

Metso Outotec's 5th Generation of CFB Alumina Calciners – Optimized Process and Equipment Design

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Abstract



Metso Outotec and its predecessor companies introduced the Circulating Fluid Bed (CFB) calcination technology to the alumina industry in 1970, and since then it has gone through several development stages with more than 60 installations worldwide, resulting in the latest generation of state-of-the-art CFB calcination technology that Metso Outotec has provided to recently commissioned alumina refineries.

The continuous design evolution of our CFB technology finally culminated with the development of the Generation 5 Calciner. The clear intent has been to advance the integration of the calciner flowsheet and to reduce overall plant weight, for example, by the implementation of a highly efficient pre-separation stage prior to the electrostatic precipitator which has significantly reduced the required size of the ESP without compromising the low dust emission figures. Furthermore, the air-lift system can be replaced, and only a lean pneumatic transport system for the ESP dust is required. At the same time, latest key equipment design developments have been implemented to improve the plant performance: These design improvements include the optimization of critical process equipment, all contributing to both an energy efficient as well as reliably stable plant operation.

Metso Outotec's Generation 5 alumina calcination technology has been successfully applied at 3 alumina refineries for a total of 5 units with a maximum capacity of 3500 tpd of alumina production.

Keywords: Alumina calcination, Capital cost, Circulating fluidized bed, Specific energy consumption.

1. Introduction

Calcination as the final step of the Bayer process is both, responsible for a very high fraction of the fuel and energy consumption in every alumina refinery as well as decisive for several critical alumina product quality parameters. With the change from floury to sandy alumina production in the beginning of the second half to the twentieth century and the main drivers mentioned before in mind, Metso Outotec and its predecessor companies developed and continuously improved the stationary calciner based on the circulating fluidized bed technology. With more than 60 applications worldwide, Metso Outotec's CFB calcination as the final step of alumina production accounts for a significant share of global smelter grade alumina production capacity.

The development of the fluid bed calciner began in the 1950s and 1960s and led to introduction of the 1st generation CFB calciner to the market in the early 1970. This marked a giant step for the calcination technology, as significant improvements of fuel efficiency had been achieved in comparison to formerly used rotary kiln plants.

Ever since the first application, the CFB calcination process is constantly reviewed and improvements have been applied. The evolution of the technology is divided in several plant generations, each of these are characterized by new key process improvements. The development culminated in today's 5th generation of CFB alumina calciners.

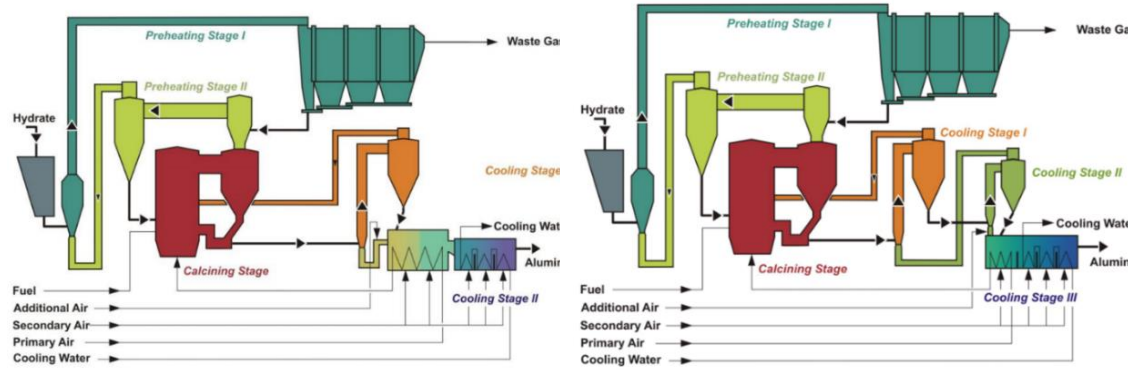


Figure 1. The CFB Alumina Calciner Flowsheet for Generation 2 (left) and 4 (right).

To exemplarily reproduce the developments since the introduction of the technology, hereafter the key process design developments for generation 2 and 4 are described. Both flow sheets are displayed in Figure 1. Generation 2 marks the first evolution step developed in the late 1970s and applied throughout the 1980s at (among others) Nalco A & B, Worsley 1,2 & 3 and Alunorte A & B. The main features include 2 preheating stages, 1 cooling stage for secondary air preheating and the fluid bed cooler for primary air preheating and product cooling. With further development in the 1990s and early 2000s, the 4th generation was launched with a second cooling stage with direct heat exchange and a joined fluid bed cooler design. This has been applied e.g. in Alunorte's plants D to G.

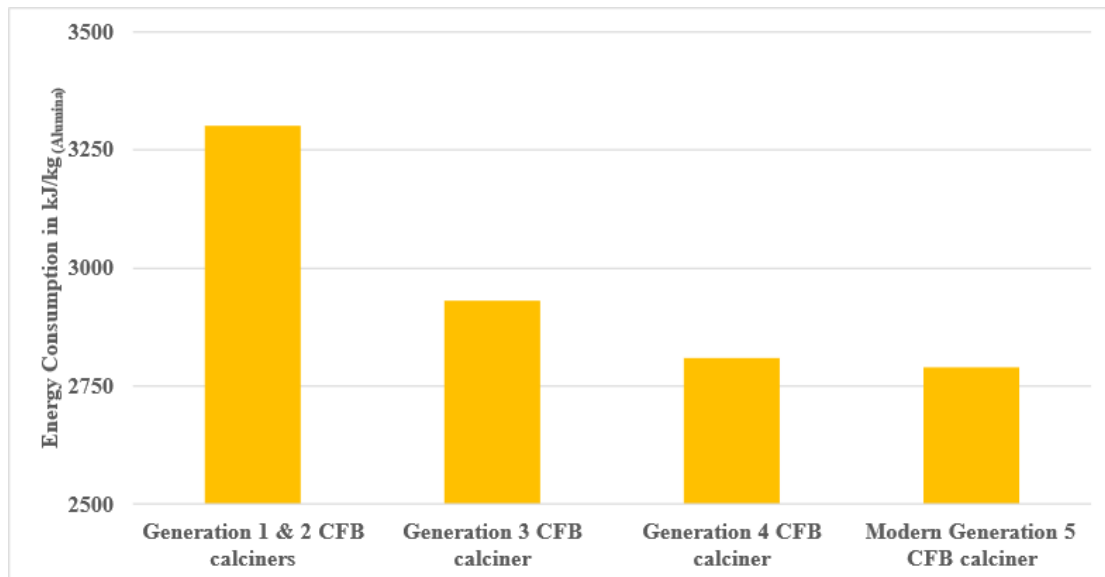


Figure 2. Fuel Energy Consumption for CFB calciners (adapted from [1]).

The constant improvement led to an outstanding development of the specific fuel consumption figures. Its decrease across the different plant generation is displayed in Figure 2 above.

This paper provides an overview on the latest generation of CFB calciners, which has recently been applied with 5 plants at 3 different alumina refineries.

outstanding performance and reliability create a measurable benefit and proves the generation 5 calciner to be a successful development step.

4. Outlook and Options for More Energy Efficient Alumina Calcination

Metso Outotec is continuously developing its CFB calcination technology by considering lessons learned from ongoing and completed plant projects and also valuable customer feedback from years of operation of our CFB calciners. Also, we keep identifying and implementing the latest developments in plant engineering and global technological trends.

In addition to the development of the fundamental calciner flowsheet and design, we offer further options to enhance the calciner performance: The application of digital tools such as advanced process controllers are an important pillar here. Independent of the plant generation, this can further boost operational stability, energy efficiency and product quality, as described by [6], based on experiences with at a CFB calciner in Brazil.

Furthermore, there is the possibility to further enhance the CFB calciner flowsheet by integrating Metso Outotec's Hydrate Drying technology, which uses heat in a range between 150-200 °C from the fluid bed cooler section to pre-dry the wet hydrate feed. This concept can further reduce the specific fuel energy consumption by up to 90 kJ/kg of alumina [7] and it is also possible to be integrated into a generation 5 CFB calciner.

In conclusion, the Metso Outotec CFB alumina calciner is under constant evolution to always offer the most competitive alumina calcination technology to our customers. The successful installation, commissioning and operation of the 5th generation of CFB calciners marks an important step and underlines this evolution.

5. References

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