Active Dust Aspiration During Packing Coke Filling

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Abstract

Active dust aspiration during packing coke filling is a new solution developed by Fives. It concerns the anode baking process dedicated to production of primary Aluminum. The invention relates to the packing coke filling which leads to dust emissions in the anode baking furnaces pits. This suction system extracts the fine particles of dust before petroleum coke gets out of the filling pipe. Thus, the packing coke is conditioned before being poured into the pit of the baking furnace. This new type of solution has demonstrated that petroleum coke no longer generates mist due to fine particles, as suction inside the filling pipe is much more efficient than out of it.
Benefits are:
- Environmental: Less dust emissions inside the baking furnace,
- Improvement of working conditions: less exposure for floor operators,
- Economical: carbon savings in the process,
- Quality: participates to a better baking homogeneity.

Keywords: Anode baking furnace, Dust reduction, Carbon saving, Packing coke filling, Furnace tending assembly.

1. Context

The primary aluminum industry is facing relatively unprecedented challenges. Its impact in terms of greenhouse gas emissions is focusing attention on the conditions under which it conducts its operations, particularly among the new generations of operators and engineers. In other words, it will have to produce "cleanly" if it is to remain attractive to its stakeholders. In fact, most of the industry's major players include waste reduction and environmental impact targets in their sustainability roadmaps.

Carbon dust emissions coming from the anode baking furnaces are just one of the issues to be improved if we are to adhere to this new objective of cleaner production. This objective will be more relevant if it also has a positive impact on the quality of operations, and ultimately on operating expenses. Indeed, it is generally accepted that the packing coke quality is a key factor for the right functioning of the furnace firewalls and ultimately for the anode baking quality [1]; as an example, Zhaohui Wang et al. [2] cite the fine coke as a factor contributing to the carbon build-up on the refractory walls.

1.1 General Information about Anode Fabrication

Primary aluminum smelters produce metal using the Hall-Héroult process which, in its modern application, involves positive electrodes made of pre-baked carbon blocks [3]: the anodes. Given that the consumption of anodes is roughly around 55 wt. of the smelter's metal production - gross carbon consumption being around 550 kg per ton of primary aluminum - the anode manufacturing process is an important activity, whether it is carried out within the foundry or in specialized plants that produce only anodes. There are two main stages in the manufacturing process of anodes: the formation of raw anodes, performed in green anode plant (GAP), where a paste is

prepared by mixing solid coke and liquid pitch and then is put in shape and baking of the green anode in a furnace, generally referred to as an anode baking furnace (ABF).

Carbon dust generation in the smelter is due to dry material handling, so it should occur mainly upstream in the GAP where dry solid material is processed (handling - crushing – screening – milling – storing – dosing, etc.). A dust collection system, made of various extracting hoods located in fixed judicious places, connected to a ductwork and finally a to an extraction fan with a filter bag, avoids excessive emissions. The other area in the smelter where carbon dust is generated is in the ABF; where the dust emission is not due to the handling of the anodes, but rather to the use of a packing material made of coke (packing coke), which is handled at time an anode batch is put in or remove from the furnace. The present paper will focus on the circumstances where dust in generated in the ABF with packing coke handling. To better visualize the problem, Figure 1 shows a typical aerial view of an aluminum plant, where dark zones correspond to carbon material processing.

Figure 1. Bird's-eye view of an aluminum smelter.

1.2 Role of the Packing Coke

During the anode baking process, part of its pitch constituent is burned while another part is coked, thus ensuring increased cohesion of the material with all the desirable characteristics for good performance in use on the electrolytic cell. This baking process lasts several days; in the initial phase, the anode passes through a relatively soft phase before the coking of the pitch gives it more cohesion, so it needs to be constrained like in a mold. On the other hand, the anode material cannot be directly exposed to the flame of a heating system, nor to the air that would oxidize it - it must therefore be insulated in some way. That is the purpose of the packing coke: 1) to maintain anodes within the pit and 2) to prevent the burning of the anode material during the firing process.

In practice, as it can be seen in Figure 2, the baking furnace comprises of a series of cells, called pits, where several layers of anodes are loaded, separated by double-walled partitions – the firewalls - in which gases are burned to provide the necessary energy. The packing coke is put around the anode blocks, between the external faces of the firewalls. The flames of the burning gases have no contact with the anodes to bake so the protective packing coke will conduct the heat towards the anode. During the firing, gases emitted by the heated anode material are sucked by the firewall cavity which is maintained with a certain vacuum.

The next step is to test the system as a pilot in a shop to confirm its performance in real conditions. It should be noted that the implementation of the active dust removal system is simple to set up, accessible financially and reversible. A patent application for such a solution has been filed.

5. References

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