Opportunities and Challenges of Bauxite Residue Valorisation from an Engineering Perspective – Revisit of Sintering Process

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Abstract

Bauxite residue is the key waste generated in the Bayer process for alumina production. The total global inventory of bauxite residue stored on land is currently estimated at over 6 billion tonnes and could reach beyond 10 billion tonnes by 2050, highlighting the significant environmental issues related to bauxite residue storage. Inaction or complacency with the current bauxite residue storage practices is not a responsible approach with regards to future generations. Process optimisation and valorisation of bauxite residue are desirable opportunities primarily to reduce the storage volume and extract other useful elements. However, due to its complexity and competition from other resources, the valorisation of bauxite residue is facing significant challenges, both commercially and regulation wise. This paper analyses these opportunities and challenges from an engineering perspective. A sintering flowsheet is presented for bauxite residue minimisation. Bauxite roasting is also discussed with the aim to address key questions: should thermal processing occur before Bayer digestion (bauxite) or afterwards (bauxite residue)? Will the traditional sintering process be re-born for valorisation of bauxite residue?

Keywords: Bayer process, Sintering, Alumina, Bauxite residue, Sustainability.

1. Introduction

Bauxite residue (BR), historically to be referred to as “Red Mud (RM)”, is the key waste material generated in the Bayer process for alumina production. Figure 1 shows the total global alumina production for the last 25 years [1], comparing with the estimated bauxite residue production. For every 1 tonne of alumina production, 1.5 tonnes of bauxite residue solids on average are assumed to be produced. Over the last 25 years the annual production of BR has increased by 180 %.

The total global inventory of BR stored on land was estimated to be around 2 billion tonnes in 2000 by Klauber et. al. from CSIRO [2]. Using this number as a basis in combination with Figure 1, the cumulative global BR storage is estimated and shown in Figure 2. About 6 billion tonnes of BR is stored worldwide nowadays, and this storage is expected to continuously increase dramatically in the future if no action is taken to recycle and re-use the residue.

The BR is commonly stored in various residue ponds (either dry or wet) close to individual alumina refineries. Often, the storage has occupied valuable agricultural land (Figure 3), has caused dusting and other environment issues, imposed a significant threat to local community, underground water, fauna and flora, and even wildlife if the storage is not managed strictly.

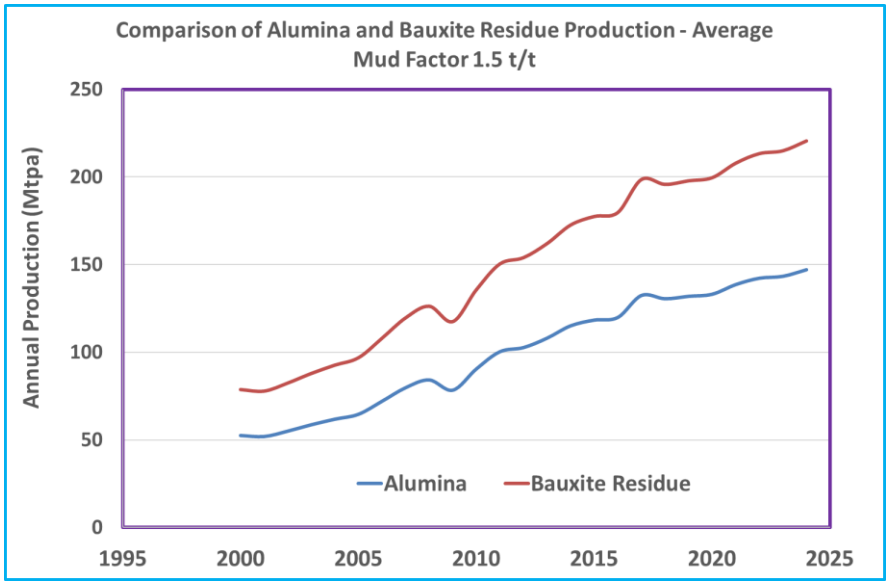

Figure 1. Comparison of alumina and bauxite residue production.

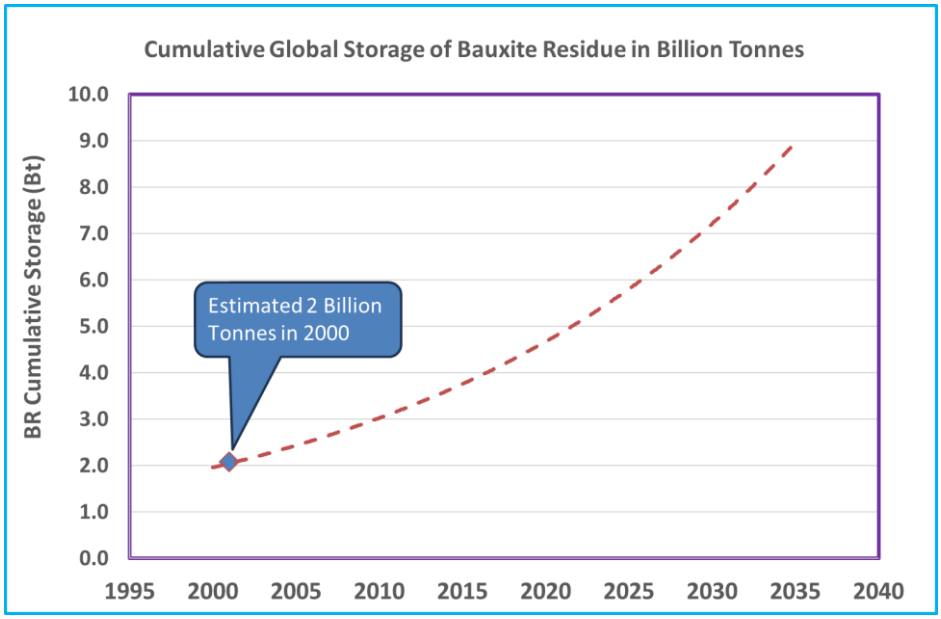

Figure 2. Cumulative global inventory of bauxite residue.

Figure 3. Bauxite residue pond near Stade (Germany) [3].

concentrate and grey mud (or further processed products). Impurities balance is another critical issue which requires to be evaluated.

As one of the key industrial stakeholders, engineering consulting firms bear responsibilities for continuous improvement of techno-economic solutions for alumina refining and bauxite residue management. Worley is dedicated to a proactive role in delivering a more sustainable world!

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