AA02 - Technology Options for Mixed Bauxites

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Abstract

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The choice of digestion technology for a new alumina refinery depends on the type of bauxite proposed to be used. For a predominantly gibbsitic bauxite with low levels of boehmite, it is generally accepted that a temperature of 140-150 °C attained finally in an autoclave is the technology choice (other than a very few refineries that operate at 100-105 °C). For mixed bauxites, however, there are different options; single or two stage digestion, tube or autoclave digesters, range of temperatures etc. Each of these options has its own pros and cons. This paper presents the details of these options and compares the broad differences with respect to equipment configurations especially Flash stages, heaters, and evaporation. The effect of boehmite content on these, as well as on efficiency and consumption parameters are evaluated using heat & mass balance calculations.

Keywords: Mixed bauxite, boehmitic bauxite, tube digestion, double digestion, digestion technology.

1. Introduction

Alumina is present in bauxite mainly as its hydroxide form apart from some associated with silica and goethite. There are three forms of alumina hydroxides (or "hydrates"). These are; i) gibbsite or tri-hydrate alumina ($Al(OH)_3$ or $Al_2O_3.3H_2O$), ii) boehmite or mono-hydrate alumina (AlOOH or $Al_2O_3.H_2O$), and iii) diaspore, another form of mono-hydrate. Bauxite is the primary raw material for the over-whelming majority of alumina production is of three distinct types; i) tri-hydrate or gibbsitic bauxite (with very low mono-hydrate content), ii) mixed bauxite, typically consisting of significant proportions of both gibbsite and boehmite, and iii) mono-hydrate bauxite consisting mainly of boehmite or diaspore.

Total global bauxite reserves are estimated to be about 30 billion tonnes whereas the total production in 2019 was about 370 million tonnes [1]. The total alumina production in 2019 was about 132 million tonnes including 8.4 million tonnes of chemical grade alumina [2]. The list of top 10 countries with largest bauxite reserves as of 2019 is presented in Figure 1 [1].

It should be noted that Cameroon is emerging as a country with a large bauxite reserve and so, the above list will undergo changes in the coming years.

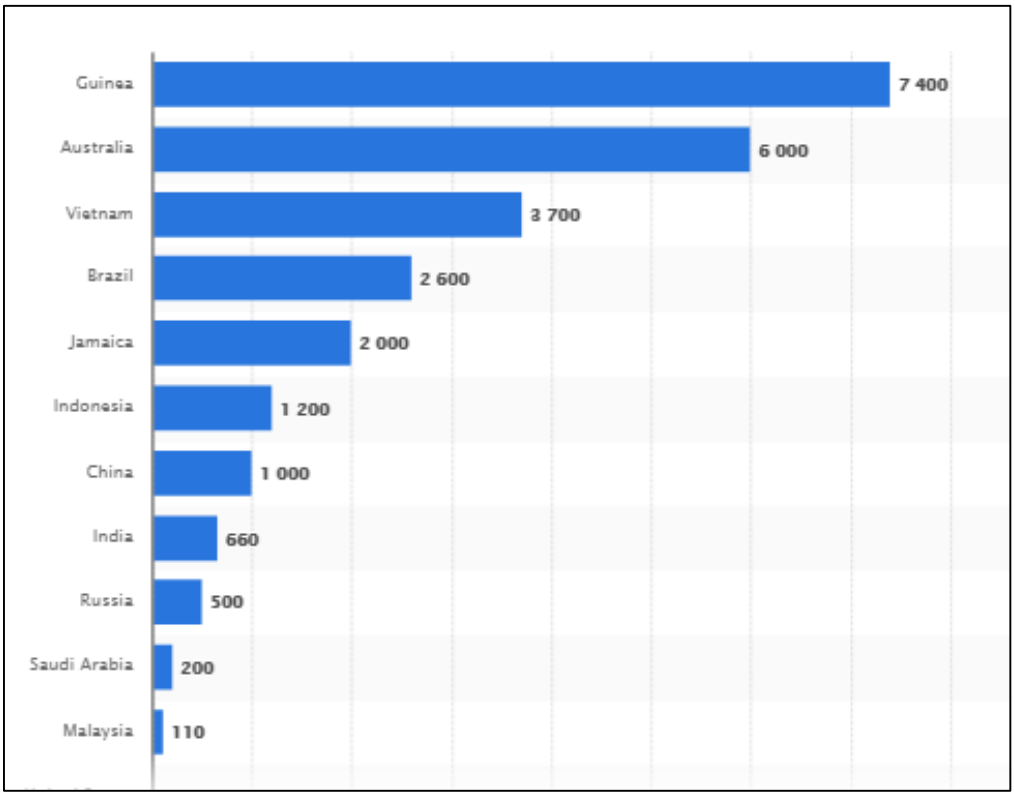

Figure 1. Top 10 countries with largest bauxite reserves- 2019 (million tonnes).

The deposits of Guinea, East Coast of India, Suriname and Brazil are generally gibbsitic bauxites. Deposits in Europe, Middle East and China are generally mono-hydrate bauxites. The rest of the deposits are mixed bauxites as defined above.

When a new alumina refinery is being designed, the choice of digestion technology becomes a particularly important design criterion. This mainly depends on the type of bauxite that is expected to be processed in that refinery over its design life. Gibbsitic bauxites are typically digested at a temperature of 140-150 °C. Mixed bauxites need about 240-250 °C for economic recovery of alumina content. Monohydrate or diasporic bauxites, however, need very high temperatures of 270-280 °C. There are of course instances of a refinery processing gibbsitic bauxite with only about 2-3 % boehmite opting for a temperature of about 240 °C, so that even the low content of boehmite is not lost, which does depend on the overall economics. Similarly, there have been instances of remarkably high temperature (270-280 °C) digestion technology being chosen for the mixed bauxites having 3-5 % boehmite only, based on the assessment by the Technology provider.

This paper deals with the various options available as digestion technology for Mixed bauxites and evaluates the possible effects of boehmite content on various design aspects.

2. Digestion Technologies

The two main process efficiency requirements while processing any bauxite are: 1) Maximum possible alumina extraction and 2) Maximum possible and satisfactory desilication of sodium aluminate liquor at the digestion stage. Maximum alumina extraction ensures all the alumina values that can be, are recovered, so as to minimise bauxite consumption and that the bauxite residue has a minimum alumina content. Maximal desilication ensures that scaling issues in the heat exchangers and pipelines are minimized, as is also silica impurity content in product.

4. References

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