

Modelling and Engineering Experience of EGA in Brown Field Modernisation of Aluminium Smelters

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Abstract

EGA has developed extensive experience in the continuous improvement of existing cell designs over the past 30 years. Earlier improvements were empirical and evolutionary, but with the introduction of mathematical modelling more significant and rapid retrofitting of old technologies became feasible. This paper describes EGA's approaches and experience in the development of improved designs for existing cells like D18+ Technology, based on thermo-electrical, mechanical and magnetohydrodynamics (MHD) modelling, as well as the engineering work and challenges which were encountered during the design and implementation stages of these cell technologies. The results of plant modernization will also be shown.

Keywords: Aluminium electrolysis cell modelling; cell design; smelter retrofit engineering; ANSYS.

1. Introduction - D18 Technology History

Dubai Aluminium (DUBAL) – an operating subsidiary of Emirates Global Aluminium (EGA) – commenced operations in 1979 with 360 reduction cells in three potlines using Kaiser P69 technology (later modernised to D18 Technology) with prebaked anodes, two end risers and the cells situated side-by-side. The cells are located in the pit and the potroom has no open basement. An additional potline of 144 cells, utilising D18 Technology, was built in 1990, bringing the total number of cells to 504. More cells were again added in 2008 and 2010, bringing the total number of D18 Technology cells at the DUBAL smelter to 520.

Continuous improvements and development of original technology were carried out on D18 Technology, including conversion to pseudo-point feeding (PPF), additional busbar, modification of the cell lining design, increased anode size and cell control logic. This has allowed the amperage to increase from 150 kA at the beginning to 210 kA today, improved current efficiency and reduction in specific energy consumption and perfluorocarbon (PFC) emissions [1 - 4].

Despite the excellent work of DUBAL's operational and process control teams, all these improvements were mainly empirical and evolutionary. To take the next step in performance improvement, it was necessary to change the design radically, which was not possible without mathematical modelling. A few earlier papers [1 - 4] described the D18+ Technology project from an operational point of view but never focused on the design process itself. Brownfield projects are very often even more complicated than the development of new greenfield high amperage technologies due to many constraints to make modernisation really meaningful and

profitable. This paper focuses on the modelling and engineering aspects of the D18+ Technology project.

Although this paper is about modelling, the focus is not on modelling details because modelling methods and model validation have been described in many earlier papers [5 - 7].

2. D18+ Technology Design Approach

2.1. D18+ concept development

D18 Technology cells in DUBAL Potlines 1 and 3 have high energy consumption that limits increases in smelter production by increasing the amperage in the other more modern potlines. A team was formed to investigate the opportunity of upgrading D18 Technology to achieve significant reduction in specific energy consumption, i.e., below 13.0 kWh/kg Al and find solutions to make modernization profitable.

For complete revision of D18 Technology, CD20 and D20 Technologies were looked at as references based on the following:

- CD20 has exactly the same inner shell width as D18 Technology, whereas D20 Technology is wider.
- Both CD20 and D20 Technologies have two more anodes (20 anodes) than D18 Technology (18 anodes), with the same anode width.
- D18 Technology potrooms have the same building width and crane rail width as D20 Technology (in Potline 9).

Based on the above features, it seemed feasible to introduce a cell with the same inner potshell dimensions as CD20 Technology into the Potline 1 and Potline 3 buildings.

An initial estimation of the possible voltage savings was done based on CD20/D20 Technology results and adjusted to D18 Technology amperage. This led to the conclusion that it was feasible to reduce the net voltage of the cell from 4.74 V to 4.14 V (Table 1). Net voltage as used in EGA is the total average cell-to-cell voltage, including all cell-cell external busbars voltage drop, all voltage adders, but excluding the voltage drop of potline busbar linkages (passageways and crossovers).

Table 1. Comparison of voltage breakdown for different technologies - initial estimation.

	D18 PPF	CD20	D18+
Current, kA	200	241	200
Anode length, mm	1485	1515	1515
# of anodes	18	20	20
Anode current density, A/cm ²	0.93	0.98	0.81
Net voltage, V	4.74	4.49	4.140
External (busbar) voltage drop, mV	421	291	242
Cathode voltage drop, mV	326	272	226
Anode voltage drop, mV	508	513	426
Bath + BEMF + bubble drop, V	3.485	3.414	3.247
Specific energy, kWh/kg Al	15.04	14.08	13.00

It was then decided to conduct a detailed investigation into the opportunity of replacing/upgrading D18 Technology cells with D18+ Technology. The main objective for the project was set to achieve the reduction of net energy consumption by at least 2 kWh/kg Al in

Potline 1 and Potline 3 (from 15 kWh/kg Al to 13 kWh/kg Al). The following limitations were imposed to ensure that the brownfield project would be profitable and that the payback time met the company criteria:

- After completion of the project, the metal production of the area should not be smaller than before:
 - Amperage is greater than or equal to 200 kA,
 - Current efficiency increased by 1 % (from 93.9 % to 94.9 %),
 - The same number of pots in the potlines – 520 cells, hence, the same cell-cell centreline distance of 5.34 m.
 - All cells to have point feed and yield standard purity metal.
- Net cell voltage to be not more than 4.14 V (600 mV reduction from 4.74 V),
- No increase in compressed air consumption,
- No change to Anode plant and Pot Repair plant,
- Carbon consumption should not be higher than in CD20 and D20 Technologies,
- Emissions of the upgraded technology should not be higher than from D20 technology,
- The overall height above the potroom floor of the upgraded pot should not be higher than D18 Technology, so as to use the same cranes,
- The pit base should not be demolished to reduce the costs of civil works,
- The production losses should be minimal during the project,
- Gas exhaust flowrate should remain the same in order to keep the existing fume treatment plants (FTP's).

The first idea was to use CD20 or D20 technology in potlines 1 and 3 because the width of the potroom is sufficient to house CD20 or D20 cells. But there were two bottlenecks:

- Cell-to-cell distance: CD20 Technology is 6.00 m and D20 Technology is 6.10 m; whereas D18 Technology is only 5.34 m. This meant that new cathode busbars and side risers would have to be designed.
- The height of the CD20/D20 deck plate would be approximately 645 mm above the present working floor of D18 cells, because of the bus bars being below the cell and the greater cathode shell height.

This meant that the CD20 Technology or D20 Technology would have to be modified for the conversion.

2.2. D18+ busbar design

Busbar design is crucial for pot performance. If the busbar design does not give good MHD-stability all other elements of the design are irrelevant. Therefore, busbar design work for D18+ Technology cells was tackled first.

DUBAL's CD20 and D20 technologies operated smoothly at more than 240 kA at the time of D18+ conceptual design. Both technologies have the same busbar design with minor improvements in D20 Technology (being a later development). So the decision was taken to model CD20/D20 busbar design first (Figure 1) for D18+ Technology project for two main reasons:

1. Using a proven design to reduce design time and
2. Using standard equipment from CD20 potrooms (wedges, wedge pullers, anode beam rising machine, etc.).

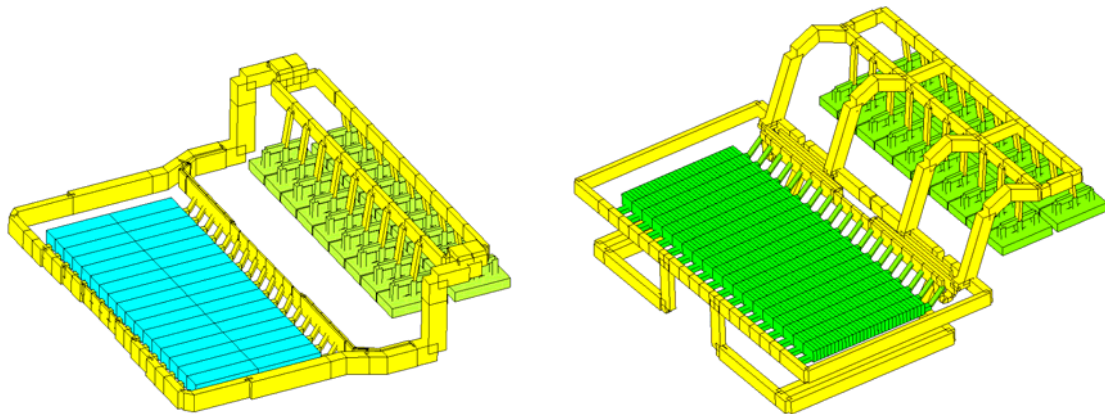


Figure 1. D18 Technology (left) and D20 Technology (right) busbar models.

The challenge was to fit the CD20/D20 cell-cell busbars into D18+ cavity which is narrower by 0.76 m due to lower cell-to-cell distance. It was found that it was feasible to fit D20 busbars into D18+ cavity with the following changes:

- Downstream (DS) busbar thickness was reduced and the height increased to maintain the same cross section area,
- The gaps between all DS busbars were reduced by around 85 - 90 mm,
- The gaps between the busbar and cradles were reduced by around 170 mm (Figure 2).

On the other hand, the gap between upstream and downstream busbars was not changed, so as to keep the same wedge pocket design as in CD20/D20 Technology cells.

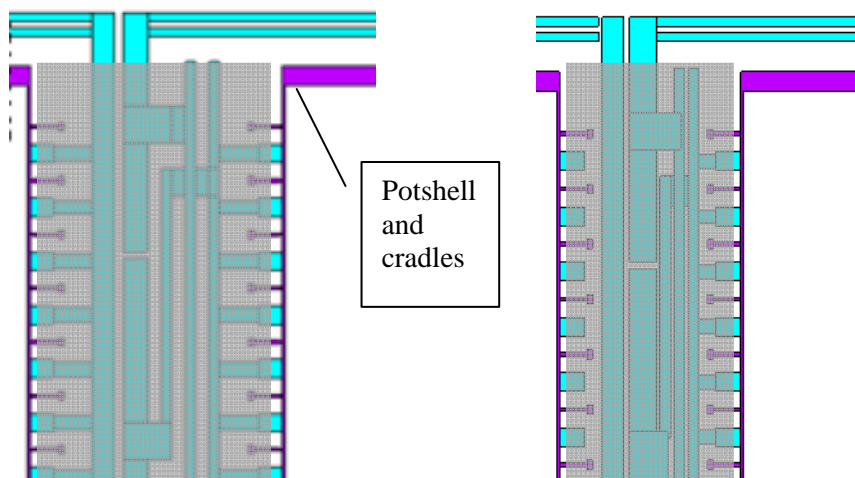


Figure 2. Cell-cell busbar system between two potshells, top view: original D20 Technology busbar (left) and adjusted busbar for D18+ Technology (right).

The second challenge in implementing the D20 Technology busbar was deckplate level increase by about 645 mm. This is because D20 Technology has underneath-cell busbars (Figure 1), whereas D18 Technology cell does not. This problem was solved by optimizing the underneath busbar orientation as well as the busbar cross-section. This change lowered the deckplate level significantly by approximately 400 mm. The remaining additional elevation of deckplate of 245 mm was acceptable and the same increase in level was added to the operating floor from tap end.

MHD modelling of the first D18+ Technology busbar design was done and results were compared with the original D20 technology modelling results. The first D18+ Technology

busbar design gave worse MHD stability than D20 Technology mainly due to imbalance of the vertical magnetic field (B_z). Therefore, the busbar had to be further optimized to improve the MHD stability.

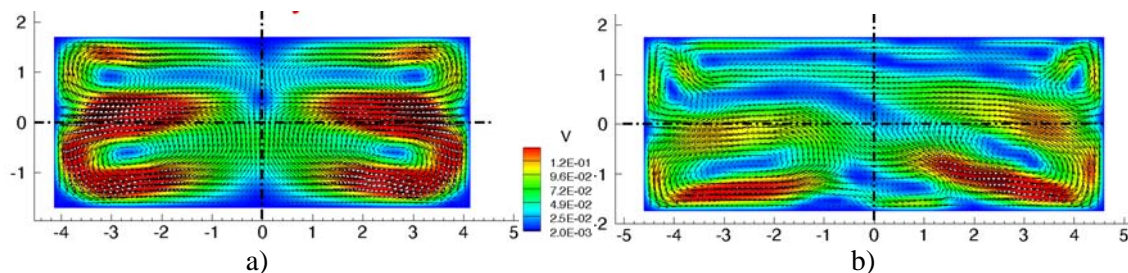
After a dozen model runs, an optimized D18+ Technology busbar was developed. Comparison of the results of MHD modelling for D20 Technology, D18 Technology and D18+ Technology cells showed that the optimized D18+ Technology busbar had very good MHD stability, much lower heave and lower busbar external voltage drop than D20 technology (Table 2). The model shows that D18+ Technology was very stable up to 2.5 cm anode-to-cathode distance (ACD) and 10 cm of metal height at 200 kA. To check the possibility of amperage increase the D18+ Technology design was checked up to 250 kA and was found to be stable at 2.5 cm ACD and 15 cm of metal height. It was concluded that D18+ Technology can operate at 250 kA with good MHD stability. However, the busbar temperature could be a concern and this may ultimately limit the amperage increase. In D20 Technology, busbar temperatures of about 150 °C were measured on downstream bars with highest current density and about 170 °C on the main downstream busbar (to which all DS collector bars are connected) in the middle. Both temperatures are much lower than our threshold (200 °C), but the gaps between the D18+ Technology busbars are very narrow and the main DS busbar is also much closer to the potshell than in D20 Technology – so it is more exposed to radiation from the potshell. During amperage increases, the busbar temperatures will be an important parameter to monitor.

Anode ring busbar was kept the same as in CD20 Technology so as to use exactly the same anodes for both technologies.

After conceptual design was finalized by modelling, close cooperation between modelling and engineering started. For practical reasons, some changes had to be made and these were checked with modelling again. For example, the inclination angle of the risers was changed in order to give adequate space for anode changing. Other small changes were made during construction of the trial pots to improve constructability.

Table 2. Results of MHD modelling for D18 Technology, D20 Technology and D18+ Technology busbars.

	D18	D20	D18+ Optimized	
Amperage, kA	200	247	200	250
Mass(from model) , t	-	26.8	27.4	
Busbar voltage drop, mV	416	278	205	273
Maximum velocity, cm/s	21.5	16.9	11.2	14.8
Interface deformation, cm	20.3	10.6	8.3	13.1
Max busbar current density, A/cm ²	100	89	77	94



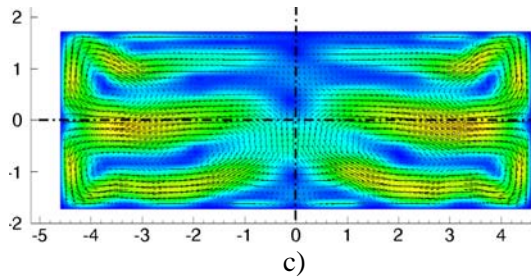


Figure 3. Velocity field: a) D18; b) D20; c) D18+ optimized.

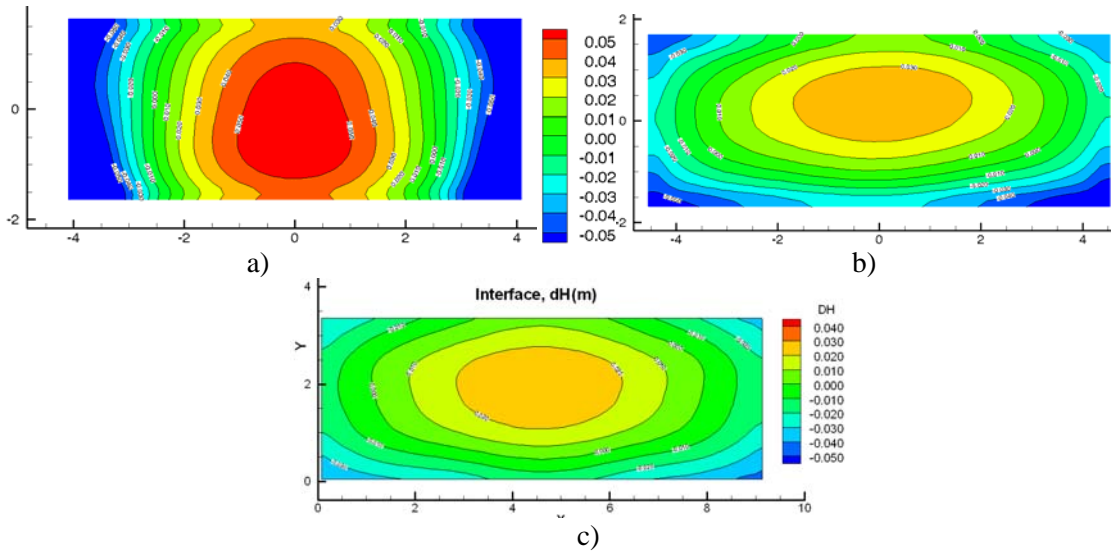


Figure 4. Metal heave: a) D18 at 200 kA; b) D20 at 247 kA; c) D18+ optimized at 200 kA.

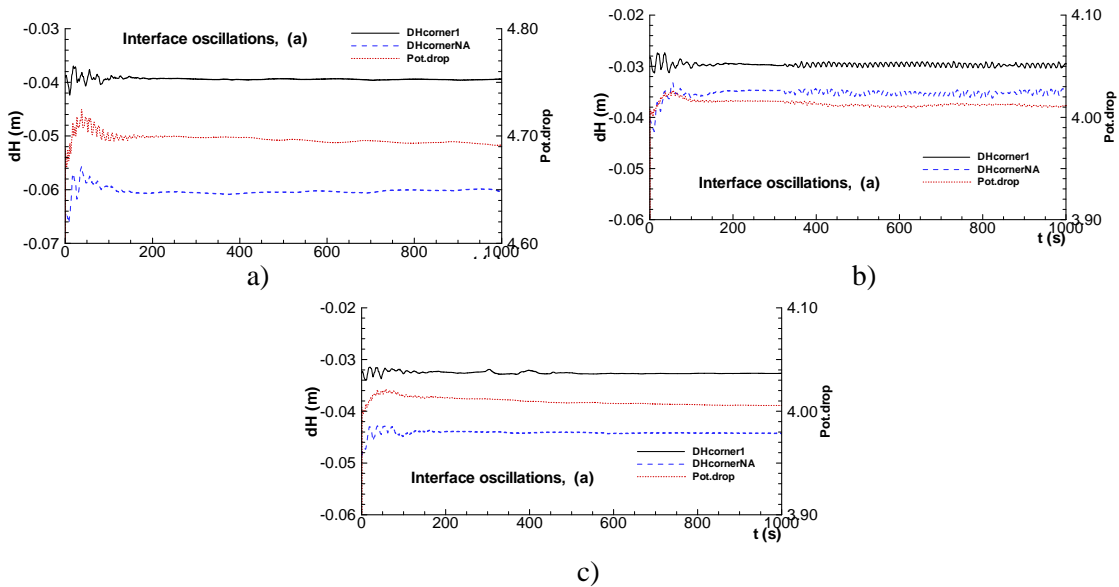


Figure 5. MHD-stability of different designs: a) D20; b) D18+ Squeezed; c) D18+ optimized.

All busbar modelling work was done initially for the middle pot in the middle potroom so B_z bias was close to 0 mT. The trial section of seven test D18+ Technology cells (No. 63 to 69) was built at the northern end of Potroom B in Potline 1. A model of all neighbouring pot rows and crossovers was built as shown in Figure 6. The B_z bias at the pot centre of all these

conductors was only 0.2 mT, which confirmed that the location was suitable for the D18+ Technology trial.

With the test section being at the end of the existing potroom, the test pots had to be connected to the normal D18 Technology pots at one end of the trial section. A special transition busbar arrangement was designed for that purpose. Figure 7 shows the transition from the last D18 Technology pot (No. 70) to first D18+ Technology test pot (No. 69). The criterion was to achieve good collector bar current distribution for cell No. 70. This design kept the boundary pot in production, which would be lost if the busbar transition was across and empty stall.

At a later stage, when the full Potline 1 conversion was approved, a new linkage busbar arrangement was designed for the end cells at the southern end of Potrooms A and B in Potline 1, which compensated the vertical magnetic field of the crossover busbar, This improved the stability of the end pots, which was not good in the original D18 Technology potline, since the crossover was located just 10 m from the centre of the end cells.

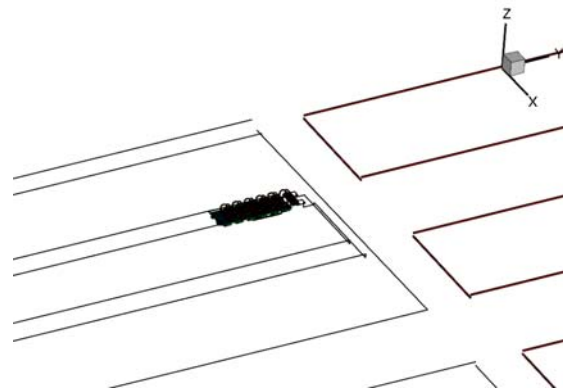


Figure 6. Model for magnetic field calculation in the section of seven trial cells.

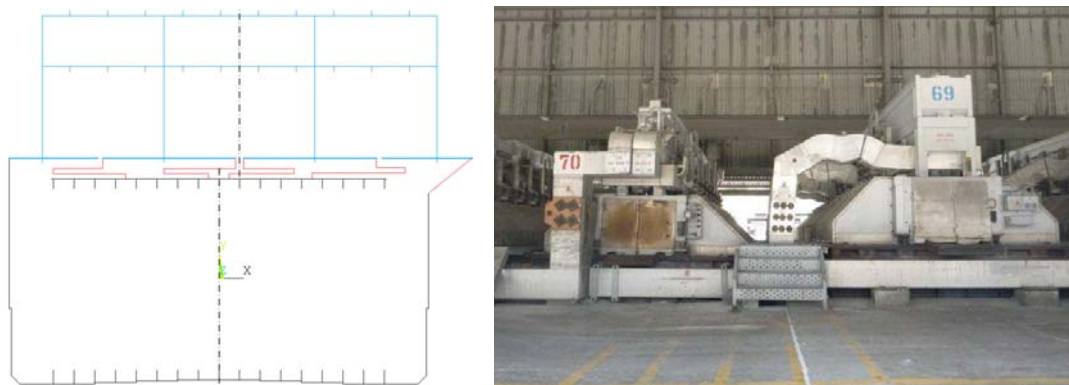


Figure 7. Transition busbar from D18 to D18+ (black – original D18 busbar, blue – new D18+ busbar, red – transition busbar).

2.3. Cell Lining and Potshell Design

2.3.1. Lining design and heat balance

After busbar design was chosen, work on the potshell and lining started. Initially, the existing D18 Technology pot shell was to be upgraded by adding 2 extra sections. The original D18 Technology potshell was very strong, so it was decided to re-use the potshells.

A thermo-electrical model of an existing D18 lining and potshell was developed and validated by measurements of an operating pot. The model was then modified to the new D18+

Technology design. It was immediately clear that it would be difficult to have enough heat in the pot at 200 kA and low target voltage. Even maximum possible insulation of the lining required minimum amperage of 210 kA in the D18+ Technology cells. It is well known that lining design is always a compromise between the desire to keep as much heat inside the pot as possible, but at the same time avoid over-insulation, which would lead to undesirable consequences. For example, the over-insulation of the bottom lining causes rapid bath penetration, which destroys the insulation and leads to high heat loss from the bottom. If the sides are over-insulated, the side freeze will protect the side lining insufficiently from liquid bath and the pot will tap out.

The final lining design is such a compromise. It uses 100 % graphite cathode blocks and semi-graphitic sidewall insert. There is more insulation in the side lining at the cathode block level and in the bottom lining. It was highlighted to the project team however that despite this there would not be enough heat in the pot at 200 kA and at the target net voltage. The model showed that with 20 cm of anode cover at 200 kA the pot was barely insulating enough for relatively low internal heat generation. Therefore, additional actions to keep heat inside the cell could be required (Table 4). The benefit of the D18+ Technology lining was that its ledge toe was very much improved when compared to D18 Technology lining. In pots with D18 Technology lining, the ledge toe was significantly longer (Figure 8).

At the beginning of the D18+ Technology lining design process, the collector bars in D18 Technology cells changed from a single round collector bar across the whole width of the pot to a split rectangular cross-section, with a centre gap in the collector bar. Despite a 10 % increase in cross-sectional area, the change to a rectangular profile allowed reducing the overall cathode height and consequently increasing the cell cavity depth. Considering these advantages, the rectangular collector bars were selected also in D18+ Technology pots [4].

Table 3. Electrical balance for D18 Technology and D18+ Technology cells.

	D18	D18+	
Amperage, kA	200	200	210
Anode voltage drop, V	0.463	0.421	0.442
Bath and bubble voltage drop, V	1.728	1.496	1.437
Electrolysis voltage (Back EMF) , V	1.774	1.783	1.791
Cathode voltage drop, V	0.301	0.209	0.219
External voltage drop, V*	0.421	0.205	0.215
Net voltage, V	4.687	4.114	4.104

*Busbar voltage drop between 2 cells including cathode flex drop and anode clamp drop

Table 4. Results of thermal modelling for D18 Technology and D18+ Technology cells.

	D18	D18+	
Amperage, kA	200	200	210
T bath in side channel, °C	962	960	964
CE, %	93.9	94.9	94.9
Super heat, °C	8.5	6.9	10.5
Anode cover height, cm	10	20	20
Net voltage, V	4.687	4.114	4.104
Voltage to make metal, V	2.027	2.043	2.042
Heat loss from cell, kW	447.9	373.2	387.8
From anode, kW / %	151.3 / 34	124.7 / 33	129 / 33
Side wall, kW / %	172.6 / 39	125.9 / 34	131.8 / 34
Collector bars, kW / %	26 / 6	39.5 / 11	40.6 / 11
End walls, kW / %	57.6 / 13	33.1 / 9	35.6 / 9
Bottom, kW / %	40.4 / 9	50 / 13	50.8 / 13

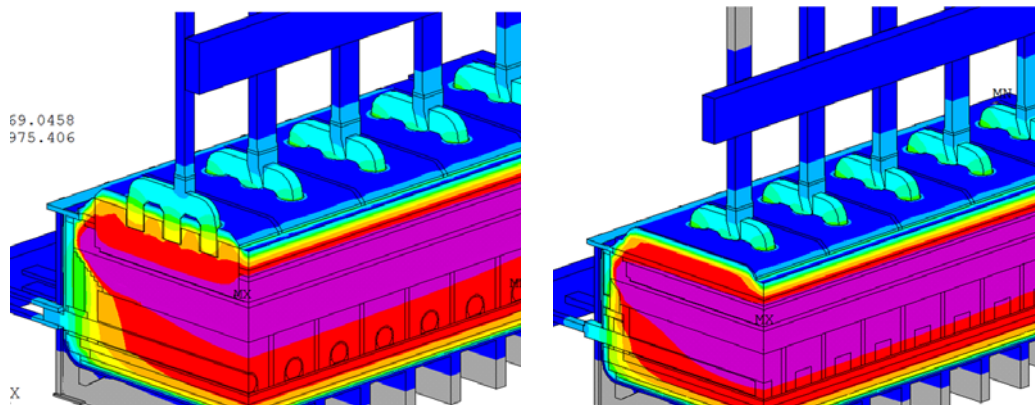


Figure 8. Calculated temperature field for D18 Technology (left) and D18+ Technology (right). The border between red and purple is freeze isotherm.

2.3.2. Cathode shell design

The next step, after finalising the lining for heat balance, was the mechanical modelling of the lining and the potshell. The mechanical model of potshell included potlining in order to make sure that the stress in the lining did not exceed the compression strength of the blocks and of the paste and that at the same time the tension did not create any cracks or gaps. For the potshell the stresses should not be too high, so as to avoid as much as possible zones with plastic deformation. Also, deflection of potshell should be small. All results were also compared with original D18 Technology lining design (Figures 9 and 10, Table 5). The overall mechanical results did not show any issues with integrity of the lining or the potshell (Figure 11).

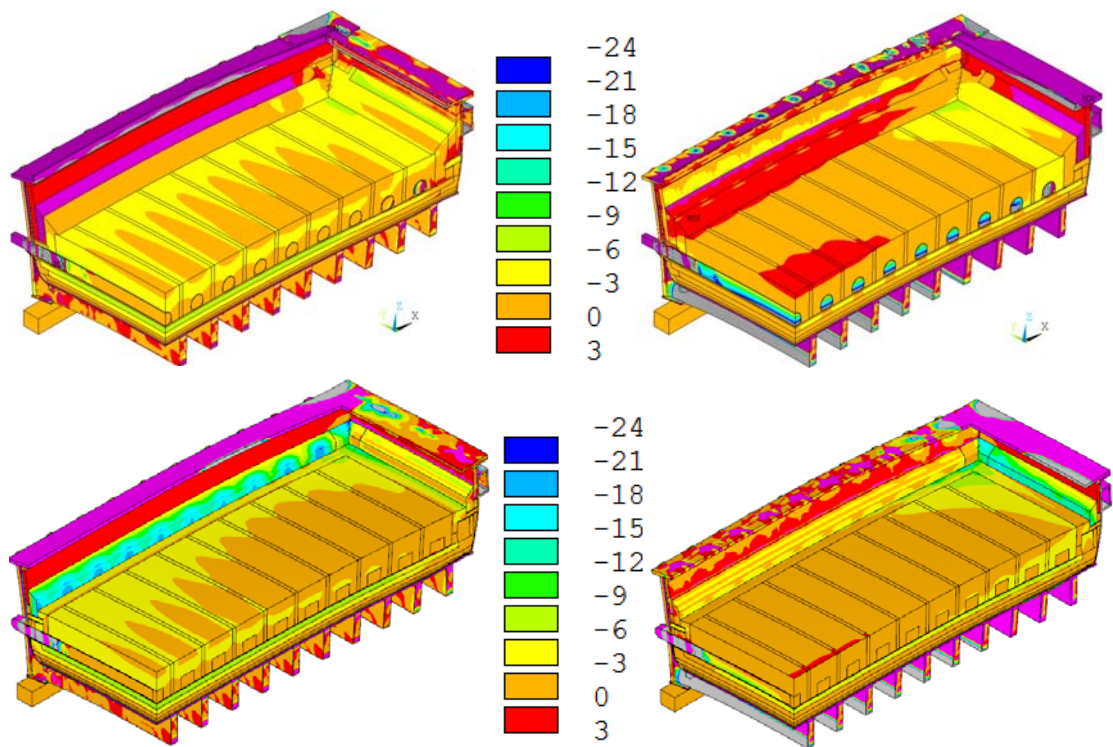


Figure 9. Stresses (MPa) in longitudinal (left) and transverse (right) directions. D18 Technology on the top and D18+ Technology at the bottom.

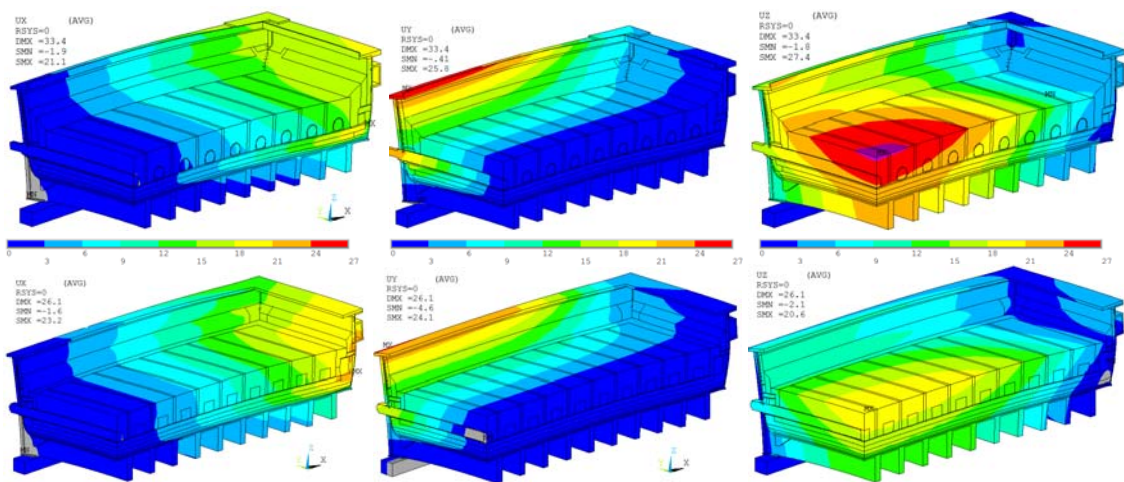


Figure 10. Deflections in longitudinal (left), transverse (centre) and vertical (right) directions. D18 Technology on the top and D18+ Technology at the bottom.

Table 5. Maximum Pot shell X, Y, Z deflection.

Pot shell deformation	D18 MK25	D18+
Longitudinal X, mm	19	22
Transverse Y, mm	25	24
Vertical Z, mm	23	15

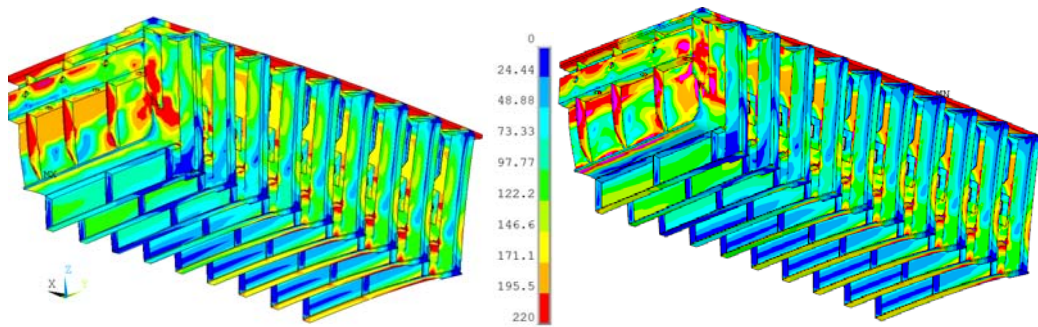


Figure 11. Von Misses stresses (MPa) in pot shell. D18 Technology on the left and D18+Technology on the right.

2.4. Novel cathode flex design

The original D18/CD20 Technologies cathode flex design has copper tabs which are bolted to the end of collector bars and are welded to the busbar (Figure 12) at the other end. Because of the restrained space between cells, the main US and DS busbars are very close to pot shell therefore the conventional collector bar flex design was not feasible. Another reason for deciding to change the flexible design was that DUBAL started to have (for the first time) high amounts of copper tab oxidation in D18 Technology (Figure 13). It is most probable that this problem was related to increased amperage (hence current densities) and consequently high temperature.

The new design solves both of these issues. The flexes were welded to the top surface of the collector bar using bi-metallic electrical transition joint (ETJ). To not compromise the new solution, the transition joint was not put too close to the potshell but the collector bar was nevertheless made much shorter outside the shell, which decreased the voltage drop by a few millivolts. The other end of the flexes was welded to an aluminium tab which was bolted to the busbar from the top (Figure 12). The engineering team developed a special bolted joint which performed well during the D18+ Technology test pot life. The D18+ test section has been more than four years in operation and during this time, the bolted joint voltage drop has been checked several times on all pots and only some locations exceeded the upper limit of 5 mV and those were easily retightened.

After this concept had shown its benefits in the D18+ Technology trial, it was further improved and implemented in DX+ Ultra Technology. The improvements consist of shorter collector bars and welding flexes to the collector bars via a tri-metallic transition joint, which sustain higher temperature than bi-metallic transition joints. Such improved flexible design according to modelling results, saves 13 mV at 206 kA.

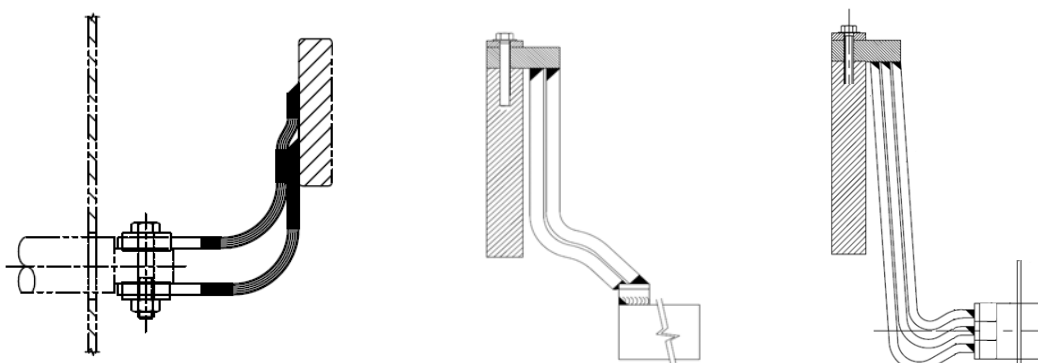


Figure 12. Cathode flex designs: D18/CD20 Technologies (left), D18+ Technology original (centre), D18+ Technology improved (right).



Figure 13. Strong copper tab oxidation in D18 Technology.

2.5. Cell supports

The original D18 Technology has continuous pot shell support (Figure 14). Modelling shows that such long continuous support is not needed because the potshell bends up due to the thermal gradient. To validate this point, a survey was done to estimate the position of the cradles on the support. The survey showed that the potshell was lifted up in the middle such that only a few end cradles were on the supports and the rest were hanging in the air. Based on these observations, the support design was changed from continuous to discrete supports. It was decided to keep two supports at the ends of the cell for operation conditions and one in the middle only to support the cell before start-up.

Busbar supports were designed separate from potshell supports. This arrangement of separate supports will facilitate basement cleaning during pot change over.

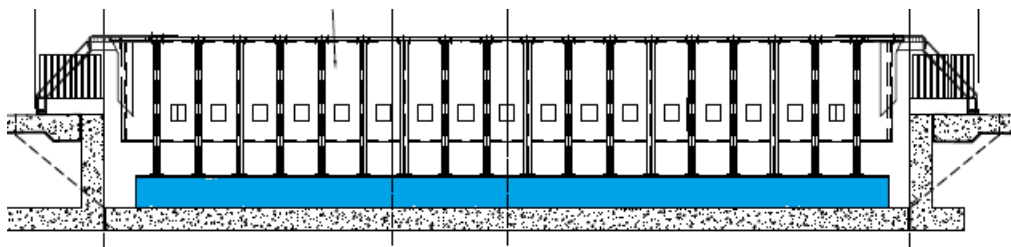


Figure 14. D18 Technology continuous cell support shown in blue.

2.6. Pot superstructure

The superstructure had to fit within the existing pot line infrastructure and keep the same overall height of the superstructure from the existing floor level had to be retained (i.e., the clearance between the top of superstructure and the crane, had to be the same as in D18 Technology pot superstructure). Therefore, the D18+ Technology superstructure should be by 245 mm lower than the D18 Technology superstructure. Also the D18+ Technology superstructure duct system design had to be more efficient than the D18 Technology design in order to extract all fumes from a longer pot effectively at the same or even lower flow rate. The experience of the engineering team, gained other technologies implementations, helped to successfully develop the shortest and most economical D18+ Technology superstructure design (proven later by real operation) by scaling down the DX+ Technology superstructure.

The new D18+ Technology superstructure has the following design features:

- Longer overall superstructure length to accommodate two extra anodes,

- The same distance between anode rods as in CD20 Technology, to keep 100 % similar spacing and the same evolution of anode size modifications,
- The jacking system has the same power as D20 Technology but may have gearbox and drive shaft changes to suit the new superstructure
- The crust breakers have bath sensing technology, alumina feeders and aluminium fluoride feeders based on most commonly used design in the plant,
- The tap hole breaker was kept, utilizing the leftover breakers from D18 Technology superstructures,
- The D18 Technology pot hoods and quarter shields were modified to suit the D18+ technology superstructure,
- The alumina conveying system uses low velocity conveying.

3. D18+ Technology Performance

While the design stage was being finished, D18 Technology amperage had already increased from 200 kA to 203 kA. The D18+ technology cells started operating at 205 kA due to temporary power availability, but a few weeks later this was reduced to 203 kA. D18+ Technology test section did not have a dedicated booster, so it had to stay with Potline 1 amperage, which was limited for D18 Technology.

After a few weeks of stabilisation, it was clear that cells had no issue with MHD stability. However, as predicted by the models, it was challenging to balance the heat in the test cells at 203 kA. After considering very robust MHD behaviour of the cells, the voltage was decreased significantly below target. Extra actions were taken to achieve the required thermal balance for the test cells, mainly by additional external insulation as well as by the adjustment of operating parameters (such as metal height and anode cover height targets) [3].

The D18+ Technology test section yielded very good performance and significantly exceeded project targets. Therefore, the EGA Board of Directors approved the full conversion of two existing D18 Technology potlines into D18+ Technology. Table 6 and Figure 18 show the main KPIs for five middle D18+Technology test cells. The first and the last test cells are excluded, because of different transitional busbars to D18 Technology cells.

Table 6. Main KPIs for five middle D18+ Technology test cells.

Year	2012*	2013	2014	January to September 2015**	May 2012 to September 2015**
Amperage (kA)	202.0	202.9	205.0	206.3	204.0
Nett Volts (V)	4.090	4.016	4.031	4.037	4.036
CE (%)	96.2	94.5	95.0	95.2	95.1
Net specific energy (SE) consumption (kWh/kg Al)	12.68	12.67	12.64	12.66	12.654
Anode effect (AE) frequency (AE/day)	0.017	0.016	0.023	0.037	0.021
AE duration (s)	28.1	18.2	33.5	36.4	27.0
Metal height before tapping (cm)	15.6	14.8	15.1	15.3	15.1

*2012 data from May after 56 days of stabilization period.

**In September 2015 the conversion of Potline 1 started, which affected the performance of seven test cells, therefore, the period of potline conversion is not included.

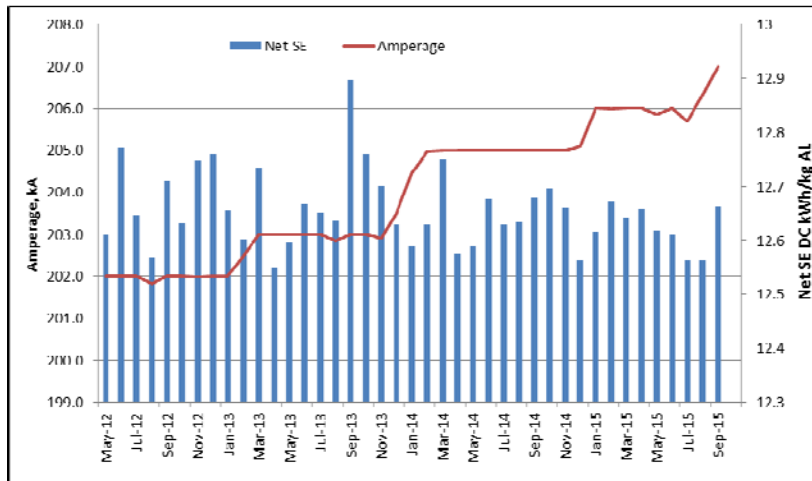


Figure 15. Five D18+ Technology test cells amperage and specific energy during trial period.

More detailed description of the conversion process was given by Akhmetov et al [9]. In July 2016, full conversion of Potline 1 was accomplished. Four sections out of eight have pot age from 56 to 90 days; therefore, the performance of these four modernized sections of Potline 1 is given in Table 7 and Figure 16. The data include only “established” cells (age greater than 56 days).

Table 7. Main KPI’s for the first four converted sections of Potline 1.

	July 2016	January - July 2016	Project target
Amperage (kA)	220.0	211.7	225.0
Nett Volts (V)	4.130	4.1	4.17
Current efficiency (%)	94.4	93.9	95.0
Net SE consumption (kWh/kg Al)	13.07	13.1	13.22
Noise (mV)	11	10	< 20
Anode effect frequency (AE/day)	0.022	0.060	< 0.1
AE duration (s)	26.2	38.8	-
Metal height before tapping (cm)	15.1	15.0	20

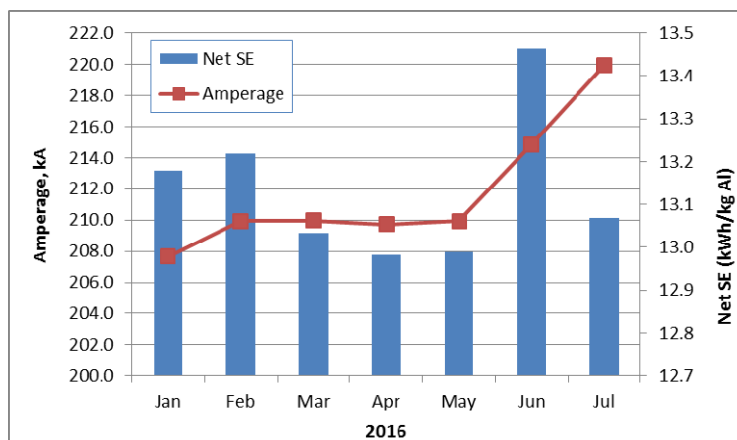


Figure 16. Amperage and specific energy consumption of first four converted sections of Potline 1 D18+ Technology cells in 2016.

As it can be seen from the data, all cells are performing well. June 2016 was a transition month when the amperage was increased from 210 kA to 220 kA. CE is lower that month due to inventory build-up, following amperage increase and freeze melting. In July 2016, the CE returned to a good value.

4. Conclusions

D18+ Technology cell design was developed as a substitute for D18 Technology which had reached its limit in terms of amperage increases. The new design successfully passed industrial trials, significantly exceeding project targets and was approved for full D18 Technology conversion (representing one third of the Jebel Ali smelter cells). Average net specific energy consumption of five D18+ test cells from May 2012 to September 2015 is 12.65 DC kWh/kg Al. The Potline 1 conversion was completed in July 2016 and amperage has already increased to 220 kA. The amperage is planned to be increased further to 230 kA.

The D18+ Technology project has proved that EGA has strong modelling and engineering capabilities to develop technologies for brownfield projects to replace old and aging technologies that have reached their limits. This is another demonstration of EGA's skills in developing highly efficient technologies. Harmonious teamwork and close collaboration between the modelling, engineering, major projects, technical and operations teams allows smooth and fast implementation of the projects.

The experience gained during the D18+ Technology project has helped EGA carry out a new and even more interesting and challenging project: the development of D20+ Technology, focusing on reducing specific energy consumption to replace CD20 Technology and D20 Technology cells which make up the other two thirds of the cells in the Jebel Ali smelter. This time, the conversion is to be done live during the cell change over.

5. References

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