Energy Consumption Optimization in Alumina Production

Bekir Çelikel¹, Hüseyin Arıkan² and Sema Vural³

1. Alumina Process Engineer
ETI Aluminium Inc., Seydişehir/Konya, Turkey
2. Professor,
Necmettin Erbakan University, Faculty of Engineering, Mechanical Engineering Department,
Konya, Turkey
3. Assistant Professor

Corresponding author: bekir.celikel@etialuminyum.com

Abstract

The alumina production process consumes not only raw materials, but also different forms of energy such as electrical, natural gas and steam. Energy is a key component of production cost, and the alumina industry works toward energy consumption reduction to maintain or improve their place in the world market. Energy is primarily used in the Bayer process as steam in the digestion and evaporation areas. The ETI alumina refinery in Seydişehir has been examining ways to reduce energy consumption and improve the overall energy efficiency of the refinery. This has included evaluating process design parameters, equipment efficiency, and waste heat recovery. In this paper, an understanding of the overall refinery energy usage is first established, then the operating efficiency in terms of energy consumption is evaluated by examining the major energy consuming areas of digestion and evaporation. The study has shown that the energy efficiency of the ETI alumina plant can be improved in the digestion area by lowering the molar ratio and in the evaporation area by by-passing spent liquor around the evaporation circuit.

Keywords: Bayer Process; Energy Optimization; Evaporation; Digestion; Steam

1. Introduction

The Eti Alumina plant is located in the south of Turkey, and has been processing bauxite mined from the Seydişehir deposit in the Konya Province since 1973. To maintain its profitability, all consumptions by the refining process must be critically checked, calculated and controlled.

The Bayer process for alumina production is a highly energy intensive in practice. The cost borne by refiners in meeting this energy requirement represents a significant percentage of the unit cost of producing a tonne of alumina. Energy use in the alumina refining process is usually in the form of fossil fuels such as diesel, gasoline, natural gas and coal, or as electricity. The theoretical energy consumption for alumina production is thermodynamically calculated for all the reactions in the process to determine the lowest possible energy consumption for alumina production. Thermodynamically, the variation in the theoretical energy consumption for producing alumina from diasporic, boehmite and gibbsite primarily relies on the key reactions and their conditions; temperatures and concentrations etc. Figure 1 illustrates that the heat of dissolution for all sorts of alumina minerals in caustic liquor is small compared to the total energy consumption in alumina production. This gap widens for monohydrate bauxites, when the dissolution temperature steps up, often to more than 250 °C