The Updated ILTD Process Case – Some Lessons Learnt from an R&D Project

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https://doi.org/10.71659/icsoba2024-aa007

Abstract

Findings are sometimes beyond the objectives of a research and development (R&D) project. This was the case with the Improved Low Temperature Digestion (ILTD) Process. The Updated ILTD Process will shortly be introduced as a state-of-the-art technology for processing gibbsitic bauxites. The Updated ILTD Process is most viable for bauxites or aluminous laterites with high reactive silica content, although this process is associated with several other benefits beyond the saving in the NaOH consumption. A method that makes possible to determine the amounts of important minerals (gibbsite and kaolinite) well below the detection limits of the X-ray diffractometry (XRD) is presented in the paper. A more accurate method for the calculation of the theoretical extraction yield for gibbsite in comparison with the conventional approach is proposed. A novel method for the calculation of the savings in primary energy consumption is explained and proposed. The breakdown of the additional investment costs to the ILTD Process and sintering-leaching step is also provided. The use of the sintering and leaching of DSP (desilication product) by-product for the elimination of the organic impurities at the same time is also explored.

Keywords: ILTD Process, DSP (desilication product), Recovery of soda and alumina, Waste free alumina production.

1. Introduction

There are excellent quality gibbsitic bauxites at different tropical regions of the World in large amount. One of the estimates suggests that the bauxite resources (i.e. reserves plus sub-economic and undiscovered bauxites) are expected in the range of 75–100 Gt [1]. Nevertheless, several alumina producers do not have access to very good quality bauxites and/or they need to make compromises when they intend to open a bauxite mine, accept bauxite with lower available alumina and/or higher reactive silica content than they would like to process. If an alumina producer is ready to accept worse quality bauxite, the amount of the reserve increases significantly, as per the well-known tonnage-grade curve [2]. A recent study showed that the average mine lead time (from the discovery of a mineral resource to the production) continues to trend upward, reaching 17.9 years for mines coming online in 2020–23 [3] (This study related to gold, copper, nickel and lithium metals. It is anticipated that a similar tendency exists for bauxite as well).

2. Updated Improved Low Temperature Digestion (ILTD) Process

The concept of the Improved Low Temperature Digestion (ILTD) Process is based on the observation that in case of sufficient amount of gibbsite is dosaged to the Test Tank Liquor it consumes almost all the reactive OH^--ions during its fast dissolution, a considerable amount of kaolinite remains undigested [4]. This concept of digestion was extensively studied in bench scale tests with Trombetas bauxite and other bauxites. The ILTD Process and the Sumitomo processes are variants of the differential extraction processes [5]. The digestion of the ILTD process is envisaged to operate at about 150 °C, a caustic concentration in the digester effluent of 240 g/L C (as Na_2CO_3), an A/C ratio of > 0.8, meanwhile the Sumitomo process used a digestion temperature of 135 °C, a caustic concentration of 219 g/L C after desilication, an A/C ratio of 0.687. The Sumitomo process operated on a commercial scale for 7 years [6,7], therefore it is reasonably considered as a proof of concept for the ILTD Process as well. All unit operations of the ILTD Process have been or were in operation on a commercial scale. The economic viability of the ILTD Process has been proven by Case Studies [8,9] and a Concept Study [10] though there are technical risks, such as how the different unit operations interact with one another, that have to be addressed in piloting. The pilot scale implementation of the ILTD Process concept as a whole is deemed to be a precondition of the commercial scale implementation and is outstanding. In the course of the pilot scale implementation the scale-up hypothesis and the operating conditions for optimum yield would be confirmed, scaling rates of equipment would be assessed, byproducts with novel characteristics would be manufactured for further studies, etc.

For the time being, the most promising way for the utilization of the DSP (sodalite) by-product is to submit the crystalline DSP to a sintering-leaching process step. This straightforward process has been in operation for processing nepheline, bauxite residue with high DSP content and sub-economical bauxites in Russia and China [11,12], formerly in the USA and Czecho-Slovakia as well. The sintering-leaching process makes it possible to recover about 90% of the chemically combined Na_2O and Al_2O_3 content of DSP, the resulting sodium aluminate solution can be used in the Bayer process. The dicalcium silicate (belite) byproduct of this sintering-leaching process can be used as principal feedstock for making Ordinary Portland Cement (OPC) and/or cementitious materials. The combination of the ILTD Process and the sintering-leaching is called **Updated ILTD Process** [8,9]. The Block Flow Diagram of the Updated ILTD Process is shown in Figure 1.

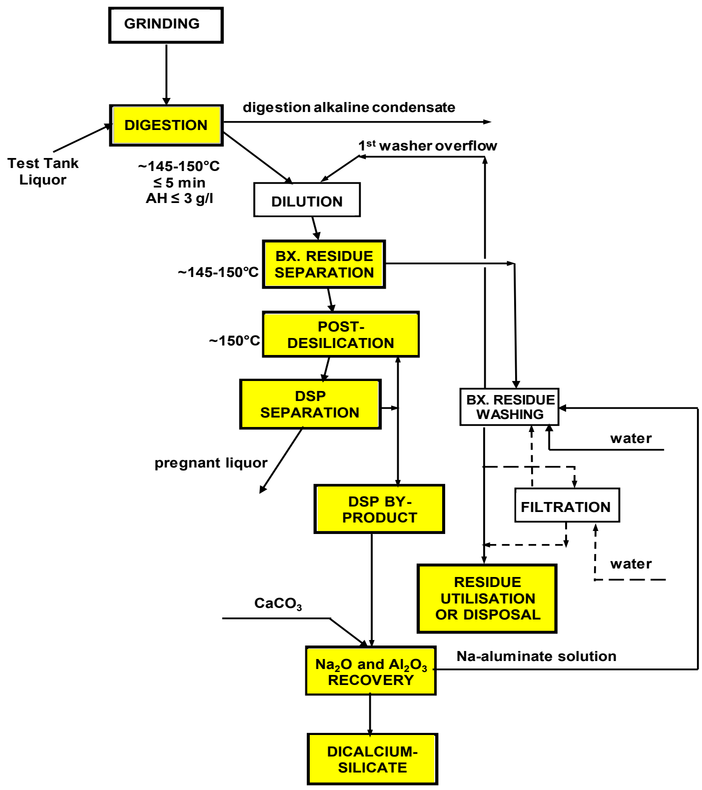

Figure 1. Block Flow Diagram of the Updated ILTD process (excerpt, in yellow) [8].

It has been proven by a recent Case Study that the NaOH consumption could be reduced by about 70 % by the Updated ILTD Process and the material and energy costs by up to about 40 %

8. Conclusions

The Updated ILTD Process concept has been introduced as a state-of-the-art technology for processing gibbsitic bauxites. The Updated ILTD Process is one of the most viable for bauxites or aluminous laterites with high reactive silica content, although this process is associated with several other benefits beyond the saving in the NaOH consumption. A Fourier Transformed Infrared (FTIR) Spectroscopy method that makes it possible to determine the amounts of important minerals (gibbsite and kaolinite) below the detection limits of the X-ray diffractometry (XRD) has been presented. An uncertainty (standard error) of 0.1 % (abs) for $Al_2O_{3,gibbsite}$ and 0.07 % (abs) for $SiO_{2,kaolinite}$ were arrived at using this method. A more accurate method for the calculation of the theoretical extraction yield for gibbsite has been proposed, especially for the case of the Updated ILTD Process. A novel method for the calculation of the savings in the primary energy consumption has also been explained and proposed. Using this novel method, some 20 % of the primary energy consumption was found to be a possible saving by the Updated ILTD Process compared with the Conventional LT Digestion Process. The least material and energy (M&E) cost was arrived at when the crude bauxite would be processed by the Updated ILTD Process. The breakdown of the incremental investment costs associated to the ILTD Process and the sintering-leaching step has been provided. Finally, the use of sintering and leaching of DSP by-product for the elimination of the organic impurities and Na-carbonate at the same time has also been explored and proposed.

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