

CREATING RA-300 POT BAKING TECHNOLOGY

V.N. SMIRNOV
/ Specialist,
Cathode
Technology
Department,
ETC



A.V. POPOV
/ Head of the
Cathode
Technology
Department, ETC



V.V. YEVSEEV
/ Senior
Production
Foreman, Baking
Area, KhAZ



Introduction

The quality of pot bottom baking is one of the major factors which influence the service life of a cathode unit. Pot preheating is intended to allow the interblock and peripheral welds to acquire the required mechanical properties, as well as for heating the cathode bottom up to the start-up temperature. In the aluminium industry, several techniques of pot baking before reduction are used; they vary depending on the type and size of the cathode unit. The most popular baking techniques are as follows:

- baking during anode formation (Soderberg anode);
- baking with resistance (coke bed):
 - at full potline amperage;
 - with a bypass resistor;
- baking with melted metal;
- thermal heating:
 - with gas or fuel oil burners;
 - with electric heaters;
- baking with hot bath (cold start).

Table 1 demonstrates certain advantages and disadvantages of the most popular baking techniques.

At present, at RUSAL Sayanogorsk baking with resistance (coke bed) is applied for baking bottoms of pots with prebaked anodes. The mentioned baking technique does not ensure adequate control of the heating speed and distribution of temperature along the bottom.

The pot flame baking technique provides for better distribution of temperature in the cathode and ensures good controllability compared to baking with resistance. The experience of using the flame baking technique, in various pot designs, by means of a four-burner automatic fuel-supplied baking system, produced by Hotwork and purchased by RUSAL Sayanogorsk in 2003, demonstrated good results of pot preheating before their start-up, therefore it is considered more promising for preheating.

.....

There are several pot baking techniques; they vary depending on the type and size of the cathode unit.

.....



Table 1

**Advantages and disadvantages
of some popular baking techniques**

Baking technique	Advantages	Disadvantages
Baking with metal	More uniform nature of end isothermal curves Smaller end temperature gradients for cathode Reduced carbon oxidation	Very fast initial increase of cathode temperature and ramming paste surface
Baking with resistance	Low baking time	Fast and local increase of surface temperature Unequal distribution of temperature over the surface and the whole cathode High temperature gradients during baking
Thermal baking (oil or gas)	Baking is easier to programme Smaller temperature fluctuations over cathode	Operation is more difficult than in baking with resistance Higher initial anode effect Requires more time and more complex process control Carbon oxidation (this phenomenon reduces if the cathode temperature remains at around 600°C or if cathodes are protected with metal covers)

Hoods made of refractory insulation material produced in Russia have a few advantages over foreign materials when used in pot baking.

RA-300 pot bottoms. Selection of the fuel-supplied baking system produced by Hotwork was determined by better baking indicators (heating steadiness), automation of the process (achievement of the preset temperature rise diagram figures even at a low rising speed) and controllability compared

to electric-powered preheating. Besides, there is an opportunity to reduce the pot baking period to 62-64 hours.

Using hoods made of refractory insulation materials produced in Russia and start-up raw materials in pot flame baking, compared to reusable sandwich-type hoods provides some advantages. The first advantage is that the pot almost does not cool off after baking before start-up. The second is that the time between burner shutdown and filling the pot with the first bath by ladle is reduced. The third is that crane operators are not engaged in dismantling of hoods.

For development of the technology, three test pot bakings were performed in 2006 (two C-255 pots of Potline 4, one RA-300 pot in the pilot area of Potline 8, RUSAL Sayanogorsk), where the optimal baking mode was developed and selected, and a temporary technical manual was developed for controlling the RA-300 pot baking process, using the fuel-supplied baking system produced by Hotwork.

Fig. 1

Hotwork Baking System Control Unit



Hotwork baking system has high indicators; the process is automated and more controlled, compared to electric powered-baking.



.....
 ...
 The quality of pot bottom baking is one of the main factors which influence the service life of the cathode unit. Pot preheating is intended to allow interblock and peripheral welds to acquire the required mechanical properties.

.....

Hotwork fuel-supplied baking system

The fuel-supplied pot baking system was manufactured and supplied by Hotwork Combustion Technology (Great Britain); it operates on diesel fuel or kerosene. The fuel-supplied pot baking system includes the following components:

- control unit mounted on a transportation cart, including a temperature regulator, electric power control board PLC Siemens and HMI, fuel pump unit, fuel filters, fuel and compressed air valve mechanisms (including regulators, pressure probes etc.), see Fig. 1;
- five fuel burners with support arms, operating on diesel fuel, see Fig. 2;
- four electric power supply cables, twenty-one air and fuel supply hoses, seven thermocouples;
- diesel fuel tank, capacity 3,000 l.

The technical specification of the Hotwork fuel-supplied baking system is presented in Table 2.

The control unit and operating burners are presented in Fig. 1.

Preparing the pot for baking

Before baking, the anode mass is raised to the required distance from the bottom surface to the anode bottom, and in burner installation locations, anodes are raised more relative to the cluster (Fig. 3). Refractory material is stacked on the bottom surface where burners are installed along the flame direction. The anode mass and the pot side-wall/anode

.....

 Fig. 2
 Checking operability of Hotwork unit burners before baking



.....

 Fig. 3
 Burner before baking of pot bottom



.....

 Selection of Hotwork fuel-supplied baking system was determined by better baking indicators (heating steadiness)... Using the new technology, we managed to reduce the pot baking period to 62-64 hours.

.....
 ...



RA-300 pots at KhAZ are baked according to the technology (using the Hotwork system) developed by ETC.

area is covered by refractory material and start-up raw materials. Hotwork fuel-supplied baking system burners and baking control thermocouples are installed in the pot bottom (Fig. 4).

Table 2
Technical specifications of the Hotwork fuel-supplied baking system

Parameters	Values
1. Diesel fuel operating pressure, kg-f/cm ²	6-7
2. Diesel fuel pressure control range, kg-f/cm ²	0.03-2
3. Compressed air operating pressure, kg-f/cm ²	4-6
4. Maximum compressed air consumption, Nm ³ /min	6.8
5. Minimum distance between anode and pot bottoms, mm	300
6. Maximum performance of one burner, kWt/hr	
7. Operating voltage/Hotwork system control voltage, V	440
8. Current frequency, Hz	400/23
9. Operating voltage of baking unit control block (box), V	0
10. Noise level of unit equipment does not exceed, dB	50
	220
	85

Pot bottom baking

Burners are turned on in accordance with the Hotwork fuel-supplied baking system operating manual. Pot bottom baking is performed for 62-64 hours. After firing all burners, the baking scheduled is entered into the Hotwork control unit execution programme, and the baking control programme is started in the automatic mode.

If a fault occurs in the Hotwork fuel-supplied baking system during baking, the baking execution programme switches to the 'retention' mode, and the baking time is automatically prolonged. If such a situation occurs in a sector of the baking control programme, it is allowed to adjust the temperature and time at the next programme sectors without increasing the temperature rise speed. The baking programme also provides for manual control with monitoring of the temperature rise schedule.

Baking of RA-300 pots at Khakass aluminium smelter is performed, according to the baking technology using the Hotwork fuel-supplied baking system, developed by the specialists of the Engineering & Technology Centre and Service Centre.

Photo by: V.V. Yevseev

Burner location during baking Fig. 4

