# Production of Ceramic and Smelter Grade Alumina in Outotec's Dual Purpose CFB Calciner

**Linus Perander[1], Yasar Bayraktar[2], Gokhan Kurşat Demir[3], Seyit Avcu[4], Mustafa Server[5], Sonia Noack[6], Alessio Scarsella[7]**
1. Head of Calcination, Outotec AS, Oslo, Norway
2. Technical Manager
3. Alumina Refinery Manager
4. Calcination Process and Project Engineer
5. Calcination Process Engineer
ETI Aluminyum Inc., Konya, Turkey
6. Senior Product Engineer
7. Director, Alumina Refinery Technologies
Outotec GmbH & Co. KG, Oberursel, Germany
Corresponding author: linus.perander@outotec.com



**Abstract**

Special grade alumina are commonly used in a range of application, such as ceramics, refractories, glasses and polishing agents. The production of these materials require calcination at higher temperatures that what is used to produce Smelter Grade Alumina (SGA), and often also the use of mineralisers. Particularly for small or mid-sized alumina refineries tapping into alternative revenue streams is an attractive option in case there is additional capacity in the upstream refinery processes. In 2014, Outotec was engaged by ETİ Aluminyum Inc. to design a calciner capable of producing both Smelter Grade Alumina for use in their own smelter as well as Ceramic Grade Alumina (CGA). This required a dual purpose-built plant to cater for the required wide range of processing conditions to produce these very different alumina qualities. This paper explores some of the design challenges, provides solutions that Outotec developed to overcome these, and also discusses the performance of the plant after commissioning.

**Keywords:** Alumina Calcination, Ceramic Grade Alumina, Circulating Fluidised Bed, Alumina Quality, Smelter Grade Alumina.

## 1. Introduction

Special grade alumina are commonly used in a range of application, such as ceramics, refractories and polishing agents. The production of these materials require calcination at higher temperatures than what is used to produce Smelter Grade Alumina (SGA), and often also the use of mineralisers. By adjusting calcination parameters, mainly calcination temperature and retention time some of the key properties can be controlled. Particularly for small or mid-sized alumina refineries tapping into alternative revenue streams is an attractive option in case there is additional capacity in the upstream refinery processes.

In 2014 Outotec was engaged by ETİ Aluminyum Inc. to design a calciner capable of producing both Smelter Grade Alumina for use in their own smelter as well as Ceramic Grade Alumina (CGA). This required a purpose-built plant to cater for the required wide range of processing conditions to produce these very different alumina qualities. The success of the challenging project was only possible through a very close cooperation between Outotec and ETİ Aluminium in all stages, from design and engineering, through to construction and commissioning. Most importantly, focusing on getting the design aspects right in the early stages of the project was a key to the success. In this the experience of both parties was crucial.

Implementation of the project comprised understanding of the functional target of the plant over the definition of engineering aspects to be re-engineered and reinforced. This involved interaction of all disciplines, process, plant layout, equipment design, materials, instrumentation, programming, controls, operation and maintenance. This paper explores some of the design challenges, provides solutions that Outotec developed to overcome these, and also discusses the performance of the plant after commissioning.

## 2. Process Parameter

Establishing the required process parameters to obtain products with the desired characteristics was one of the most important activities in the early stages of the project. This defines not only the design parameters of the main vessels but also the sizing of several key vessels. It is well known that calcination time and temperature impacts on the alumina properties [1], and this is also utilized in the calciner control, for example by adjusting the furnace temperature to achieve the target SGA properties.

Several chemical and physical properties such as loss of ignition (LOI), specific surface area (BET) and alpha alumina are related to each other. A typical relationship as derived in Circulating Fluid Bed (CFB) calcination, is shown in figure 1, in which BET and LOI are represented with blue and green lines, respectively, and alpha alumina with a red line. As can be seen in the relatively narrow temperature range (used for SGA production) the BET and LOI appear to follow an almost lineal trend inversely proportional to the temperature. Alpha alumina formation, on the other hand increasing exponentially with calcination temperature. Impurities and mineralisers can further enhance/catalyse or inhibit this phase transformation reaction. As an example, fluoride which is often used as a mineraliser has a strong influence in catalyzing the conversion to alpha alumina.

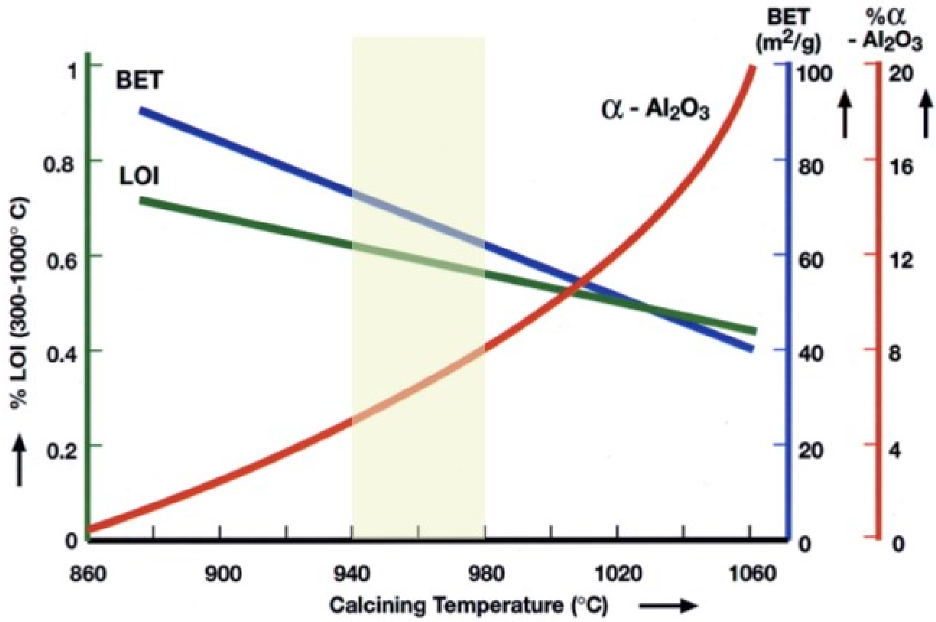


**Figure 1. Development of BET, LOI and alpha alumina as a function of calcination temperature in a CFB (at fixed residence time). Typical range for SGA production indicated in the shaded area.**

However, these relationships are highly idealized as the development of alumina microstructure and properties are influenced also by other factors [2]. Most notably for a Bayer refinery would be

## 7. References


1. Wefers, K. and C. Misra, eds. Oxides and Hydroxides of Aluminum. Alcoa Technical Paper No. 19. 1987, Aluminum Company of America: Pittsburgh, PA.
2. L.M. Perander, Evolution of Nano and Microstructure During the Calcination of Bayer Gibbsite. PhD Thesis, The University of Auckland, 2010.
3. L.M. Perander, Z.D. Zujovic, T.F. Kemp, M.E. Smith, and J.B. Metson, JOM 61(11), 33 (2009)
4. Klett C., Perander L., Alumina Calcination – A Mature Technology under Review from Supplier Perspective, TMS Light Metals (Warrendale, Pennsylvania): pp. 79-84. (2015)
5. Schmidt H-W., et al., Alumina Calcination With The Advanced Circulating Fluid Bed Technology: A Design With Increased Efficiency Combined With Operating Flexibility, TMS Light Metals 1996.