

New Study and Application of Intelligent Breaking Control Device for Aluminium Reduction Pot in the MPPIC Technology

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Abstract



The first generation of the Multivariable Process Parameter Intelligence Control (MPPIC) technology of the CHALIECO GAMI had been developed over 10 years up to now. Every respect concerning this technology had been improved and upgraded considerably during these years. With this technology selected by the domestic and overseas aluminium smelters for all kinds of the larger and super large aluminium reduction pot technologies, substantial progress has been made of their combined technical performances and economic indexes [1]. Based on the third generation of the MPPIC technology, the intelligent alumina breaking and feeding device has been innovated as well. It will create better conditions and process fundamentals not only for alumina concentration distribution and anode effect intelligent control, but also for the stable operation and enhanced performance of the larger aluminium potline for production.

Keywords: Aluminium reduction pot, the MPPIC Technology, pot controller, intelligent breaking control device.

1. Technical Background

In the background of rapid development of Internet+ and intelligent industrial technologies, intelligent design and control technology in today's primary aluminium industry has stepped into a new stage. Since 2008, with popularization of larger and super large reduction cells in and beyond Chinese market, CHALIECO GAMI has advanced the first generation of MPPIC (multivariable process parameter intelligence control) [1] technology to its third generation. This means that GAMI is now ranked as one of the world leaders in intelligent manufacturing and control technologies for aluminium reduction cells.

CHALIECO GAMI focuses on the innovation and advancement of intelligent devices and products, committing itself to propel intelligent production and improve enterprises' intelligent level of research, production, management and service. The MPPIC technology realized integration of information technology and manufacturing technology from two aspects: process management technology and manufacturing and executing technology.

MPPIC technology is centered around the pot control system and deployed with an intelligent tapping system, an intelligent feeding system, online temperature measurement system, a pot condition analysis system and RDTS (remote data-diagnosis technology service). The detailed integration platform is presented in Figure 1 [2].

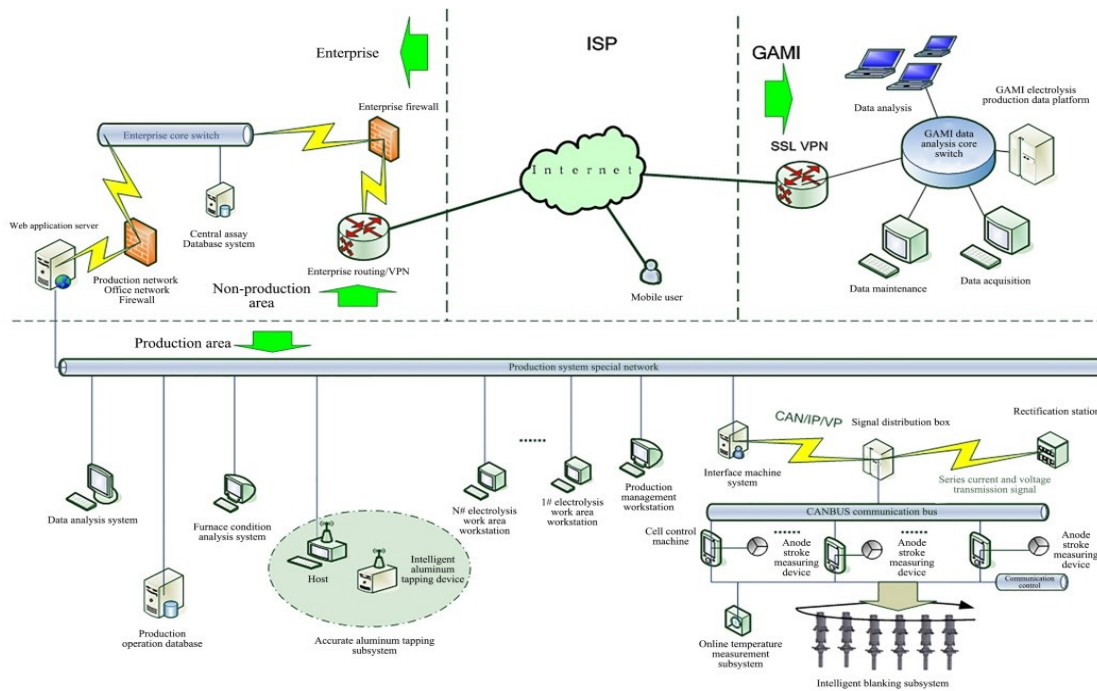


Figure 1. Integration Platform of MPPIC.

2. R&D content

During the production of aluminium, crust breaking and alumina feeding are two of the most essential working procedures that are intelligently controlled by computer; added to this, it is the most vital factor relating the normalization and stability of a pot. The traditional feeding method is a single breaking followed by a single dose of alumina, which is not as reliable and accurate as expected. The shortcomings of this method are:

- A breaker jam cannot be identified automatically: When a breaker jam occurs, it can only be observed from anode effects (AEs) or by manual inspections, which leads to increased manpower requirements as well as increased power consumption caused by AEs.
- Breaking continues when the feeding hole is unobstructed, which increases the wear of the breaker, shortens breaker life and wastes compressed air.
- Time spent for penetrating the feeding hole cannot be predicted, and the breaker cannot withdraw immediately after entering the bath, which increases the duration of breaker being soaked in the bath resulting in a real possibility of elephant leg formation with reduced breaking efficiencies.

With continuous improvement of the intelligent control technology in aluminium production, there is now a high demand for a new intelligent breaking method to solve all these problems. The device and technology being discussed in this paper, which based on CHALIACO GAMI's MPPIC technology, are served to meet such a demand.

3. Technical Description

The newly-developed intelligent breaking device consists of a breaking cylinder, a pressure sensor, a data-collection card and a pot controller. Every single part is interconnected and linked to the SCADA through the pot controller.

- energy.
- Lifetime of cylinders and breakers can be prolonged by more than 30 %, saving on costs of repairs of equipment.
- Intelligently identify and deal with breaker jams to save on manpower requirements.

Considering a 400-kA pot with average current efficiency of 93 % as an example, and given that the power price is CNY 0.3/kWh (~ 44 USD/MWh), the direct economic benefits can be calculated as:

- Direct economic benefit acquired by saving more power is CNY 16400 per pot (2380 USD/pot).
- Direct economic benefit acquired by saving 30 % compressed air is CNY 6560 per pot (950 USD/pot).
- As cylinder and breaker life is being prolonged by 30 %, annual equipment investment will be saved as CNY 3000 per pot (435 USD/pot).

All above direct economic benefits amount to CNY 25900 (3765 USD) annually for one pot. The calculation does not take some auxiliary and environmental benefits into consideration, such as reducing labor intensity, increasing current efficiency (CE), reducing AE, and stopping or halving air compressors after the device is fully implemented with all features.

At present, the new device and technology have applied for patent of invention/utility model [3]. With advantages of low production and installation cost, for a 400 to 500-kA large potline, if it has already installed MPPIC system, the total investment costs are only CNY 12000 per pot (1740 USD/pot) including spare parts for the device (domestic installation included as well), which means that only in one half a year the investment can be recovered .

6. Conclusion

By the end of 2018, CHALIECO GAMI's pot control system has been installed in more than 70 potlines with a combined capacity of more than 1.9 million tonnes all over the world.

The development and application of intelligent breaking control device not only creates advantages for alumina concentration control and intelligent control of larger aluminium pots, but also lays a solid foundation for stable production and operation and technical and economic index improvement of potlines.

7. References

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