Alumina Properties and Challenges Ahead

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Abstract

The author explores non-traditional approaches for dealing with the challenges that Smelter Grade Alumina may pose to end-users at primary aluminium reduction plants. These are not entirely aimed at identifying what Bayer process refineries may be able to do for Hall-Héroult process reduction plants. The author encourages primary aluminium smelters to adopt a stance of empowerment and self-determination before looking for solutions from others. A part of this approach includes establishment of regular customer-supplier dialogues in the manner of Customer Satisfaction Indexes. Additionally, the author encourages development and offers a first draft proposal of a set of minimum standards for Smelter Grade Alumina that will serve to better define the generic moniker of SGA.

Keywords: Smelter grade alumina (SGA), Customer satisfaction, Minimum standards, Product quality, Guaranteed limits.

1. Introduction

From the perspective of users of Smelter Grade Alumina, SGA, the challenges ahead include more than a few uncertainties.

- Alumina refineries are exploring ways to lower their CO_2 footprint and to become more energy efficient. This may require advancements in technology for the Bayer process, especially in the area of calcination.
- Aluminium smelters continue to creep amperage using platforms of modified base-technology. This introduces challenges to adequate dissolution between feed shots.
- Amperage creep is also beginning to increase fluoride evolution rates that challenge all but the most modern dry scrubbing systems.
- Production of aluminium in the People's Republic of China is capped at 45 million annual tonnes. But this cap has no impact upon plans for additional refinery capacity that could drive China to become a regular exporter of metallurgical grade alumina.

These and other changes on the horizon place aluminium smelters and alumina refineries in a position of need for greater definition of desirable and acceptable product quality. This in itself may be a challenge for an industry that has not yet clearly defined the meaning of terms such as "sandy" or "floury" alumina, or metallurgical grade alumina vs. SGA. Even the term "calcined" alumina begs additional meaning with the advent of concerns around pore sizing requirements for efficient dry scrubbing of hydrogen fluoride. This also extends to a need for greater clarity on acceptable Loss On Ignition, LOI, content which is a primary contributor to the production of HF by Hall-Héroult reduction cells.

2. Product Quality Concerns

Product quality concerns are often focused on: variation in fines content, sodium oxide content, attrition index, and/or specific chemical or physical properties. Underlying issues with SGA properties may be linked to process operations at the refinery, the type of bauxite that is processed, and the design of the alumina refinery itself. Underlying issues may also have more to do with individual users of SGA adopting an external focus with regard to product quality issues. Thus, an alumina refinery can become the focal point for problem-resolution efforts that may be able to be more effectively addressed by the smelting client.

Solutions or partial solutions are often more readily available to reduction plants when an internal focus on problem solving is chosen as a starting point or as a parallel path of effort as with management of alumina fines [1].

Examples for reflective problem resolutions include:

- Placing appropriate focus on Fe_2O_3 levels in SGA when the iron content of alumina usually accounts for less than 15 % of the Fe that reports to aluminium metal.
- Placing appropriate focus on Attrition Index values when the attrition "footprint" of alumina handling systems and inadequate de-scaling of fluorinated alumina processing and handling systems contribute greatly to the generation of fines.
- Placing appropriate focus on the variation in fines content from shipment-to-shipment when there is no active silo management strategy in place to minimize particle segregation at the receiving port facility or aluminium smelter.
- Placing appropriate focus on alpha-phase content due to bottom sludge formation that may be more closely linked to superheat and the kilograms of alumina per hour that must be delivered by each point feeding device.

Some issues, such as high sodium oxide content, high P_2O_5 content, or low flowability of product may best be directed to the attention of the alumina refinery [2]. However, this oftentimes includes a caveat. As with aluminium electrolysis, alumina refining is a continuous process that does not have an abundance of independent variables. Client smelters that ask for a change in one parameter are often inadvertently asking for changes in other product quality parameters that may be counter to their own best interests.

A textbook example is illustrated with the calcination sub-process. Requesting a change in BET Surface Area also serves as a request to change the alpha-phase and LOI content of product [3]. Refer to Figure 1. Adjusting the target may also alter the pore size distribution of SGA which may not be favorable for dry scrubber removal of hydrogen fluoride.

been taken within the People's Republic of China to identify alumina quality by grading, AO-1 and AO-2.

Creation of a set of minimum standards is also not intended to have alumina refineries downgrade their existing guaranteed product quality limits. Doing so would risk damaging brand name and customer perceptions of premium product that is more desirable in a long market.

5. Conclusion

Challenges for Smelter Grade Alumina are tied to a range of uncertainties that include technology changes in alumina refineries and in primary aluminium reduction plants. New entries into global alumina markets add additional factors of concern.

To meet these challenges as they emerge two not so common approaches are endorsed. Aluminium smelters should look inward to develop new solutions or counter-measures to alumina-based concerns. Closer ties of regular communication between aluminium smelters and alumina refineries are also advised. From such interactions alumina refineries can also take the opportunity to be more introspective around the question: Are we making a preferred product that satisfies the needs of the customer base?

Beyond this a need for better definition of the term "SGA" is needed now more than ever. There have been attempts to develop more universal specifications for Smelter Grade Alumina. None of these have gained universal traction towards acceptance. Perhaps it is best to begin to define SGA with a set of minimum standards. Identification of what is not SGA only serves to classify products into two grades, as with the example given for the quality of fluorspar. These may come to be known as SGA and MGA for Metallurgical Grade Alumina.

Perhaps the future may see grading systems that identifies product quality by well-defined monikers such as: SGA, MGA, AO-1 and AO-2. The last two of these have already been defined. It is time to create greater definition for SGA and it is hoped that the draft shared in Table 4 provides a starting point for that discussion.

6. References

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