Hydrocycloning Technology Contribution to Productivity Improvement through Fines Loss Recovery and Seed Classification

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Abstract

Since 1978, AKW Equipment + Process Design high performance polyurethane based hydrocyclones, type AKA-VORTEX, have been successfully installed and used in more than 50 alumina refinery projects. With the alumina industry returning to growth after a challenging market period, key players have understood that a successful come-back requires first a careful and thorough look into their overall production process, with a focus on productivity improvement:

- By increasing the product discharge, at same input capacity,
- By increasing efficiency through higher recovery rate,
- By minimizing losses of valuable materials from usual discharge streams.

If the first 2 productivity improvement levels are already well established, recently, a particular focus was put on the recovery of fines lost throughout the various liquor streams of the alumina plant. This aspect on which limited attention had been put on in the last decades, now raises more attention, with AKW Equipment + Process Design offering unique process solutions to make it an opportunity. The recovery principle of such losses, characterized by low alumina content and specific size range of particle size distribution (PSD), will be presented on the basis of a selected example.

Keywords: Alumina refinery, alumina classification, hydrocyclones, seed classification, fine loss recovery.

1. Background of AKW Equipment + Process Design / AKW Apparate + Verfahren GmbH ("AKW A+V")

AKW A+V is a medium-sized, privately owned company focused on process engineering and equipment supply, as well as on plant engineering, construction and service for mineral processing plants. Since the year 1833, kaolin, feldspar and silica sand have been processed in the area around Hirschau/Germany. This is where AKW A+V was founded in 1963, initially as a research department of the mining company Amberger Kaolinwerke. Since the early beginnings, innovations, new product ideas and technologies have been key drivers, which have now turned the company into a global operating enterprise with headquarters in Hirschau (Bavaria, Germany), and with offices in Kiel, Moscow, Shanghai, São Paulo, Dubai and agencies in many other countries. With the aim to increase the wide-ranging service capabilities, improve the customer satisfaction and provide the best solution for each individual application, AKW A+V opened in the year 2011 a new and enlarged technical test center. This test center (and warehouse), arranged on an area of approx. 900 m² right next to the headquarters, is equipped with a full range of process equipment, ensuring effective test work and allowing the characterization and development of almost all sort of processing steps. Combined with measurement capabilities (3D digital microscope, XRF system, laser particle size analyzer), small scale up to pilot tests can be organized and fully handled out of one place.

Figure 1. (a) Test center and warehouse; (b) Test center extract from the main hall.

2. Introduction

The Bayer process is constantly evolving and the specific techniques, employed in this highly sophisticated industry, for the various steps of the process do not only vary from plant to plant, but also are often held as trade secrets. As a more detailed, but not comprehensive, description of the Bayer process, the ground bauxite ore is fed as an aqueous slurry, typically prepared with spent liquor and added caustic, to a series of digesters, where about 98 % of the total available alumina is released from the ore as caustic-soluble sodium aluminate. The digested slurry is then cooled. The aluminate liquor leaving the flashing operation contains from 10 to about 20 w.-% insoluble solids.

This clarified sodium aluminate liquor, also referred to as "green liquor", is a hot caustic liquor, generally containing the highest values of dissolved sodium aluminate. Sodium aluminate-containing liquor is kept at elevated temperatures during the beneficiation steps so as to retain its high values of dissolved sodium aluminate. It is charged to a series of precipitation tanks, and almost always seeded with recirculated fine particle aluminium trihydroxide crystals. In the precipitation tanks it is cooled under agitation to induce the precipitation of alumina from solution as aluminium trihydroxide. The fine particle aluminium trihydroxide crystal seeds act as crystal nucleation sites for this precipitation process. Aluminium trihydroxide crystal formation (the nucleation, agglomeration and growth of aluminium trihydroxide crystals), and the precipitation and collection thereof, are critical steps in the economic recovery of aluminum values by the Bayer process. Bayer process operators strive to optimize their crystal formation and precipitation methods so as to produce the greatest possible product yield from the Bayer process while producing crystals of a given particle size distribution. A relatively large particle size is beneficial to subsequent processing steps required to recover aluminum metal. Undersized aluminium trihydroxide crystals, or fines, generally are not used in the production of aluminum metal, but instead are recycled for use as fine particle aluminium trihydroxide crystal seed. The state of the art technique to separate the coarse particles as product and the fine particles as seed (coarse and fine seed) utilizes hydrocyclones.

3. AKA-VORTEX – The special Polyurethane Hydrocyclones for the Alumina Industry

Hydrocyclones are important and economically viable systems for the wet-mechanical separation and classifying processes of ores and minerals. Capitalizing on more than 50 years of own development, AKW A+V hydrocyclones (AKA-VORTEX brand) demonstrate a mature construction, compact design and are also continuously improved.

Over the time, AKA-VORTEX polyurethane based hydrocyclones have shown significant advantages with regard to their key design features, as follows:

6. Conclusion

Although the alumina refinery constitutes a mature industry, opportunities for improvement are still existing, especially for process equipment that can offer flexibility and versatility. As such, the hydrocyclones constitute a solution of choice. As alumina refinery engineers identify weak points into their process that can lead to significant loss of valuable materials, they should consider addressing these issues with hydrocyclone suppliers that are able to highly customize their solutions in order to address at best those specific issues. To this, the high modularity of the high-performance polyurethane based hydrocyclone from AKW A+V has shown to be of great advantage. The recently gained project references in the specific field of fines loss recovery are opening a new chapter for AKW A+V hydrocyclone activity in the alumina refineries.

7. References

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