Preheat and Start-up Practice of SAMI SY 300 kA Prebake Pots at ETI Aluminium

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Abstract

This article gives a complete introduction for preheating and starting up of Shenyang Aluminium and Magnesium Institute (SAMI) SY 300 kA electrolysis potline in Turkey. As a key point, the article in particular analyzes and compares different methods of preheating and starting up cells and discusses in detail the improvements and practices of key technological aspects. It makes a scientific design for controlled changes of technical conditions of the cells after start up. The procedure implements new findings and is of special significance as reference for the start-up of prebake pots.

Keywords: SAMI SY 300 Smelter, preheating and start-up of pots, prebake electrolysis potline, cathode lining.

1. Introduction

In recent years, in the rapid development of aluminum electrolysis, the productive capacity of aluminum exceeded demand seriously; furthermore, the speed of economic growth slowed down and the pressure on economy intensified. Aluminum price has been continuously low and loss of money has become a difficult problem for the whole industry. In order to reduce cost and transform the loss into profit, aluminum industry has developed many new technologies, the technology development enterprises have made many useful trials in the process. Just to see from the stage of preheating and starting up, in order to reduce energy consumption, the preheating time has been shortened from 4 days to 3 days, and even shorter; it seems that the use of high voltage and three days of preheating time has become the common practice in the industry. Whether this is scientific and reasonable or not, there are really few people who review and think about these practices.

2. Conventional Start-up of Prebake Pot

Nowadays, most of Chinese aluminum smelters pour bath and have no start-up anode effect (AE) by preheating with coke. The pure calcined coke or a mixture of graphite and coke are used as heating resistance. The thickness is commonly from 1.5 to 2.5 cm. The charging material in the sidewall channels is composed of sodium carbonate, a small quantity of cryolite and bath lump material. Some companies even use a small quantity of magnesium fluoride or calcium fluoride. Before energizing, shunts must be mounted on all pots. In some companies, larger and smaller size of shunts are used simultaneously and use only part of the potline current and high voltage to preheat; the common preheating time is approximately 3 days. During the

preheating, phenomena such as uneven rate of temperature increase in different position and carbon burning may frequently occur. The data measured before bath up indicates that the abnormal temperature increase in cathode collector bars and potshell side may happen now and then, therefore, the use of compressed air is a common to decrease the temperature and guarantee a safe start up.

3. Preheat and Start-up of Turkish 300 kA Electrolysis Pot

The 300 kA electrolysis pot of Turkish ETI Aluminum is a large capacity advanced electrolysis pot, designed and developed by Shenyang Aluminium and Magnesium Institute (SAMI). It has integrated many new ideas and technologies. The service for starting up and operation management was undertaken by CHALCO Liancheng Branch. The potline began the start-up on 26 May 2015 and finished the start-up on 22 August 2015. During the whole start-up process, the pot preheating was smooth and good and no phenomena such as crust surface collapse and red stubs ever happened. During the start-up nearly none of the cathode windows had yellow smoke, the preheating temperature was even and the middle channel showed bright yellow colour with liquid bath. During start-up, there was no leakage and all 94 pots were started up smoothly and successfully and were changed over to normal operation and production quite well.

3.1. Preheat and Start-up Method

Electrical preheat was used and pouring liquid bath to start up without AE. The preheating time was 4 days.

3.1.1. The Choice and Proportion of Coke and Graphite Material

(1) Choice of material: Both graphite and coke were purchased from Germany; the particle size was approximately 2 – 4 mm, the resistivity of graphite was 80 μΩm and that of coke was 355 μΩm.

(2) The proportion of graphite and coke:
During start up, two proportions of carbon material were used for preheat as follows:
- Graphite to coke, 2:8, with resistance of the mixture of 290 μΩm;
- Graphite to coke in the ratio of 1:9, with resistance of the mixture of 320 μΩm.

(3) Laying out coke
The thickness of the mixture material was 2 cm; multi mesh positive cone sifter was used to lay out the bed. The contact surface area between anode and carbon bed was above 95 %.

3.1.2. Charging the Pot

(4) Charging material included: High cryolite ratio (CR) cryolite, sodium carbonate and crushed bath, including 7 tonnes of cryolite, 14 tonnes of crushed bath, 3 tonnes of sodium carbonate, a total of 24 tons.

(5) Charging method: Charge material by keeping central channel empty while laying between anodes and side blocks with different layers. Along the cathode surface of the central channel, only 5 cm thickness of cryolite was laid out in order to avoid oxidation of the cathode surface. Between anodes and side blocks, sequentially, from downstream to upstream, cryolite, sodium carbonate and crushed bath were charged. The thickness of material on anode top surface was 10 cm.

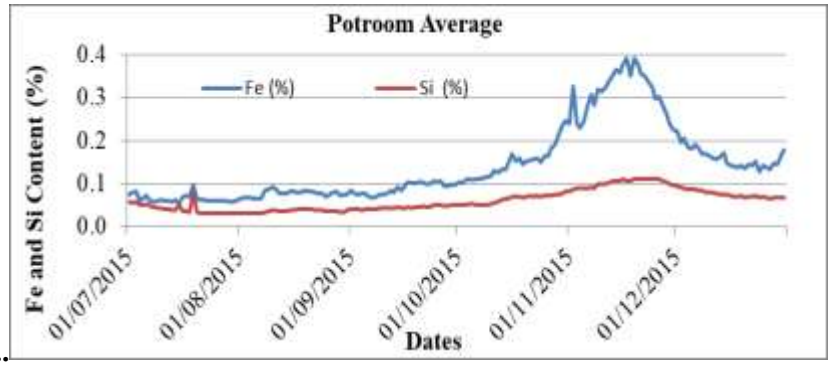

Figure 6. Iron and silicon concentration in the metal.

7. Conclusions

1. At the time of charging the channels between anodes and sidewall, they should be filled up but the central channel should be left empty in order to decrease energy consumption and in order to make sure that the liquid bath flows below every anode during start up. This increases the safety of the start-up.
2. The preheat temperature of the cathode is very important for startup and later operation, and must guarantee the temperature in the central channel above 900 °C and the temperature on the sides above 700 °C. Measures could be taken, such as increasing preheat time and dismantling preheat flexibles ahead of schedule. If necessary, the thickness of coke layer could be increased by 1 - 2cm to make sure that the startup will be safe and effective and that the pot will efficiently operate in long term with good lifetime.
3. Preheating with full current is safe, energy saving and simple. High quality of coke and graphite is chosen with reasonable proportions between the two to control the pot voltage below 4 V. This is medium voltage preheating, which provides steady and slow preheat temperature increase.
4. The first pouring of liquid bath into the pot should be more than 5 tonnes. Make sure that the anode is raised 3 – 4 cm in order to bring all the anodes into normal working state rapidly. Ensure even anode current distribution at the beginning of the start-up; use a large amount of liquid bath to start up the pot (twice the amount in normal production); this may shorten the startup time and increase the start-up safety.
5. In industrial practice, manual AE is quite necessary sometime after bath-up. This not only melts all materials in the pot completely, but also increases liquid bath temperature and finally ensures good quality of the startup, lays the foundation for long pot life and improves technical and economical key performance indicators.
6. After the startup of the pot, pouring metal twice is useful for continuous heating of the side wall and for slowly decreasing liquid bath temperature instead of suddenly, which would happen if all the metal would be poured at once.