Carbon capabilities

Production of Best Performing Anodes Requires Attention to Every Step of the Production Sequence.

Anode Quality and Potroom Performance

Anode production and the carbon plant often are not given the necessary importance when thinking of improved reduction performance and reduced energy consumption, however good quality anodes can not only reduce carbon consumption but also energy consumption, and rework needed to change anodes that fail early in the rota.

In order to produce best operating anodes, each stage of the production line should be examined and operating optimally. LMRC extensive knowledge and experience in carbon plants and rodding rooms can provide the necessary support in each step of the process to produce optimised anode with best performance.

Comprehensive Carbon Plant Audit

LMRC provide a comprehensive audit of each stage of the anode production process, the main focus include:

- Work practices.
- Safety.
- Correct use of technology.
- Sampling & Analysis (including method and frequency).
- Process management - Procedures, specifications, data recording and analysis, monitoring and response plans.

The outcome of the audit provide recommendations to achieve:

- Stability & optimization of process and materials.
- Identification of critical and common problems, their root cause(s), and provide recommendations to remove them.

Table IV Summary of Carbon Recommendations

	Recommendation	Investment	Urgency
C1	Recommend that the anode upper dimensions be changed (see Potroom recommendation P1)	Low	High
C2	For the current anode dimensions, it is recommended that the protective collar should be cancelled	Low	High
C3	Worthwhile to retry formed slots for anodes (Cut slots are more ideal).	Low – High	Low
C4	Overall safety recommendations: lighting especially in stairwells, and wearing safety glasses	Low	High
C5	Strengthen data analysis and application	Low	High
C6	Must get results from analysis to operators quickly to allow control actions	Low	High
C7	Must display data so that it shows when process requires attention (control charts)	Low	High
C8	Carbon plant control system display need to be improved (graphs). Such as at the calciner, paste plant and baking.	Low	Med
C9	Position the rodding room close to potrooms (for new smelter design)	Low	Low
C10	Reduce the overall distance between locations in the green anode plant (for new smelter design)	Low	Low
C11	The number of routine analysis and analysis frequency need to be increased, anode core testing frequency need to be dramatically increased (see Table 1.1)	Low - Med	High
C12	Current core sampling will not detect most internal cracking. Longer core length (600mm) and regular anode survey (cutting anodes open) is recommended	Low - Med	Med
C13	Continue to monitor green coke VM and introduce concern limits and action limits	Low	High
C14	Pitch should be segregated and blended by QI	Low	High
C15	Set up an laboratory on-site at the calciner for faster analysis	Med	High

Figure 1: LMRC recommendation sheet with priorities.

Following the audit, LMRC engineers will examine each step of the production process and can provide the following:

- Process control plan: data collection (sampling & analysis, measurement) , data analysis and response plan.
- Continuous process improvement: quality control systems, raw material characterisation and improvement.
- Tailored training: provide expert training.
- Carbon plant conceptual design.

Raw Materials Segregation & Blending

In order to produce good quality green anodes with low dust and minimal cracking the carbon plant raw materials consistency must be carefully managed especially for very high amperage cells.

Often the raw materials supplied to smelters are inconsistent in terms of quality; hence the raw materials entering the coke calciner (green coke), the paste plant (calcined coke and pitch) should be controlled by segregating different materials qualities in storage, and then blending.

In order to achieve good consistency LMRC can help by:

- Optimising target calcining parameters.
- Provide blending strategy- both before and/or after calcination to target specific properties in certain aggregate fractions.
- Storage segregation and blending strategy for solid pitch.
- Optimised temperature regime in the pitch melter.

Paste Plant and green anode forming

The baking process is time consuming and costly, hence it is important to use quality green anodes to maximise the benefit from this process and minimise non-complying anodes.

In order to produce quality green anodes LMRC can provide:

- **Optimise Process temperatures –** the target temperatures are designed through assessment of pitch properties.
- **Optimise aggregate recipe** - by adjusting all fractions to maximise aggregate vibrated bulk density, to minimise porosity.
- **Optimise pitch level and adjustment strategies to pitch demand -** Pitch optimisation such as Green Dry Density experiment which will optimize most anode properties.
- **Pitch demand and adjustment** according to pitch and coke properties (Pitch QI, Coke VBD and more)

Baking Furnace

Even when using good quality green anodes the result baked anode is still depended largely on the baking process quality.

In order to make sure the baking process is tuned and optimise LMRC can help with:

- Providing standardised operating practice— detailed SOP's that include the necessary measurements needed, the tools and safety measure needed to ensure the process is optimised and safe by giving attention to details in the process.
- Provide firing control strategy – to achieve uniform and controlled baking according to correct baking curve and reaching the desired temperatures.
- Provide pitch burn mapping and response plan- this will maintain a uniform advancement of the pitch burn front in the correct baking rate.
- Providing maintenance procedures and scheduling - by recording the condition of the refractory blocks and scheduling refurbishment to minimise lost production time.

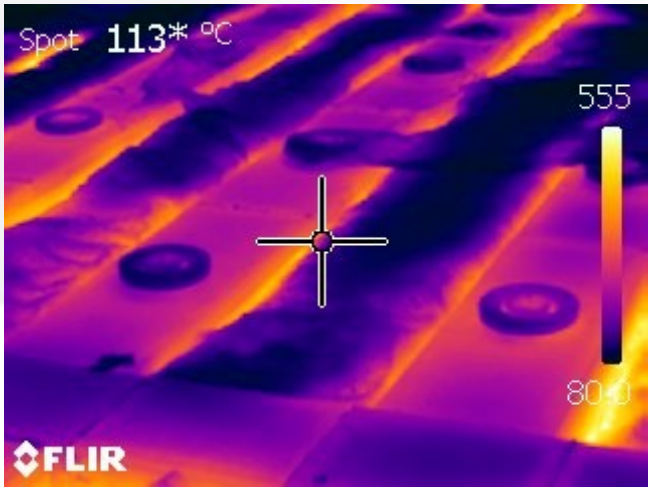

Figure 2:Thermal image of top of baking furnace.

Rodding Room

Correct work procedures in the rodding room can maximise the use of anode butts without compromising the new anode integrity. One of the challenges that the rodding room operation is facing is avoiding inclusion of contaminants into the new anodes. This contaminants can come from the anode butts or from the cast iron recipe.

The rodding room can provide essential feedback to the potroom by analysing the butts condition that are processed daily.

LMRC engineers can provide the standard needed to produce new anodes that are free from contaminants such as sodium or phosphorous that can reduce the efficiency of the reduction process.

The operation procedures that LMRC provide to costumers are customised to the specific client and are built to achieve the necessary quality targets/ standards.

In order to meet the quality targets LMRC can asses:

- the rodding room equipment — whether it's sufficient or specify modification and/or new equipment that should be purchased.
- The measurements and data needed to monitor the quality of butts, cast iron/thimbles and rodded anodes.

In addition a response plan will be assigned to deal with any excursion from the acceptable quality range.

Figure 3: Clean anode butt in good condition.

Production of the wrong cast iron can lead to continuous problems that will affect both the potroom and the rodding room performance. LMRC can guide the rodding room team to:

- Produce using the correct cast iron recipe to ensure that it won't contaminate the bath in the pots and reduce the current efficiency, avoid late rota cracking and provide easy–to-strip thimbles.
- Attention-to-detail work such as aligning the rods properly in the stub hole will maintain equal current flow through the stubs without preferential heating of one of the stubs.
- Control the casting procedure temperature to maintain the right flowability and microstructure of the cast iron which will lead to good thimbles.

Figure 4: Correct cast iron application.

Maintenance — as part of the anode quality program LMRC will specify a repair/replacement standard for anode rods/stubs, this will ensure equal current flow in the anodes, reduced voltage drop and energy consumption and reduce the occurrence of early failed anodes and spikes.

Contact:

Mark Dorreen, Operational Manager
Light Metals Research Centre
+64 9 923 8302
m.dorreen@auckland.ac.nz

Gary Putt, Executive Manager
Auckland UniServices Ltd
+64 9 923 8206
gary.put@auckland.ac.nz