AL02 - Rio Tinto Smelter 4.0: From Vision to Delivery

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Abstract

Significant progress has been made since Rio Tinto presented its Smelter 4.0 vision in 2017. In the field of automation, the first autonomous anode transport vehicle is currently being tested in the Alvance Aluminium Dunkerque smelter. Regarding remote activities, the Aluminium Operation Centre is delivering support to all Rio Tinto Atlantic Operation smelters, adding significantly to their value creation. The Technical Assistance 4.0 team does the same for Rio Tinto Aluminium Pechiney licensees. Virtual reality is now embedded into training modules. Mobile applications like Mobile KPI, SmartPot and APM4.0 are used to support operation and process. Closer to the pot, new sensors deliver information unavailable hitherto, which is stored in data lakes. New algorithms based on Artificial Intelligence drive the cell to its optimal performance. This article presents some of these concrete achievements of the Smart Cell, focusing on operator training, sensors, algorithms and cell performance.

Keywords: Smelter 4.0, smart cell, sensors, artificial intelligence, cell performance.

1. Introduction

Industry 4.0, the fourth industrial revolution, represents a new stage in the organization and control of the industrial value chain. In 2017 Rio Tinto delivered its Smelter 4.0 vision [1] with ambitious developments in automation, remote support, mobility and advanced control systems. The autonomous anode transport vehicle MAX (patented technology) is a good illustration of what we achieved in terms of automation (see Figure 1).

The first MAX series vehicle started its commissioning at the Alvance Aluminium Dunkirk plant at the end of 2019 and is currently being validated. MAX is a safe and environment-friendly anode transport solution, aiming at optimizing aluminium production operations. The vehicle is connected to an intelligent Fleet Management system, and can continuously and autonomously circulate within the plant, whether indoor or outdoor, safely operating and transporting loads up to twelve tonnes. Thanks to its guidance technology, MAX can be integrated into existing operations without any additional equipment.

Figure 1. Anode transport vehicle (MAX) with full load of anodes.

Regarding remote activities, our Aluminium Operation Centre based in Canada continues to deliver strong support to our Atlantic smelters. So does our AT4.0 team based in France for our external clients, using dedicated methodology and tools such as Radar™ [2]. These remote support centres have been and still are essential in the Covid-19 crisis we all face.

As technology evolves, it is also vital to continually improve the skills of our people to make sure that they will take appropriate decisions. Industry 4.0 technologies have been embedded into our training tools. Significant progress has also been made in enabling people to get real time information using a standard smartphone or a tablet. Cells have been equipped with new sensors providing data that are analysed with the latest data analysis techniques to develop new algorithms, which increase cell robustness and performance. These developments will be presented in the following section 2.

2. Improving and Maintaining the Skills of Operators and Technicians

2.1. What We Have Done Since 2010

We established a training system based on the BLOOM taxonomy [3]. People's knowledge is tested every two years, and methods of training include traditional face-to-face training, eLearning, remote training, on-the-job training, blended learning, and webinars. We have recently tested Virtual Reality (VR) training (Figure 2), which consisted of making live 3D videos of potline activities and embedding exercises to help students recognize electrical risks and to anticipate events in the potline. It has been designed to train everyone working in or passing through a potline about electrical hazards. Feedback from students encourages us to continue with this approach because it is flexible, affordable and feels real.

Figure 2. VR training session.

6. Conclusions

Significant progress has been made towards Smelter 4.0. Each pot is equipped with sensors giving information which is used automatically to improve the performance of that particular pot, the algorithms adjusting the response to suit its specific characteristics. All relevant information can be easily accessed anywhere by operators and managers, enabling them to take better decisions. This is only the beginning, because technology evolves quickly and opens new opportunities for the aluminium industry to face the coming challenges. The most important of these challenges is a consequence of climate change: better management of energy consumption, which will oblige smelters to be more flexible in adjusting their power levels. As Rio Tinto sees it, Digital Twinning will be instrumental in bringing about this revolution.

7. References

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