Millivolt Anodes and Cicero - new tools for better pot and potline control

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Abstract

Uniform anode current distribution is the basis of stable pot operation and best pot performance. The most common method to control the anode current distribution is to measure voltage drop between two points on each anode rod, the so called anode millivolt (mV) drop, with a fork. In order to make this measurement more reliable, rapid and automatic, Maestria Solutions, in collaboration with Rio Tinto, has developed Millivolt Anodes (mVa) tool, including a lightweight fork, automatic recording of the anode mV, pre-programmed sequence of measurements and automatic modern data transfer to the computer. This tool has been in use in several smelters, in some for over 25 years in its version using Microflex computer. Another Maestria development is Cicero, a smart vocal annunciation system for potrooms, which broadcasts in different ways (audio, SMS, e-mail, display) relevant messages coming from pot control system. Cicero has also been used in several smelters for years. In this paper, mVa and Cicero will be presented and their features, benefits and advantages will be discussed. Actual results of the most recent versions of these tools will be shown, in collaboration with smelters who are currently testing them and a live demo will be shown.

Keywords: Anode current distribution measurement; mVa; anode setting; potroom annunciation system; potroom alarms.

1. Introduction

There are a significant number of new technologies that can be of great help for aluminium smelter. Often these solutions are the results of continuous work for improvement over many years. Some are kept for internal use only because they are seen for some time as proprietary; however it may happen that they become a spinoff product and made available for distribution on the open market. This is also the case with Millivolt Anodes (mVa). Such technologies attract particular attention if they improve safety and security and also help gaining operational advantage.

In this paper, we present two technologies that have evolved through years and have been used in many smelters worldwide designed specifically for use in aluminium smelters. These are:

1) mVa (Millivolt Anodes), which is used to determine anode current distribution from the measured voltage drop between two points on each anode rod, the so called anode millivolt (mV) drop and
2) CICERO, a smart vocal annunciation system for potrooms, which broadcasts in different ways (audio, SMS, e-mail, display) relevant messages coming from pot control system.

2. mVa, a smart anode current distribution control solution

2.1. Anode current distribution and anode setting

The factors affecting the cell behaviour come from many sources. The cell parameters are linked in such a complex way that the best setting to apply to each cell is not obvious. For example, the change in cell temperature can be attributed to any of the following parameters: cell voltage, cell current, feed cycle, alumina concentration, depth of metal pad, ledge formation, frequency and duration of anode effects, amount of alumina covering over the anodes, metal tapping, anode change, cell instability, etc. Deviations from normal operation have to be detected and an indication given what might be the source of the deviation; this is the first logical step to cure the problem.

Uniform anode current distribution is the basis of stable pot operation and best pot performance. Some people consider that 80 % of pot operation problems are caused by anodes. Even though this certainly is an exaggeration, it is well known that the anodes are often a source of potential problems. It is therefore logical to monitor closely the anode behaviour in order to find and correct any irregularity early.

Specifically, anode setting certainly disturbs the cell operation for several hours after setting if not several days.

The anodes are set to a certain target height with respect to the old anode butt for proper operation of the cell. Anode setting accuracy in typical operational condition is influenced by many factors. Even in the best situation, it is quite common to have some margin of error in the actual height adjustment. Operators have typically found the following pattern, explained in [1]:
Anode set too low has the following consequences:

- High current flow in this anode
- Prone to cracking carbon, causes bad connection in cast iron-carbon contact
- Early instability as metal waves increase, higher noise,
- Computer adds resistance modifiers,
- Detrimental to current efficiency, reduces aluminium production.

Anode set too high has the following consequences:

- Low current flow in this anode,
- Longer time to heat up,
- Local bath freezing, side ridge formation under the anode,
- Risk of setting anode on side freeze with down bridge moves,
- Current increase in the other anodes, instability, noise,
- Resistance modifiers added.

2.2. Development of Microflex anode mV system

At the beginning of the nineteen eighties, one well known company in the aluminium world, Aluminium Company of Canada (Alcan), began to work on an efficient way to detect this kind of problem in actual production situations, not just for test or research purpose. What was to be found needed also cost to benefit evaluation, if the solution was to be implemented in a large scale aluminium smelter or even spread to most of its smelters. It is good to recall that Alcan was for some time, the second largest primary aluminium producer in the world with several smelters in the Saguenay region of Quebec, Canada. Also the Arvida Research and Development Center (ARDC), still operating now as part of Rio Tinto, was a very active research branch of Alcan, which supported development of new solutions in improving everything to do with aluminium production in the associated smelters.

of a PAS (Public Address System) without having to install audio cable and avoid having the cumbersome process to route cables through a large plant, greatly reducing cost associated with that work.

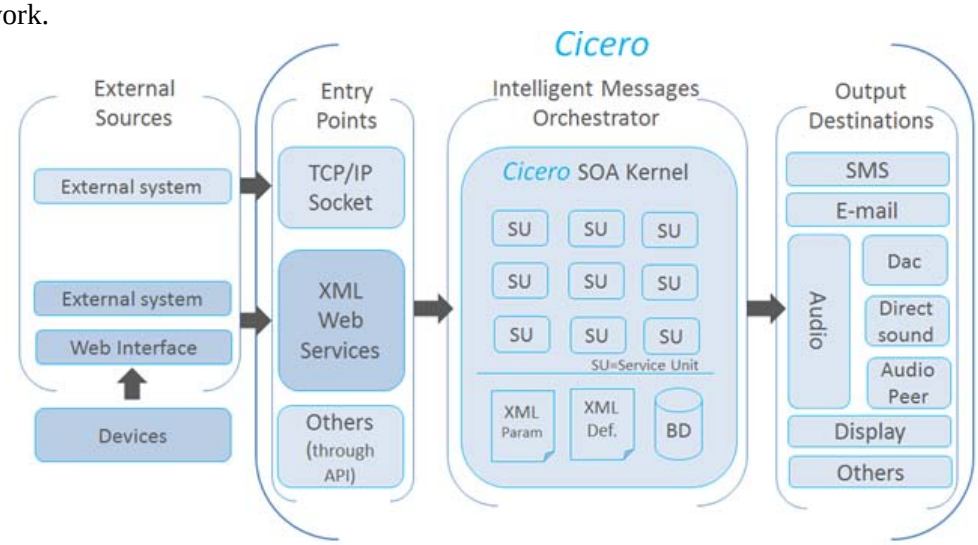

Figure 6. CICERO Architecture

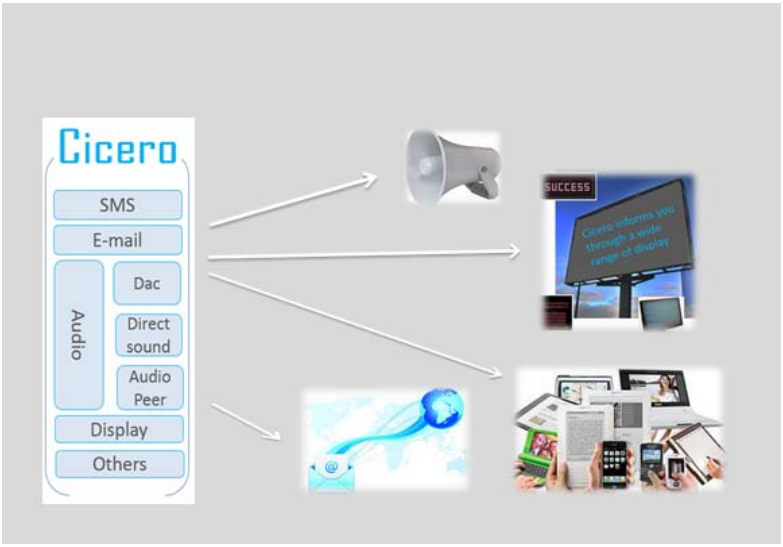

Figure 7. CICERO output device

4. Conclusions

For mVa, the operation gain and increase of current efficiency confirms that the system offers a very good solution for better anode control in an aluminium smelter. Any abnormal or even potential faulty situation can be detected early. The new version with the built-in sophisticated electronics and software can be also closely adjusted for each smelter technology. For CICERO, the system does exactly what was designed for and has been operating very well since many years in many smelters worldwide. Operators gain increased situation awareness in their plant. With the new open architecture implemented, connection to external system will be facilitated.

5. Reference

1. Alton Tabereaux, The Minerals, Metals & Materials Society (TMS) Industrial Aluminum Electrolysis 2012, Chicoutimi, Quebec, Canada, September 10–14, 2012, pp 21-22.