	Action	Result
Excessive anode exposure below the gas collector duct.	Reduction of the size of the gas collector; Reduction of the depth of the pot shell.	Reduction of exposed anode from 25 cm to 18 cm
High number of fissure in the anode	Improvement of system of studs replacement; Increased frequency of stud recovery;	Reduction of fissures in the anode; Reduced leakage of paste; Improved of the efficiency of stud replacement.
Anode quality	Changing composition of anode paste.	Improvement of paste and anode quality.

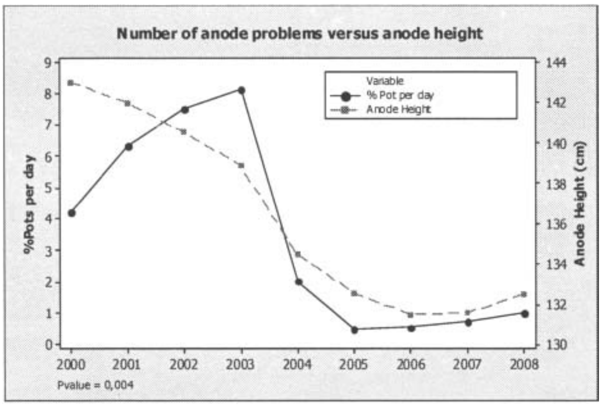

Figure 6. Reduction of anode problems

<u>Liquids control</u>

To achieve an extended period of time without the occurrence of an anode effect and to avoid occurrence of operational problems such as sludge, delay, and others, it was necessary to ensure a stable level of bath as well as an efficient bath chemistry control.

Table II. Table of improvements of liquids control

Problem	Action	Result
Bath level control	Implementation of daily measurements of bath's level after metal tapping	Stability of bath level
Bath chemistry control	Weekly sampling of bath to measure chemistry. Daily measurements of temperature.	Improvement of superheat control
Sludge	Daily inspections of the cathode.	Reduced incidence of sludge.

To ensure the proposed results were achieved, actions were implemented with aim of improve operational practices such as to meet the operational standards, which were important to reduce the kill time of the AE. However, the most effective action was the operational training, which allowed the dissemination of knowledge of the automation tool, such as interpreting graphs of resistance and noise behavior, which allowed more rapid detection and efficient operator response, as well as standardization of the actions and awareness of the importance of each task in building the final result. (See Table III)

Table III. Table of actions of operational practices

Problem	Action	Result
Excessive time to kill the AE	Information via radio to operator of the crust break vehicle when an AE occurs; Installation of visual and audible alarms that provide the operators the information of time to kill the AE. Logistics and distribution of operators in the lines.	Reduction of time to kill the AE.
Compliance with operational standards	80 hours of training in operational practices and process control	Qualified personnel. Immediate detection of operational problems.

Result

The results achieved in reducing the emission of PFCs were significant, reducing emissions of 1.20 tonnesCO2-e/tonneAl in 1998 to 0.41 tonnesCO2-e/tonneAl in 2009 close to the estimated reduction 93% based on 1990 which provides for 0.34 tonnesCO2-e/tonne Al in 2020[3] (Figure 7).

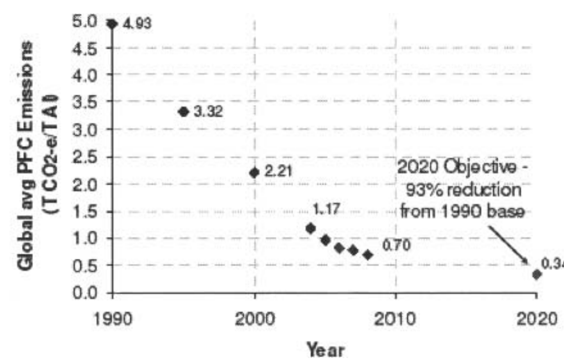

Figure 7. Trends in PFC Emissions per Ton Primary Aluminium Production. Source: 2008 Global Anode Effect Survey Results [3]

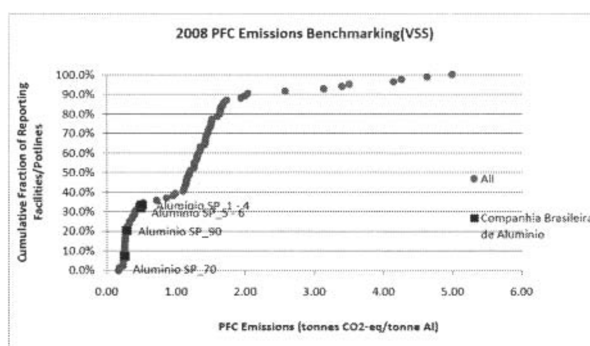

Figure 8. PFC Emissions Benchmarking (VSS) – Source: International Aluminium Institute – Anode Effect Benchmarking 2008 [2]

The result is due to the reduction in the number of anode effects per year in the order of 75,000 AE/ year in 1990 to 19,000 AE / year in 2009, a reduction of 65000 AE/year which equates to a reduction of about 3.0 GWh/year in energy consumption taking into account only the anode effect frequency and a reduction of 66 % of PFC emissions from 1998 to 2009.

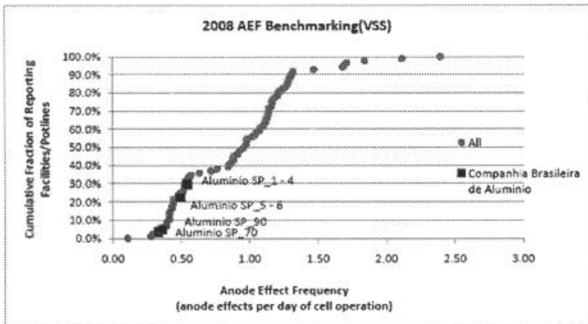

Figure 8. Anode Effect Frequency – Source: International Aluminium Institute – Anode Effect Benchmarking 2008[2]

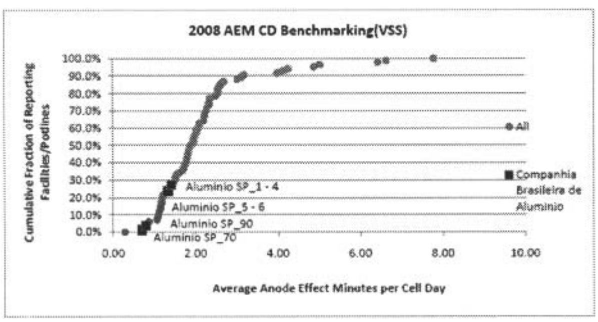

Figure 10. Average Anode Effect – Source: International Aluminium Institute – Anode Effect Benchmarking 2008[2]

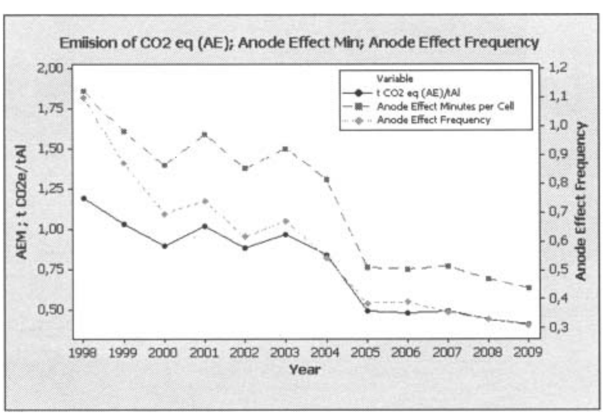

Figure 10. Evolution in PFC emissions, AEM and AEF

Conclusion

The biggest challenge for succeeding in reducing PFC emissions was the preparation and awareness of staff to use new tools for operational analysis, to predict and deal with problems without the occurrence of anode effect. The result achieved has motivated the team to strive to improve even more, with the assurance that the problems occur, but can be predicted and studied.

References

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