Rhodax Process – Recent Evolution and Future Challenges

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Abstract

The Rhodax® process is the result of two parallel developments started in early 1990s. By beginnings of 2000s, Fives and Aluminium Pechiney (AP now Rio Tinto) joined their R&D efforts and co-patented the SCAP-RHODAX® process.

This paper summarizes in a first part, what are the key initial characteristics of this process, how it performed over the past 25 years.

In the second part, it describes how the return on experience from the customers, forced the evolution of this technology to address new challenges faced with either variability in raw coke properties, maintenance issues, continuous amperage creeping resulting in high anode current density requiring even higher stable anode quality or again better energy efficiency to lower their carbon footprint.

Then the paper presents the studied technology developments (equipment, process and digitization), those which have been successfully implemented and also those requiring further R&D work.

Keywords: Aluminium electrolysis anode, Rhodax crusher, Fives.

1. Introduction

For the past 25 years, SCAP-RHODAX® process has been a best-seller technology with nearly 3 Mt of anodes produced annually by 12 green anode plants (GAP) over the world, half of them operating in the GCC countries and India.

Along these years and based on the return on experience from our customers, needs for evolution of this technology were identified. Indeed, new challenges are faced by users including:

- Higher variability in raw coke properties requiring higher process resilience
- Maintenance issues due to more intense use of the equipment or new maintenance practices with lower planned shutdown frequency
- Continuous amperage creeping requiring bigger anodes with even higher and more stable anode quality
- Request for higher energy efficiency to lower carbon footprint
- Or simply, technology driven with more electronic or digital functions

This paper summarizes the studied technology developments (equipment, process and control), those which have been successfully implemented and also those still at R&D stage.

2. RHODAX® Technology at a Glance

2.1 History and Reminder of Forgotten Technical Features

The Rhodax process is the result of two parallel developments started in early 1990s. In early 2000s, Fives and Aluminum Pechiney (AP now Rio Tinto) joined their R&D efforts and co-patented the SCAP-RHODAX® process (Figure 1) which consists mainly in:

- Mixing all solids (raw coke, green and baked scraps) and crush them all together at the same time without any detrimental impact on anode quality,
- Producing a recipe based on two size fractions only:
  - Fines with 70 wt.% of particles smaller than 32 µm (< 32 µm),
  - Grains from 300 µm to 30 mm.

Both leading to a drastic flow sheet simplification.

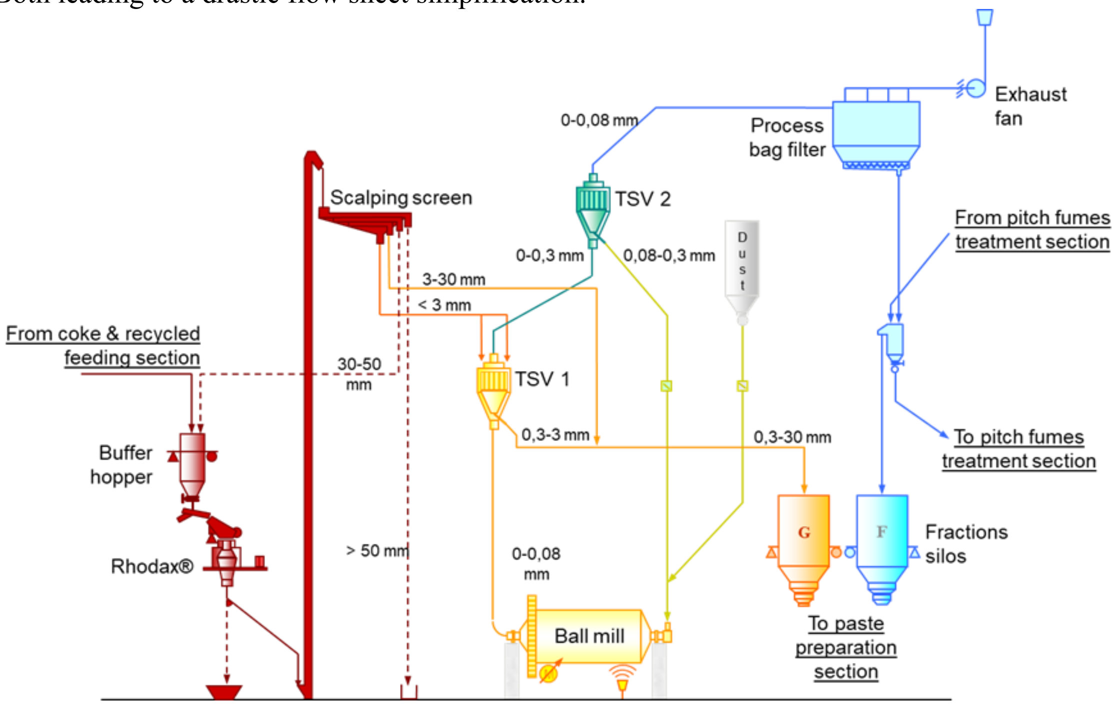

Figure 1. Original RHODAX® dry mix preparation line.

The key implementation characteristics and advantages of this technology are well known and described in [1]. In addition to the naturally high G/S (Grains/Sands fractions ratio > 4) and simplified flowsheet, several other important (and often forgotten) underlying technical features are recalled below.

First, the in-bed compressive grinding principle is a key technical differentiation factor of the Rhodax crusher compared to any other type of conventional crushers like cone crusher for instance. When it comes to crush together the fresh coke and the harder butts, it allows preservation of the crushed butts on the coarser side (selective crushing) preventing production of fines from them while crushing, in priority, the porous fresh coke particles. Moreover, as shown in Figure 2, initial tests also demonstrated a better cubicity of the particles, measured with the flakiness index, which is known to lead to better bulk density [2] of the dry mix and which was also verified with the Rhodax crusher.

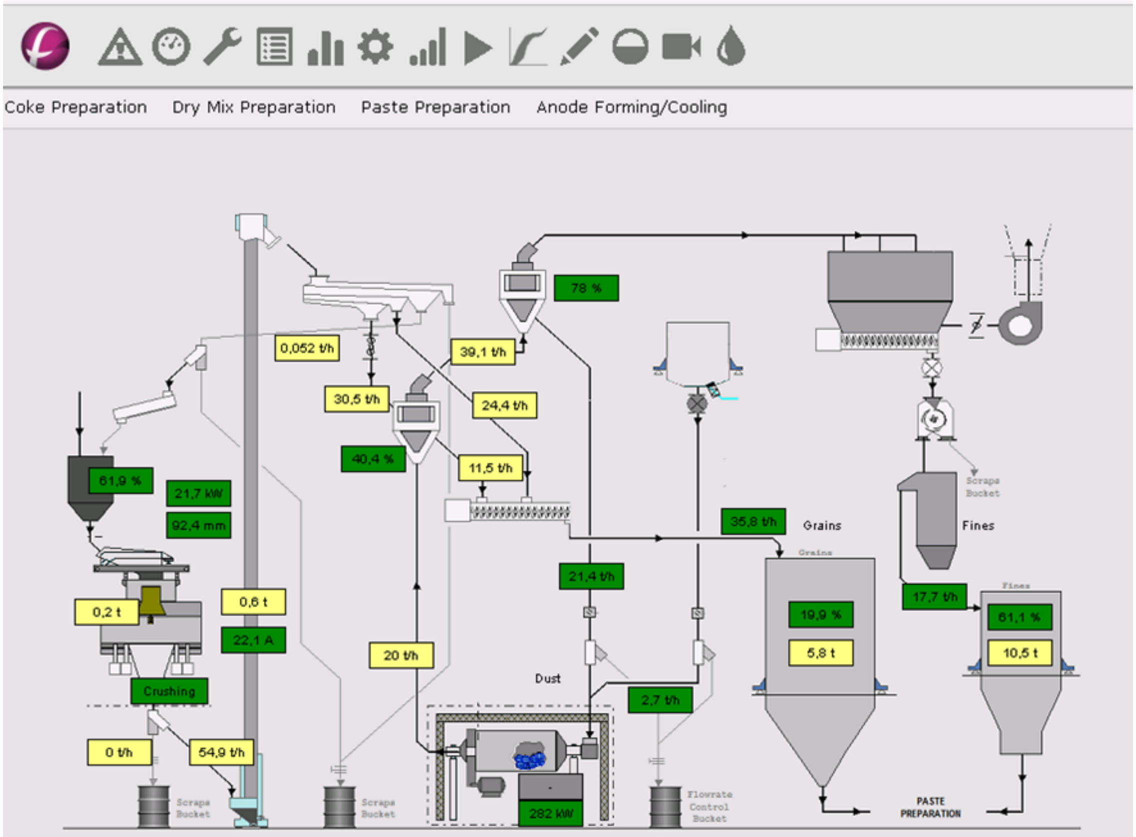

Figure 15. Auto-Adaptative on-line Population Mass Balance Model of the Dry Mix Preparation Line – Estimated mass flow for several streams.

4. Conclusions

Designed to implement the high G/S ratio concept developed 1990's, the Rhodax process came with a lot of other important features which were reviewed in this paper. Over the years, new challenges came and forced the continuous evolution of this technology to add new features dealing with process, control and equipment performance.

These new features aim at adapting the technology to user's new constraints (like raw material variability, new anode quality requirements or operation and maintenance) without jeopardizing the key initial benefits of the Rhodax process. A lot of these new features are already successfully tested at industrial scale and some others remains at R&D level, like high fidelity simulation of the crushing process to prepare the future of the green anode production.

5. References

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