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Potline Start up without anode effect frequency

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Abstract: In this Research the details of preheat stages, bath up and metal pouring, the pots number 186(new method without anode effect) and 38(old method with anode effect) through 175KA-D18 technology, and pots number 88((new method without anode effect) and 103(old method with anode effect) by technology 230kA-D20 have been Compared and studied. our calculations have shown that in these technologies for starting up the one pot, we have respectively 11.89 and 21.41 Mwh reduction energy consumption for one pot. It seems with this new method we would have such reduction 3532.96Mwh for the other of the pots up to the end of year.

Keywords: "potline start up; Without Anode effect"

Introduction

The pot start-up and early operation have always been considered as important for cathode life, cathode voltage drop variations and early production performance. Pots are preheated before start-up to avoid thermal shok, the temperature of the new cold cathode being slowly raised to reach a value close to normal operating temperature . it is important to mention that it is not necessary to take the line power outage when a pot is put on preheat because the purpose is achieved using pot by-pass shunt system.[5,1]

Extensive studies have been carried out in smelters around the world to understand the fundamental cause of an anode effect.

The exact nature of the onset of an anode effect is still shrouded in mystry. However, the consensus is that anode effects are detrimental to cell operation; they result in reduced energy consumption and cause emission of CF and C2F64 gases. With the intention of reducing carbon footprint, there is an excellent opportunity to reduce anode effects and the resulting PFC emissions. Occurrence of an anode effect was studied in relation to different aspects; alumina feed rate, work schedule, cathode type, operating parameters, mechanical issues, etc. Onset of an anode effect was primarily due to inability of the response strategy to deal with it efficiently. - A strategy to kill an incipient anode effect was developed and implemented. Consequently, AE frequency has improved by more than 50%.[2].

A pilot project was initiated to test an automatic Anode Effect Termination (AET) program on 400kA cells in Zhongfu, China. This paper demonstrates the success of the new anode effect termination (AET) program in killing AEs on this cell technology without conflicting with normal cell operations[3] .Anode effects occur in industrial aluminium cells when the

dissolved alumina concentration becomes too low during normal electrolysis. The anode effect is characterized by an abrupt and rapid increase in cell voltage, resulting from an increase in ohmic voltage due to dewetting of anode surfaces and subsequent increased coverage by gas bubbles [4].The current business management is based on tackling sustainable development and social responsibility. Alcoa, in line with this objective, is searching continuously f or alternatives to eliminate or reduce the environmental impact caused by operations. Alumar, an Alcoa unit in Brazil has implemented a change in its Potroom Control System (QLC) so that it is now running the anode effect(AE) suppression routine at a one second interval. The new control has made it possible to detect, kill and recover from anode effects at a faster rate[6]. In this research the details of preheat stages, bath up and metal pouring, the pots is compared and studied.

Method

The Pot88
Preheat

This pot Reliningly and with cutting the line flow (due to welding finger on five branches) and installing Carrier shunt was inserted into circuit . The initial flow through the pot was 48KA and gradually increased. Resistant average height below the anodes was 28 mm. Cathode surface temperature during reheating, considering new ways to open the shunt (every 8 hours from the tap and duct sides, a shunt were opened simultaneously) in the final stage that third shunt was opened, temperature equilibrium in the duct was proper, and thus thanks to shunts life in fourth stage faced decrease of temperature growth in duct and finally cathode surface temperature before Bath up became as (tap = 830, center = 830, duct = 713). It is notable that because of alumina fall from valve in duct side, the last stage of measuring removed. During reheating, the anodes (15 and 16)passed greater flow from themselves which have no increase in that part of the pot. The numbers of cracked Anodes are as (9 and 11 and 14 and 15 percent).

Bath Up(pot88)

After opening the flexible anode and Measurement of Collector bar temperature, the pot at 16.30 in 31/12/2011 was bath up. Before the first crucibles,the voltage and added bath were 2.93 and 5500Kg respectively. The pot's Volt after the first crucibles, was 5.70. In second stage 2500Kg bath was added to the pot so that the pot voltage gets to 6.92. In the third stage 1000Kg bath was added that finally showed 6.3 voltage. The initial state of beam raiser ruler: 4cm and secondary state: 8cm and final one: 9.5cm was used. During the bath up, 39 bags of 15Kg (Na2co3) was added to the pot (585Kg). In 6/1/2012 bath first measured temperature at 1025 ° C was 2.44. Bath's final height was 30cm. While raising the anodes, the anode 15 which its yoke was of two- weld type, was red and was cut from the

Insert region , and instead, a hot anode was set.

Metal Pouring

At 18:30 in 6/1/2012, about 5100Kg of hot metal were added to the pot. Beam raising ruler status was on 11 cm and after the addition of metal was 19.2 cm. The voltage of pot before adding gets to 5.64 and after that, 5.8 volts. The temperature of the bath before pouring metal 1019 ° C (45 minutes later) and after it reaches to 992 degrees. The temperature rise again and reached up to 1030 degrees

Bath up of the pot No. 186:
Without Anode Effect
Pre heat

This pot as Relining in 2012-02-04 at 12:15 with installing carrier shunt was entered into the circuit. The initial flow through the pot was 86KA that gradually increased. The average height of resistor below the anodes were 15.4mm. Before Bath up, the temperature of cathode surface was (tap = 892, center = 945, duct = 885). During preheat, the anodes number (1) passes a greater flow of themselves which the increase of temperature in that part of the pot and the stub anode will be resulted. The numbers of cracked anodes was (11).

Bath Up(pot186)

After opening the flexible anode and Measurement of Collector bar temperature, the pot was loaded in 06-02-2012 at 15:12.Before the first crucibles, voltage and added bath were:2.7 v and 4500Kg, respectively. After the pour first crucibles, the voltage of pot was: v5.70. In second stage about 2000Kg bath added into the pot. In third stage 2000Kg was added to bath which finally showed 5.463v.The initial condition of Beam: 5cm and the final one was: 10cm. 20 bags containing 10 kg sodium carbonate during loading were added to the pot(200Kg).First measured temperature was 1029 degrees and the bath's final height was 40cm.

Metal Pouring(pot186)

In 2021-02-8, amount 5200Kg hot metal was added to the pot.

Table1- Daily Summary 038 For the month Feb-11

Daily Summary 038 For the month Feb-11																
Date	Amp(from L2D Rectifier .x is file	BRSP	Smooth resi	Pot voltage	CRSP	Avg BFT	Total Dumps manual	Noise volts	AE	AE Duration	Avg AE Volts	Tap Logic	Anod Set Logic	Beam Raise Logic	Time on Tap	Time on manual
		μΩ	μΩ	V	μΩ	Sec	no	v	no	sec	v	no	no	no	min	min
01-02-11																
02-02-11																
03-02-11																
04-02-11	227	12.70	20.400	6.27	13.10	92.0	347	0.041	1	582	8					
05-02-11	226	12.70	22.043	6.64	13.10	90	974	0.021								1
06-02-11	226	12.70	24.110	6.63	13.10	50.7	1274	0.018	2	5398	14					
07-02-11	226	12.70	16.087	5.30	13.14	40.7	1536	0.018								
08-02-11	227	12.70	14.753	4.96	13.13	49.0	1741	0.016	1	164	28		2			
09-02-11	227	12.80	13.620	4.47	13.12	49.7	1741	0.017				1			1	
10-02-11	227	13.00	13.317	4.67	13.32	50.	1743	0.014				1	1		3	
11-02-11	227	13.00	13.353	4.67	13.36	49.7	1794	0.012	1	28	22	1			6	
12-02-11	227	13.00	13.387	4.69	13.36	49.0	1968	0.012					1			
13-02-11	227	13.00	13.313	4.66	13.26	50.3	1493	0.009	1	78	24	1	1	1	3	
14-02-11	227	13.00	13.177	4.64	13.20	50.0	1779	0.006				1	1		1	
15-02-11	227	12.67	12.940	4.58	12.96	50.7	1742	0.005				1			1	
16-02-11	227	12.50	12.767	4.55	12.76	50.3	1719	0.006					1			
17-02-11	227	12.50	12.720	4.54	12.74	51.7	1629	0.006		30	24	1	1		3	
18-02-11	227	12.50	12.880	4.56	1278	52.3	1654	0.006	1			2	1		23	
19-02-11	227	12.40	12.730	4.53	12.71	53.0	1548	0.008				1	1		4	
20-02-11	227	12.20	12.43	4.47	1246	54.0	1604	0.004					1			
21-02-11	227	12.20	12.45	4.47	12.45	54.0	1629	0.005				2	1		32	
22-02-11	227	12.07	12.22	4.48	12.20	52.0	1624	0.008				1			5	
23-02-11	227	12.00	12.05	4.42	12.10	51.3	1593	0.005				1			4	
24-02-11	227	12.00	12.02	4.38	12.19	51.0	1621	0.004								
25-02-11	227	12.00	12.13	4.38	12.13	52.0	1559	0.004				1		1	5	
26-02-11	227	12.00	12.07	4.41	12.13	50.0	1598	0.004				1			5	
27-02-11	227	12.00	12.11	4.39	12.13	50.0	1582	0.006				1			5	
28-02-11	226	12.00	12.11	4.39	12.25	50.3	1580	0.006					3			
	226.64	12.4	14.05	4.819	12.77	53.8	1563	0.011	0.26	1668	19	17	17	2	6.7	1.0

Table2- Data to be entered manually

Pot037-cut in date/time 31-jan2011- 10:50 bath up date/time 02-feb-2011																
Data to be entered manually																
Date	Hot Metal production	Anode problem	Ahead of Schedule	Pot voltage	Metal purity	Iron	Silicon	Bath Temperature l	AE Excess ALF3	CaF2	P2o5 in Bath	Lining Drop	Alumina in Solution	Metal Height	Bath Height	Bath added
		NO	NO	AL	%AL	%	%	c	no	%	PPM	mv	%	cm	cm	kg
01-02-11																
02-02-11																
03-02-11																1425
04-02-11								1035						4	42.0	
05-02-11	-4,15							1012								
06-02-11																
07-02-11								968								
08-02-11																
09-02-11	2,060				99.61	0.14		978	7.2							
10-02-11	2,040							980								
11-02-11	2,130							979								
12-02-11					99.71	0.11										
13-02-11	2,008							980								
14-02-11	2,134							975	8.1							
15-02-11	2,288							977								
16-02-11					99.82	0.07										
17-02-11	2,320							976	7.1							
18-02-11	2,310							980								
19-02-11	2,085							975						20.0		
20-02-11														20.0		
21-02-11	2,345				99.85	0.06		978						20.0		
22-02-11	2.255							977						20.0		
23-02-11	2,290							973						17.0		
24-02-11														20.0		
25-02-11	2,323				99.86	0.06		974						20.0		
26-02-11	2,270							975	5.5					18.0		
27-02-11	1,480							973						19.0		
28-02-11																

Table3- Daily 186 For the month Feb-12

Daily 186 For the month Feb-12																
Date	Amp(from L2D Rectifier.x is file	BRSP	Smooth resi	Pot voltage	CRSP	Avg BFT	Total Dumps manual	Noise volts	AE	AE Duration	Avg AE Volts	Tap Logic	Anod Set Logic	Beam Raise Logic	Time on Tap	Time on manual
		μΩ	μΩ	V	μΩ	Sec	no	v	no	sec	v	no	no	no	min	min
04-02-12	232	12.70	6.420	3.140	13.10	94.0		0.006								334
05-02-12	223	12.70	7.383	3.267	13.10	94.0		0.010								480
06-02-12	220	12.70	9.370	3.780	13.10	83.7	377	0.026								991
07-02-12	230	12.70	17.080	5.463	13.10	70.0	1178	0.029								
08-02-12	230	12.20	16.373	5.433	15.20	26.7	1215	0.015					1			
09-02-12	232	12.20	15.747	5.267	15.75	49.0	1458	0.006					2			
10-02-12	230	12.20	15.157	5.140	15.21	53.3	1074	0.008					1			
11-02-12	230	12.20	14.337	4.950	14.26	57.3	1276	0.006				1	1		2	
12-02-12	230	12.20	14.023	4.863	13.87	56.7	1473	0.005					1	1		
13-02-12	230	12.20	13.260	4.703	13.16	56.0	1540	0.006				2	1		7	
14-02-12	230	12.20	12.560	4.540	12.50	54.7	1568	0.005				1			6	
15-02-12	230	12.20	12.517	4.533	12.46	55.3	1526	0.010				2	1		7	
16-02-12	230	12.20	12.567	4.547	12.46	55.7	1519	0.009					1			
17-02-12	230	12.20	12.463	4.520	12.40	56.0	1461	0.008				1	1		12	
18-02-12	230	12.20	12.407	4.507	12.46	56.0	1529	0.004				2			9	
19-02-12	230	12.20	12.370	4.497	12.46	56.0	1506	0.005				2	1		7	
20-02-12	230	12.20	12.647	4.563	12.50	55.7	1532	0.009					1	1		
21-02-12	230	12.20	12.650	4.560	12.40	56.3	1412	0.012				1	2		3	
22-02-12	230	12.20	12.397	4.503	12.46	60.7	1462	0.005				2			3	
23-02-12	230	12.20	12.490	4.523	12.36	56.7	1562	0.005				2	1		10	
24-02-12	230	12.20	12.380	4.500	12.39	54.3	1559	0.004					1			
25-02-12	230	12.20	12.440	4.513	12.30	56.7	1358	0.011				2	1		12	
26-02-12	230	12.20	12.337	4.490	12.9	56.3	1534	0.015				2			7	
27-02-12	230	12.20	12.410	4.507	12.36	55.3	1431	0.005				2	1		8	
	229.43	12.283	12.658	4.555	13.08	59.4	1389	0.009				22	18	2	7.2	225.6
														sum	93	1805

Table4- Data to be entered manually-pot186

Curr Mth Febv-2012 Pot 186 Cut In Date/Time 04—feb-12 12;15 Bath up Date/Time 06-Feb-12															
Data to be entered manually															
Date	Hot metal production	Anode problems	Ahead of schedule	Metal purity	iron	sillcom	Bath temperature	Excess ALF3	CaF 2	Alumina in solution	Lining Drop	Shell TEMP	Metal Height	Bath Height	Cryolite Added
	kg	NO	NO	%AL	%	%	ċ	%	%	ppm	mv	%	cm	cm	kg
01-Feb															
02-Feb															
03-Feb															
04-Feb															
05-Feb															
06-Feb															
07-Feb															
08-Feb	-5200														
09-Feb															
10-Feb											325.0				
11-Feb	1070			99.570	0.220	0.180	1029								
12-Feb															
13-Feb	2254						1010	3.9	5.0				20.0	18.0	200
14-Feb	2245						990						20.0	16.0	225
15-Feb	2497						989						20.0	17.0	100
16-Feb													20.0	13.0	300
17-Feb	1477						1003						21.0	13.0	225
18-Feb	2559			99.740	0.09	0.060	990	4.1	5.4				21.0	17.0	
19-Feb	2342						976				230.0		21.0	16.0	
20-Feb							996						20.0	15.0	100
21-Feb	2347						990						21.0	15.0	150
22-Feb	2625			99.780	0.100	0.090	980						22.0	19.0	
23-Feb	2299						980						20.0	19.0	50
24-Feb													19.0	18.0	
25-Feb	1960						1006						20.0	18.0	180
26-Feb	2376												20.0	19.0	275
27-Feb	2249														
28-Feb							970								
29-Feb	2303						966						20.0	17.0	225
				99.820	0.080		977								
							969				320.0				
	25420			99.728	0.123		988.8	4.0	5.2		292		20.3	16.7	2030

Table5- pots 38 and 186 compared in terms of energy consumption.

pots 38 and 186 compared in terms of energy consumption							
Loding 05-01-2011				Loding 22-12-2011			
POT: 186	Voltage(v)	Current(A)	Energy(KWh)	POT: 38	Voltage(v)	Current(A)	Energy(KWh)
DAY1	5.46	230	30155.76	DAY1	6.27	230	34610.40
DAY2	5.43	230	29990.16	DAY2	6.64	230	36691.44
DAY3	5.26	230	29073.84	DAY3	6.68	230	36890.16
DAY4	5.14	230	28372.80	DAY4	5.3	230	29256.00
DAY5	4.95	230	27324.00	DAY5	4.96	230	27395.76
DAY6	4.86	230	26843.76	DAY6	4.47	230	26203.44
DAY7	4.70	230	25960.56	DAY7	4.67	230	25817.04
DAY8	4.54	230	25060.80	DAY8	4.67	230	25817.04
DAY9	4.53	230	25022.16	DAY9	4.69	230	25905.36
DAY10	4.54	230	25099.44	DAY10	4.66	230	25723.20
Total energy consumption			272.90	Total energy consumption			294.31

Table6- pots 88 and 105 compared in terms of energy consumption

pots 88 and 105 compared in terms of energy consumption							
LOADING: 05-01-2011				22-12-2011			
POT:88	Voltage (v)	Current(A)	Energy (kwh)	POT:88	Voltage(v)	Current(A)	Energy(kwh)
DAY1	6.573	175.25	27646.0	DAY1	8.527	175.25	35864.56
DAY2	5.697	175.25	23961.5	DAY2	6.724	175.25	28281.14
DAY3	5.575	175.25	23448.4	DAY3	5.58	175.25	23469.48
DAY4	5.473	175.25	22868.0	DAY4	5.278	175.25	22199.27
TOTAL			97.92	TOTAL		175.25	109.81

Results and Discussions

The benefits of loading without anode effect

1 -To prevent excessive voltage in loading time and reduces the electrical press on the cathode and lining and accessories of finger and collector in early pot-life

2 –Regarding presented delay during addition of melted electrolyte into the pot , providing suitable time frame for the formation of the sidewall of the Lodge

3 –Reduction of sodium carbonate induction into the pot through loading process which will have well results in decline of probable inconveniences for cathode.

4 –Decline of the transmitted temperature to loosen and eventually fall injuries on the steel shell

5–Due to the reduction of the loosen temperature after loading and metal addition, applicable duration of loosen's cooler air, decreases and finally will resulted to decline of consumed press air's cost.

6 –Reduction of cathode's voltage drop (about 50 mv)which have a significant role in decline of set point voltage

7-Up to 92% ampere efficiency of the pot, which comparing started up pots with typical method has been 10% increased(5 days after loading, the first unloading was 1070 kg and the second one after two days was 2254kg)

8.Reduction of consumed energy during loading and after that (in first ten days about 22 MWh reduction of energy rather than pots which has been loaded with old method)

9 –Applicability of storing pot's anodes program, for using in future shifts of the same pot

10- Proper and programmable control of operational conditions in order to prevent the incidence of anode effect in pot (with prediction of 60-day period). The pot 186 from loading onset about 23days were without anode effect that ultimately thanks to the

problems like variations of production line flow, has been anode effect

2 - considering to created cause by the addition of liquid electrolyte into the pot, creating a suitable timeframe for the formation of the side wall of the Ladge

Conclusion

Which should be considered in the next startup:

1.-Use of 3-ton-crucible and assurance of its capability for increase of hot bath in next stages.

2-Strengthening the measuring devices(thermometers, thermocouples the melt temperature and surface temperature measurement , multi meters and etc..).

3-Reinforcement of human resources for more control, attention and practice of pot

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