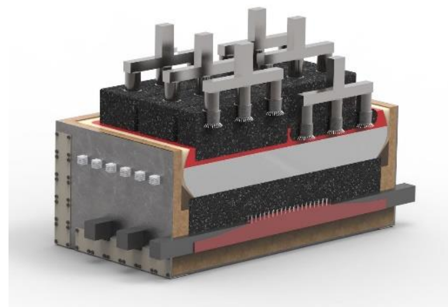
AluCellTech

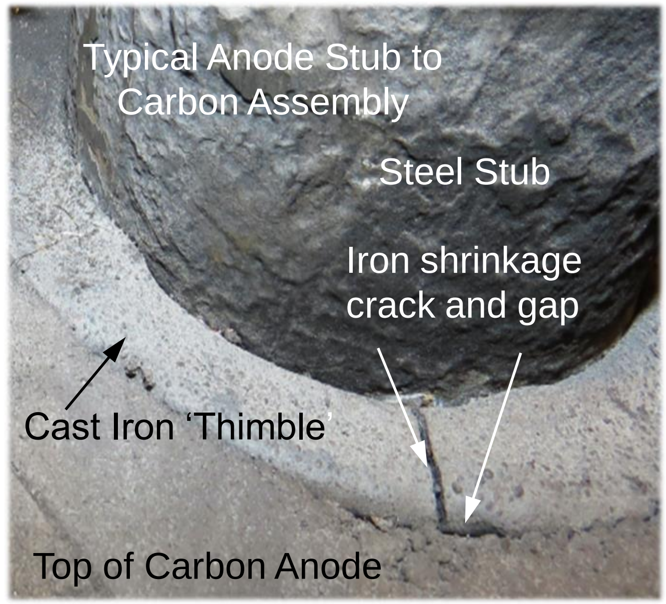
Technologies to improve the performance of existing and new Aluminium Reduction Cells



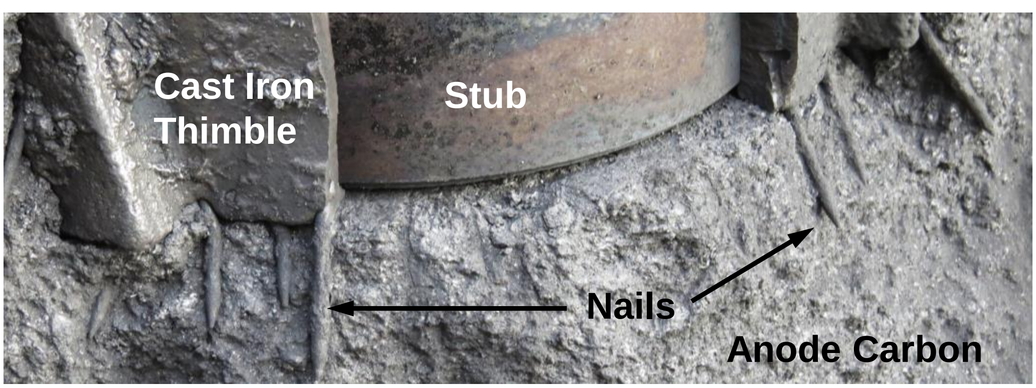
Aluminum Electrolysis: Anode Nails Technology

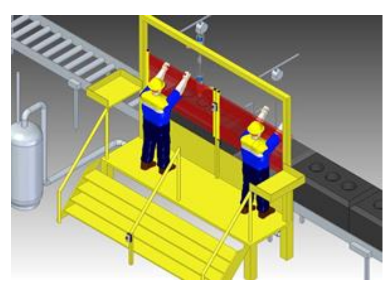
Anode Assemblies suffer from:

- **High electrical contact resistance:** High ECR at the Stub to Carbon STC connection due to the iron's >3% solidification shrinkage during rodding, resulting in an air gap and thimble cracking. The ECR worsens with stub wear and thickening thimbles.
- **High ohmic heating:** Resulting high temperature at the STC connection accelerates anode air burn, stub corrosion, stub toe-in, and increases electrical resistance through the stub and yoke.
- **Uneven current distribution**: High variation in resistance between hot (old) and cold (new) anode assemblies, causing uneven current distribution among anodes and promoting potnoise.



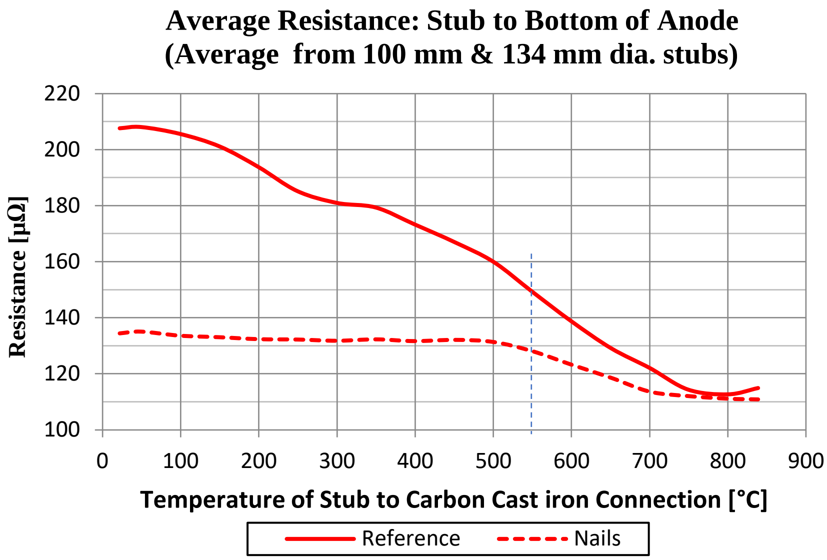
Anode Nails: Custom alloy hardened nails inserted into the stubhole walls, prior to anode assembly. The nails bridge the air gap to reduce electrical contact resistance. The nails are recycled by remelting with the cast iron thimble. Nails may be installed manually or robotically.





Benefits of Anode Nails include:

- Low electrical resistance across the STC connection which is unaffected by iron shrinkage or stub wear.
- Lower operating stub temperature to reduce anode air burn, stub wear and stub toe-in.
- Reduced variation in anode resistance between new and old anodes, thereby improving current distribution among anodes for improved current efficiency, lower potnoise and potentially lower PFC emissions.



Laboratory test results of electrical resistance through full height anodes with 155.5 mm stub hole diameter. The plots include the average of 134 & 100 mm diameter stubs to reflect a normal stub population.

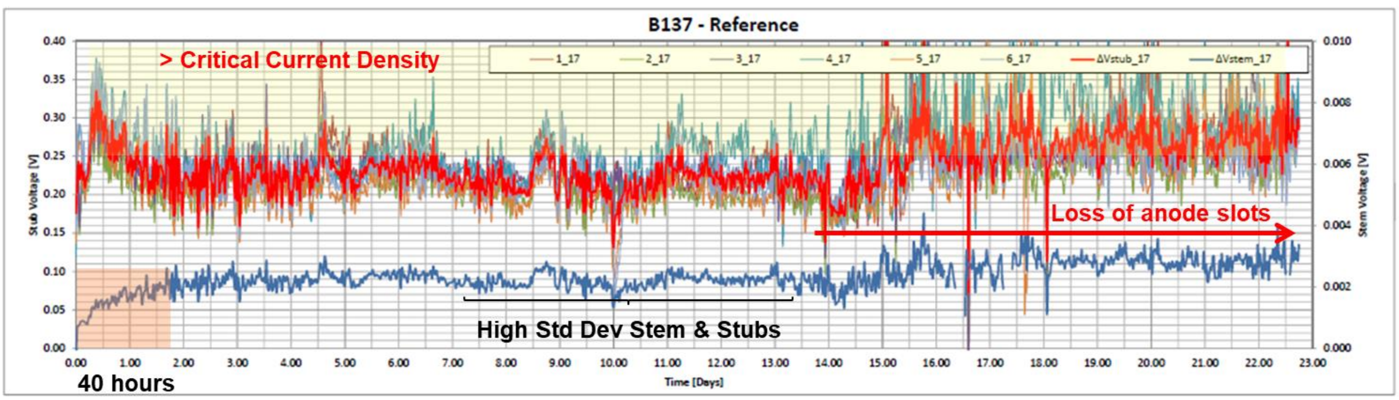
The Reference line is without nails. The Nails line is with Anode Nails, demonstrating significant resistance savings over the entire anode cycle.

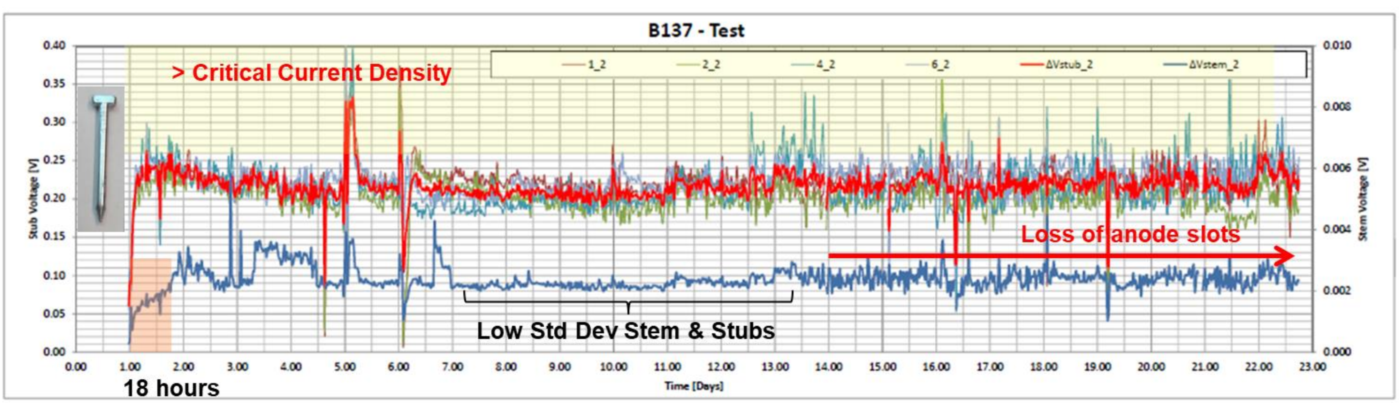
For average stub temperature over the anode cycle of 550 C, an average resistance savings of 22 µΩ, with 2500A/stub, the potential voltage drop savings = 55 mV, and power savings with 120 stubs/pot = 16.5 kW/pot, approximately 1.5 % of total power consumption. Results will differ with average thimble thickness and stub condition.

The more uniform STC resistance per stub results in more uniform current distribution through the anode and across the bottom surface, which reduces pot noise and can improve current efficiency. In pot test results of pairs of anodes with/without nails, the STC and Stem voltage chart below demonstrates the significant reduction of pot noise observed over a full anode cycle. (AP30 pot). The voltage signals are per stub and average (red), shown below. The rod stem voltage is plotted in blue.

Observations of anodes with nails included a 66% reduction in voltage that exceeded 125% of average, considered the critical current density that may generate Perfluorocarbon PFC emissions. Results will vary with pot design and operating practises. PFC emissions vs voltage behaviour require simultaneous verification testing for each potline.

Additional benefits include a faster amperage pickup by new anodes (18 vs 40 hours) and continued lower pot noise after the anode slots are eliminated due to anode consumption.





Patents CA2914511,
CN204385308 + Int'l filings

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