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STARTUP OF SHUT-DOWN POTS - PROBLEMS AND SOLUTIONS TO IMPROVE RESULTS

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Abstract

Due to the operational crisis at Votorantim Metais CBA in 2011 (VSS Soderberg technology – 128kA), some anodes were lost, consequently the cathode lifetime and conditions were compromised. With the high amount of shut-down pots, and with the need to resume production (pots in operation), a so-called "recovered cathode pot" was decided to be made, in which the pot side walls (the refractory and ramming paste layers) were cleaned, the refractory and ramp replacement for cold ramming paste was realized and, subsequently, the baking of anodes was carried out.
The recovered cathode pots have different lifetimes ranging from 600 to 2700 days. Compared to the normal line pots, these pots showed high amount of leakages, premature failures and lower current efficiency. After several meetings with the technical pot room team, in May 2012 the previous process parameters were altered in order to increase the lifetime, reduce the number of the leakages and improve the current efficiency.
This paper will show the implemented changes and the better results of lifetime, leakages and current efficiency to these pots.

Introduction

The conditions of the anodes at the pots (VSS Soderberg) to production of primary aluminium, are extremely important for a good performance. To keeping the anodes in good conditions beyond the good operating routine, are necessary high quality in raw materials and when one of then not happens, have negative consequences weakening the anode, which can generate carbon dust, concentrations and cracks anodes resulting in anodes operations.
In 2011 the raw materials received by CBA for production of the anodes has changes and parallel to major operational disturbances, brought negatives consequences for the operations of this pots resulting in losses of anodes and consequently production losses.

Methodology

With the goal to return the production quickly, was decided to make the "recovered cathodes", Where after removal of the anode and cathode cooling became the scraping of the blocks, cleaning of refractories and monolithic (figure 1). After cleaned, made de use of cold ramming paste to substitute the refractories and monolithic showed at the figure 2. After the conclusion of the side walls begins the pre heating, baking of the anodes, subsequently did the startup and beginning the operation of these pots.

Figure 1. Cleaning

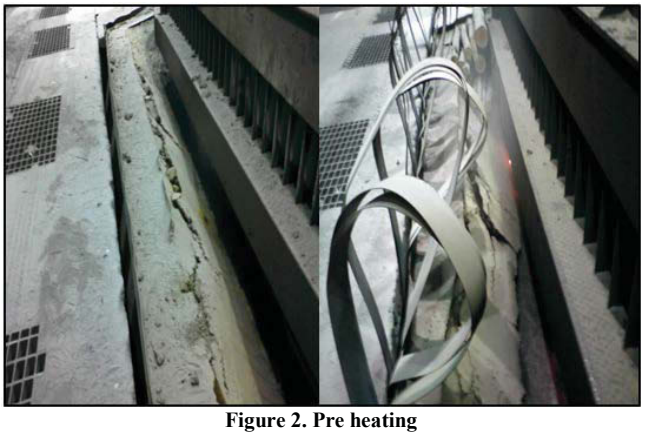
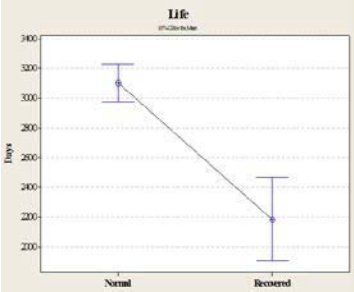


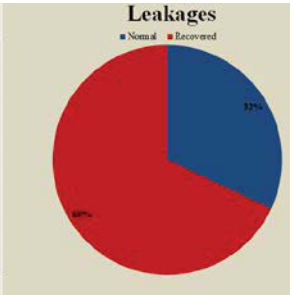
Figure 2. Pre heating

After the startup, receiving of the metal pad, these pots was schedule to resume the bath chemistry of the line in one week, stabilizing the operations and returning the production.

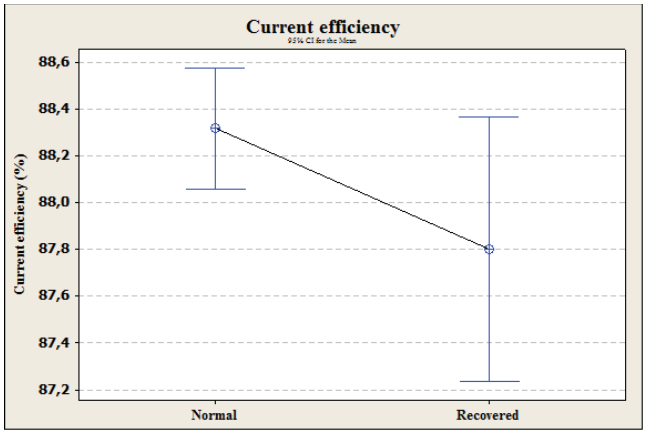
With the amount of 109 "recovered cathodes "pots the Votorantim Metais CBA, achieved resume a faster production, resulting in a volume of 13,8 thousand tons of primary aluminium in 2011.
When the normal operation of these pots returned, began some problems as: early cathodes failures (graphic 1), high amount of leakages (graphic 2), lower current efficiency (graphic 3) and consequently high energy consumption.



Graph 1. Life



Graph 2. Leakages



Graph 3. Current efficiency

Due the undesired results and the negatives consequences to the operation, the process and operation team decided to make changes in process parameters of these pots in order to reduce the temperature operation, to advance the side ledge, reduce the amount of leakages, prolong the lifetime of cathodes and being more efficient. The table I shows the main changes of the process parameters.

Table I. Process Parameters

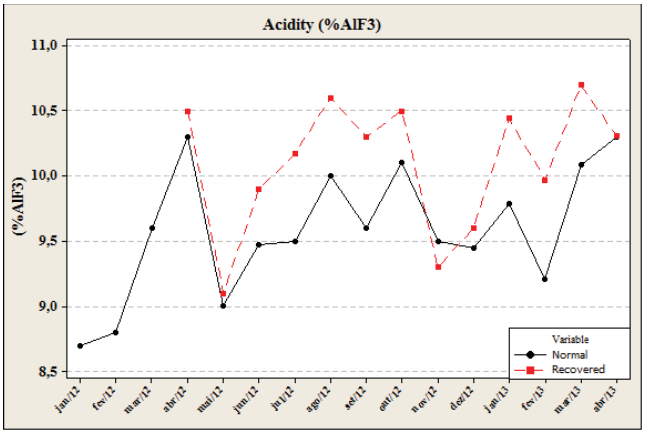
	Cathode	
	Normal	**Recovered**
Temperature	**962 ± 4°C**	**958 ± 4°C**
%AlF$_3$	**9,5 ± 1%**	**10,5 ± 1%**
Metal level	**Change with life**	**40 ± 1 cm**
Bath level	**Change with life**	**16 ± 1 cm**

Results

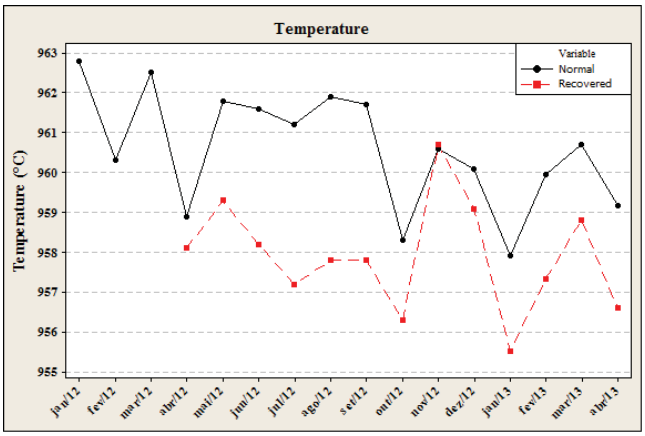
The results below show the performance comparison between the recovered cathodes with the normal pots of the line.

Temperature and bath chemistry (%AlF$_3$)

The proper control of the temperature and acidity (%AlF$_3$) were essential to maintain the thermal equilibrium of this pots and consequently improve the performance thereof. The results of the acidity and temperature are shown as monthly means at graphics 4 and 5, respectively.

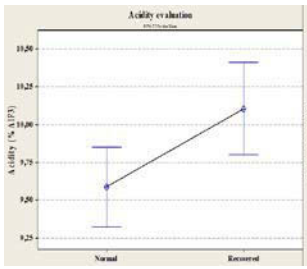


Graph 4. Acidity evolution (monthly means)

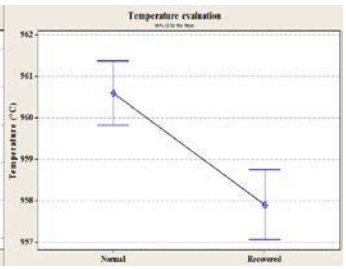


Graph 5. Temperature evolution

The graphics 6 and 7 show the comparison of acidity and temperature respectively between normal and recovered cathodes pots in the period of the tests.



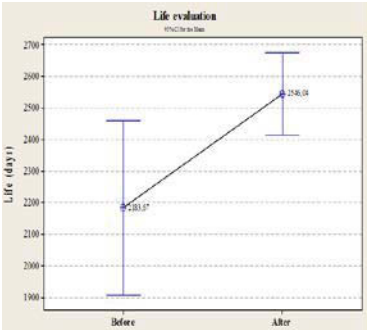
Graph 6. Acidity evaluation



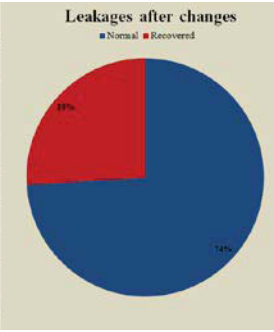
Graph 7. Temperature evaluation

Life and Leakages

By the operation temperature reduced, seeking superheat maximum of 12°C and greater control of the side ledges of the recovered cathodes pots, the leakages reduced to percentages of 26%, showed in graphic 9. And due to greater stability and temperature control, the lifetimes of the recovered cathodes increased by 362 days (graph 8).



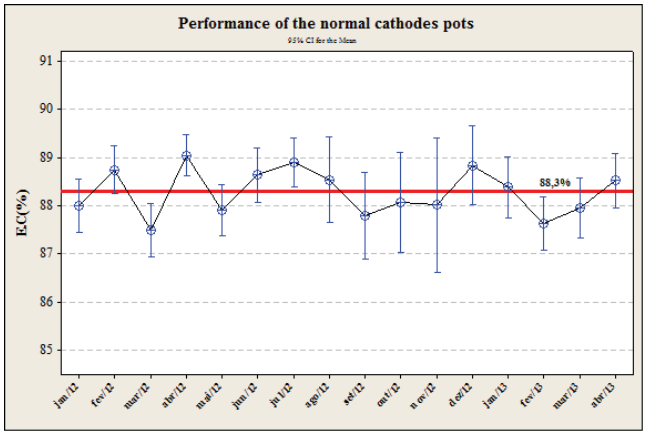
Graph 8. Life evaluation



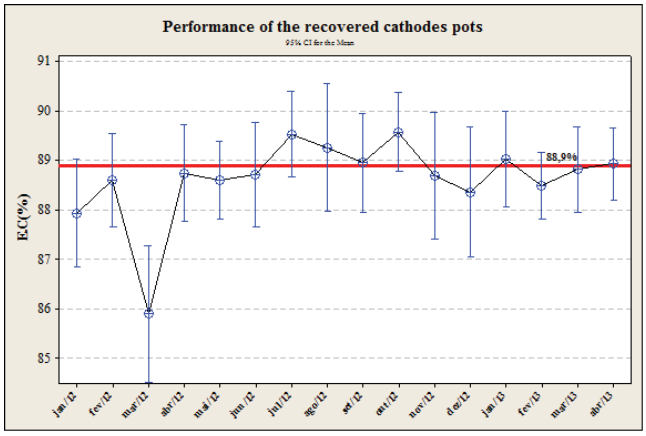
Graph 9. Leakages after changes

Performance

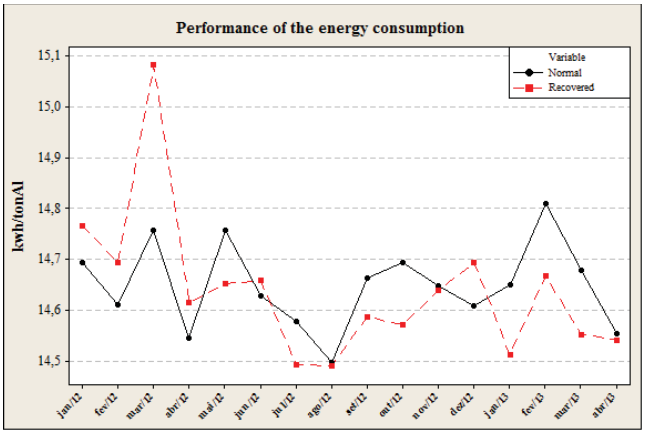
On the graphs 10 and 11, are shown the performance of the normal pots compared with the recovered cathodes pots through the current efficiency and energy consumption (graphic 12).



Graph 10. Performance of the normal pots (Current efficiency-%)

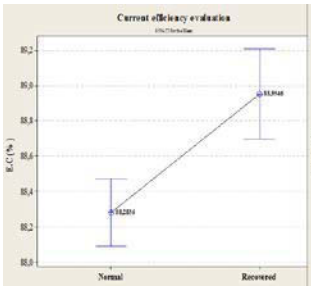


Graph 11. Performance of the recovered cathodes pots (Current efficiency-%)

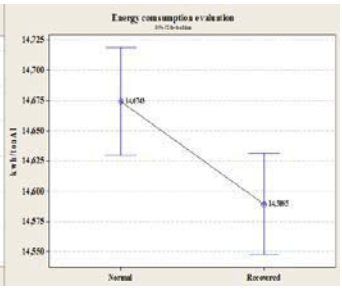


Graph 12. Energy consumption performance(kwh/t Al)

On the graphs 13 and 14 respectively, are shown the comparison of the current efficiency and energy consumption of normal and recovered cathodes pots.



Graph 13.Current efficiency



Graph 14.Energy consumption

Conclusions

The recovered cathodes pots were a quickly and economical solution to return the production in the 2011 crisis, producing 13,804tons in 2011 and 23,894tons of primary aluminium in 2012.

Despite the operational difficulties encountered in the return of the operations of this pots, with the process parameters changes and greater control of this pots, the recovered cathodes pots showed better performance after the changes, obtaining a current efficiency 88,95% (0,65% higher than normal pots) and the energy consumption of 14,58kwh/tAl (0,08kwh/tAl lower than normal pots). In addition to improve the operational results, the leakages decreased for 26% of the total, increasing the average life in 362 days at the recovered cathodes.

References

GRJOTHEIM,K.; KVANDE,H.; Understanding the Hall-Héroult Process for Production of Aluminium. Oslo: Aluminium-Verlag, September 1986. 163p.