The Continuous Optimization of the Primary Energy Input at AOS – A Story of Success

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Abstract

Producing alumina at Aluminium Oxid Stade GmbH (AOS) has a long and successful history. In over 40 years of operation, engineers developed and delivered a series of optimizations regarding the specific primary energy consumption. The tube digester technology, invented by German engineers and applied on an industrial scale for the first time in Stade, was brought to an unprecedented performance level by its innovative cleaning methods, which led to a consistently high heat transfer, low pressure loss and excellent digester availability. Further improvements in recent years, such as the heat recovery from the exhaust gas stream of the salt heater, as well as the optimization of one of the fluid bed calciners and the installation of a combined heat and power generator (CHP), has led AOS to where it is now, a leading alumina refinery with regard to the energy consumption per ton of alumina.

Keywords: Energy optimization, Tube digester, alumina.

1. Introduction

Aluminium Oxid Stade GmbH (AOS) is an alumina refinery (Figure 1) with an annual production capacity of approximately 1 000 000 tonnes Al_2O_3. From 1970 to 1973, the plant was built with a designed annual production capacity of 600 000 tonnes Al_2O_3. Due to continuous optimizations of the process, smaller enhancements and the installation of an additional tube digester, the production has been increased to the present quantity. Apart from the ongoing increase in the production rate, engineers at AOS developed a series of optimizations to minimize the specific primary energy consumption.

Figure 1. Production area at AOS.

The basis for the plant´s low primary energy consumption is firstly the tube reactor, and secondly the fluid bed calciner. The tube digester technology, developed by VAW and primarily used at AOS, makes digestion at temperatures as high as 270 °C possible. Therefore, practically all kinds of bauxite can be processed. Ever increasing energy costs, cleaning costs and environmental aspects led AOS to introduce their innovative cleaning methods, to install heat recovery systems and to build a combined heat and power generator.

2. The Tube Digester at AOS – Overview

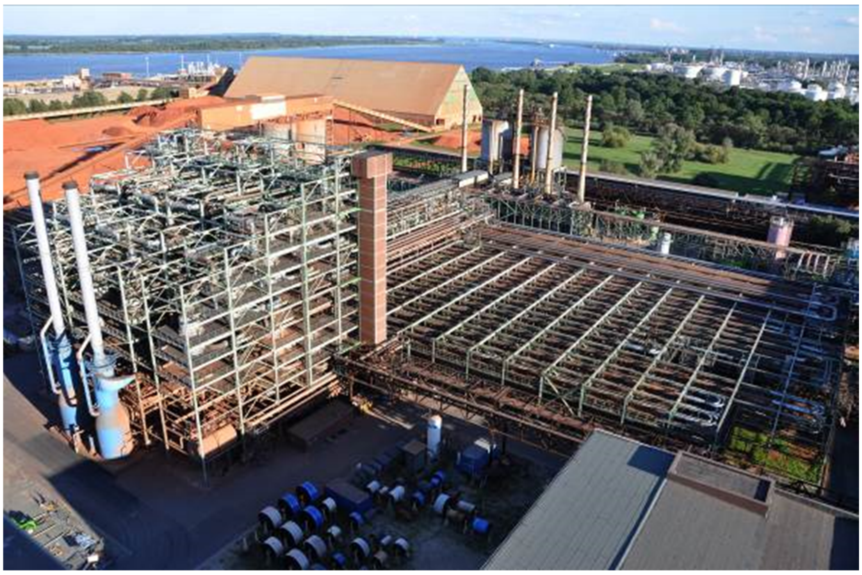

Figure 2. AOS tube digester.

At AOS four high temperature tube digesters are operated independently at a digestion temperature of 270 °C (Figure 2). Digestion feed liquor and bauxite slurry are mixed prior to the digestion process and are pumped with a piston diaphragm pump through eight vapour heat exchangers using regenerative flash vapour (Figure 3). Final stage heating to 270 °C is then accomplished by using molten salt. After adding oxygen for the wet oxidation process and lime slurry to enhance the yield, the heated slurry runs through a retention time section to increase alumina extraction, before it enters a cascade of eight flash tanks. In each flash tank, vapour is recovered to heat the digester feed slurry stepwise in counter-current flow. In the last heat recovery step, the pregnant liquor leaving the cascade is fed to a heat exchanger transferring heat to the digestion feed slurry, which is entering. By using this heat recovery system, more than 75 % of the necessary digestion energy is provided.

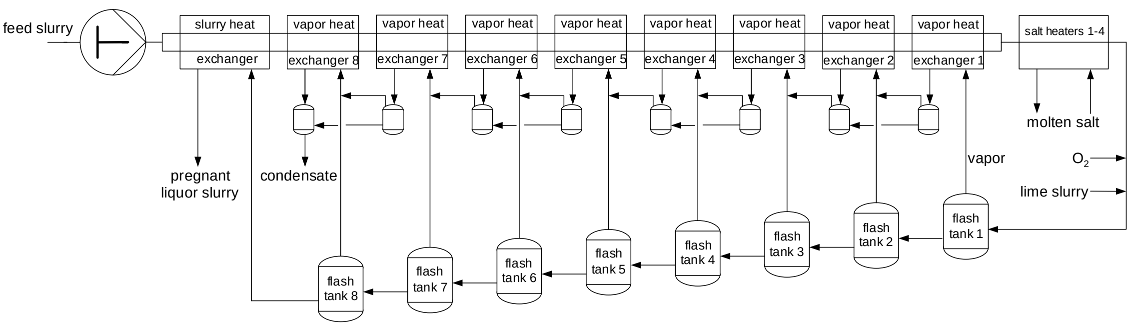

Figure 3. Schematic of the tube digester at AOS.

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