Anode Baking Furnace with Optimized Heating Curves and Natural Gas Consumption Reduction at Sohar Aluminium

Ahmed Belfoul[1], Hamdan Al Alawi[2], Olivier Rival[3], Mohammed Al Balushi[4], Raghu Nandan Joshi[5], Hamood Al Brashdi[6], Rashid Al Maamari[7], Shashi Sing[8], Javith Basha[9], Mahfoud Al Ghaithy[10] and Ciro R Kato[11]

1. Carbon Process Specialist
2. Carbon Process Engineer
3. Technical Superintendent
4. Operation Superintendent
5. Maintenance Superintendent
6. Maintenance Senior Supervisor
7. Refractory Process Technician
8. Maintenance Lead Engineer
9. IT Senior Engineer
10. Carbon Operation Manager
11.Technical Manager

Sohar Aluminium Smelter, Sohar, Sultanate of Oman
Corresponding author: Ahmed.Belfoul@Sohar-Aluminium.com
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Abstract

With the aim of reducing the Anode Baking Furnace (ABF) natural gas consumption, this work describes, in its first part, the series of measures addressing the process deviations, the equipment failure modes, the refractory aging condition, and the operation performances, through a portfolio of business improvement tools (Six sigma lean tools, design of experiment, root cause analysis). As a result, the baking curves were revised while optimizing the alternative preheating process without altering the baked anode quality.

The second part studies the benefits of positioning further the plastic sheet on the preheating zone and investigates the influence of the usual packing coke loading operating procedures. The positive impacts were measured on the reduction of the air infiltration and on the heat loss from furnace top.

As a consequence, these improvements implemented within 18 months led to a reduction of 0.22 GJ/t in natural gas consumption of Sohar Aluminium's anode baking furnace.

Keywords: Natural gas consumption, Air infiltration, Packing coke insulation, Lean Management, Teamwork.

1. Introduction

In the primary aluminum industry, electrolytic cells reduce alumina into metallic aluminum while consuming carbon blocks, called baked anodes. These anodes are made of calcined coke bound together with pitch. First, the green carbon anodes are produced in the Paste Plant (PP), and then transformed into baked anodes in the Anode Bake Furnace (ABF), where they undergo thermal treatment to achieve proper thermal, electrical, mechanical, and chemical properties. The ABFs use natural gas or heavy fuel to generate energy for the baking process.

Sohar Aluminium is a primary smelter producing metal in three forms, ingots, sows and hot metal. The smelter, established in 2008, operates 360 reduction cells using AP36 technology and

produces 397 kt/y at a current operating amperage of 398 kA. The Anode Baking Furnace at Sohar Aluminium utilizes the latest AP technology. The ABF has 52 sections and 10 flue walls per section (Figures 1and 2). Each pit holds 3 layers of 7 anodes. Natural gas is used to generate heat and is equipped with an Innovatherm firing system in gas-fired open top bake furnaces. The ABF has three fires and operates with mainly a fire cycle of 24 to a fast one up to 22.5 hours. The latest generation of flue walls has been installed with an average flue wall life of over 140 heats.

Figure 1. SA's anode baking furnace.

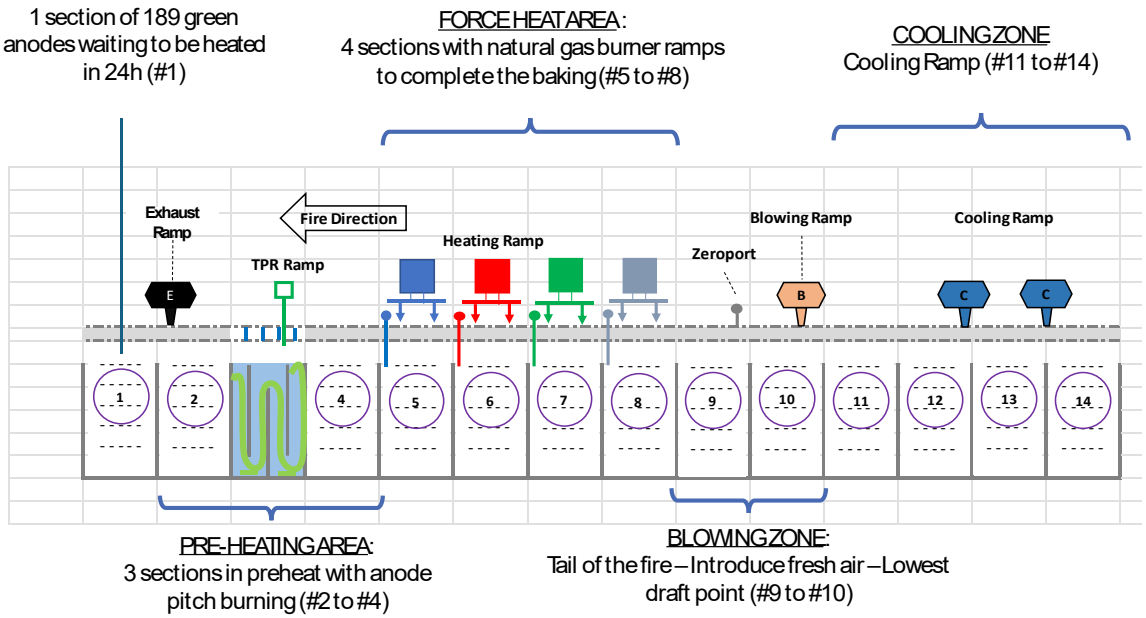

Figure 2. Anode baking furnace cross section.

The specific energy consumption in ABF (defined by energy consumed by tonne of baked and expressed in GJ/t) is determined by the furnace design, anode pitch content, anode size, operating parameters, and refractory condition [1].

Since then, and thanks to the involvement of every ABF stakeholder all along the project execution, these improvements are now embedded in SA's daily routine practices. They paved the way to developing further enhancements leading to a 2.08 GJ/t reduction (Figure 29), especially in the cross-over baking management, described in a second upcoming article.

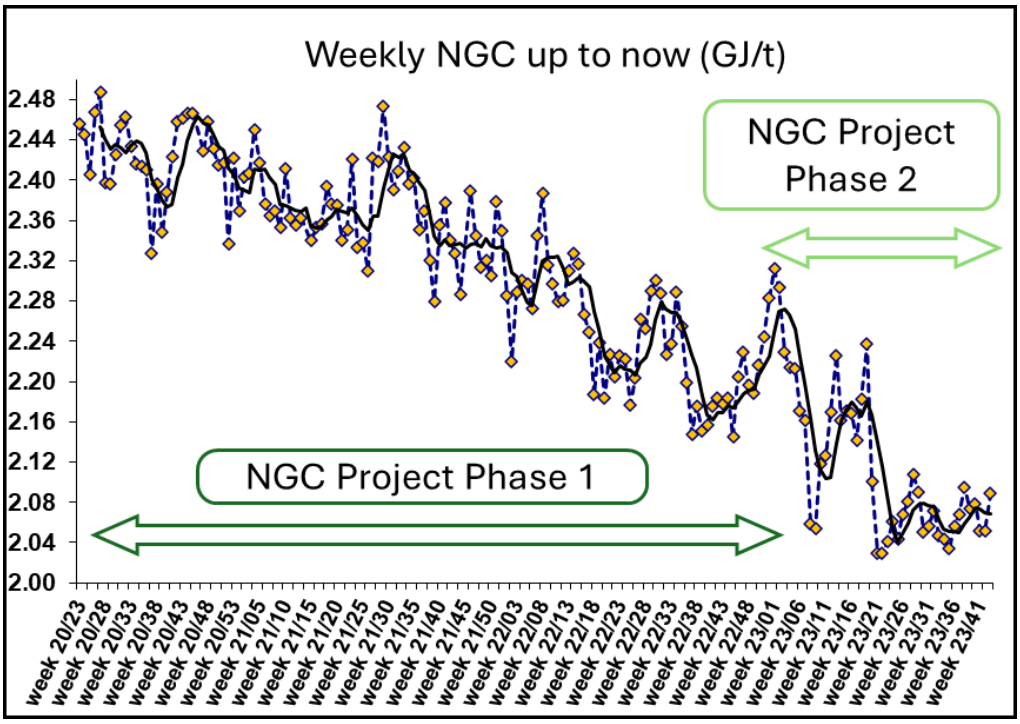

Figure 29. ABF natural gas consumption.

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