DX cell technology at 400 kA and beyond

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Abstract

Potline 8 at Dubai Aluminium (DUBAL), which comprises 40 DX Technology pots, was started-up in March 2008 at 350 kA. In June 2014, Potline 8 achieved a major milestone of successfully reaching 400 kA through set of modifications made to the working practices, pot lining material, pot shell and anode designs all of which allow for smooth operation in spite of higher anode current density. Potline 8 has operated at 402 kA since February 2015. This paper summarises the performance of the DX cells during the period of increasing from 390 kA to 402 kA. During the whole period of operation, the metal production per pot day increased from 2 980 kg/pot-day to 3 070 kg/pot-day and the specific energy consumption reduced from 13.24 kWh/kg Al to 13.14 kWh/kg Al, while current efficiency was maintained at almost 95 %. The successful results were accompanied by excellent sustainable performance in the environment aspects as well; necessary changes in the process were induced to prevent any increase in PFC emission with amperage increase.

Keywords: DX pot technology; amperage increase; DX pot performance.

1. Introduction

DUBAL has developed DX Technology in-house, which currently operates in DUBAL Potline 8 (40 cells) at 402 kA and in EMAL Potlines 1 and 2 (756 cells) at 388 kA. Recently the number of cells in DUBAL Potline 8 was increased to 44. Potline 8 is located at the end of Potline 6, which currently operates at 253 kA and supplies the same to Potline 8; the rest of the current is provided by four booster rectifiers with a maximum capacity of 50 kA each. The booster rectifiers were designed to allow for increasing the amperage to the desired level and to explore operation at higher amperages while adjusting the pot operating parameters and operation practices. This paper presents the results for DUBAL Potline 8.

The DX cells in DUBAL Potline 8 were started in March 2008 at 350 kA. The amperage of these cells was increased thereafter, reaching 380 kA on 28 October 2010 and 390 kA on 24 December 2013. In June 2014, DUBAL Potline 8 achieved a major milestone of successfully reaching 400 kA. After a demonstration of excellent results over nine months, amperage was further increased and reached 402 kA by the end of February 2015. Figure 1 shows the history of potline amperage and cell net voltage of DUBAL Potline 8.

2. DUBAL Potline 8 DX performance

The operational performance of DUBAL Potline 8 has been reported earlier [1, 2]. In this paper the performance at amperages from 390 kA to 402 kA is analysed in detail. The DX key performance indicators (KPIs) are given in Table 1. The performance was excellent throughout the whole period. As DUBAL Potline 8 had a combination of different linings and pot shell designs, the KPIs for DX Technology are listed at different stages of amperage increase in Table 1 and for different cathode designs later on in Paragraph 6.

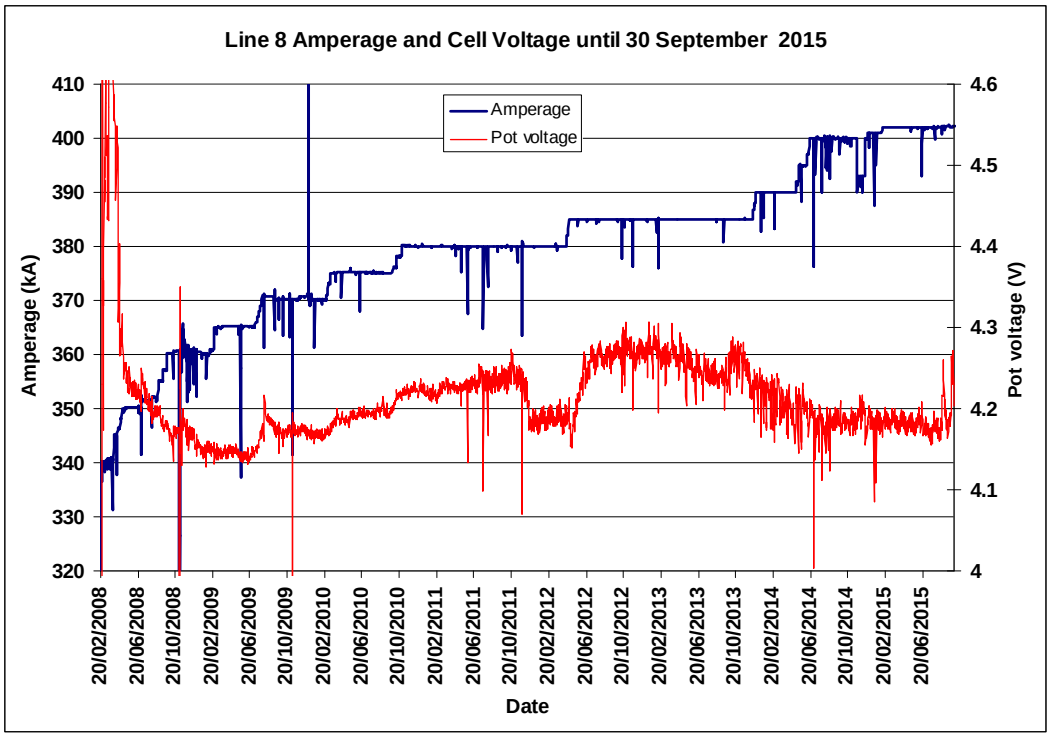

Figure 1. Historical evolution of DUBAL Potline 8 amperage and net cell voltage.

Table 1. Key performance indicators for DUBAL Potline 8 DX cells.

Parameter	Unit	Jun '08 to Sept '15	Jan '14 to May '14	Jun '14 to Feb '15	Mar'15 to Sept '15
Amperage	kA	380.9	390.6	399	401.9
Current efficiency	%	94.9	95.1	94.9	94.3
Metal production	kg/pot-day	2 912	2 991	3 048	3 051
Cell voltage	V	4.20	4.20	4.18	4.18
DC net specific energy	kWh/kg Al	13.19	13.21	13.13	13.20
Net carbon cons.	kg/t Al	414	416	402	407
Gross carbon cons.	kg/t Al	534	559	509	521
Fe	%	0.046	0.067	0.039	0.041
Si	%	0.026	0.026	0.024	0.025
Bath temperature	°C	961	964	962	966
Excess AlF_3	%	9.9	10.4	10.1	10.1
AE Frequency	AE/pot-day	0.057	0.070	0.083	0.094
AE Duration	s	18	7	10	9
PFC Emission, CO_2 Equivalent*	kg/tAl	19	9	15	15

*CO_2 equivalent is calculated as in [3], using the Tier 2 method and SAR (Second Assessment Report) of Intergovernmental Panel on Climate Change (IPCC).

3. Modifications for further improvement and amperage increase of DX Technology

3.1. DX Technology potshell design modifications

The objective of modifying the DX Technology potshell was to allow for further amperage increase by increasing the sidewall heat loss and reducing the pot shell weight. The

end of the year 2015. At the same time, the full potential of reduced cathode voltage drop will be implemented on G2 lining + G2 shell pots and copper insert pots.

Table 2. Key performance indicators for DUBAL Potline 8 DX cells by cathode design groups from 1 October 2014 to 30 September 2015.

Parameter	Unit	G1 lining+ G1 shell	G2 lining+ G2 shell	Pot 41 (Cu insert)
Number of cells		4	21	1
Amperage	kA	400.7	400.7	400.7
Current efficiency	%	94.80	94.7	94.5
Metal production	kg/pot-day	3 058	3 057	3 050
Cell voltage	V	4.19	4.19	4.04
DC net specific energy	kWh/kg Al	13.19	13.19	12.74
Net carbon consumption*	kg/t Al	405	405	405
Gross carbon consumption*	kg/t Al	512	512	512
Fe	%	0.034	0.039	0.052
Si	%	0.024	0.026	0.027
Bath temperature	°C	964	964	961
Excess AlF_3	%	9.9	9.9	10.5
AE Frequency	AE/pot-day	0.13	0.07	0.12
AE Duration	s	5	8	8
PFC Emission, CO_2 Equivalent**	kg/t Al	12	10	17

*Gross and net carbon consumption is not followed separately by cathode design groups. The values given are for the whole potline.

**CO_2 equivalent is calculated as in [3], using the Tier 2 method and SAR (Second Assessment Report) of Intergovernmental Panel on Climate Change (IPCC).

7. Conclusions

In DUBAL Potline 8, the amperage of the DX Technology cells has been successfully increased to 402 kA while maintaining excellent pot performance. Different cathode designs did not affect the performance, since the pot operation and control parameters were properly adjusted for each group. Increasing anode length helped the amperage increase. The new cathode designs will have an advantage when amperage is increased further in the near future.

8. References

1. Ali Al Zarouni et al., The successful implementation of DUBAL DX Technology at EMAL, Light Metals 2012, pp 715-720.
2. Michel Reverdy et al., Advancements of DUBAL high amperage reduction cell Technologies, Light Metals 2013, pp 553-556.
3. Ali Al Zarouni et al., DX+ an optimized version of DX Technology, Light Metals 2012, pp 697-702.
4. Marwan Bastaki et al., DUBAL cell voltage drop initiatives towards low energy high amperage cells, Light Metals 2014, pp 451-455.