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300 kA铝电解槽中焦粒焙烧过程温度场的仿真优化

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摘 要：使用有限元法建立了300 kA铝电解槽的焦粒焙烧三维1/4整槽模型，针对目前普遍采用焦粒均匀铺设方式，对其焦粒焙烧过程的温度分布与变化特征进行了瞬态数值仿真研究。当前的焦粒焙烧启动方式存在阴极表面温差过大、各阴极炭块随空间位置不同温度分布差异过大、端部第1至第3块阴极炭块平均温度低于900 ℃、阴极炭块和捣固糊升温速度过快等缺陷。提出在阴极表面从电解槽边缘向中心依次铺设电阻率递增的焦粒层的优化焙烧方案，并进行温度场仿真计算。结果表明：该优化方案可以使阴极表面温度分布更加均匀，端部第1至第3块阴极炭块表面温差比优化前降低8%以上，中间第4至第13块阴极炭块表面温差降低30%以上，阴极炭块和阴极缝糊平均升温速度降低12%，该优化方案更有利于减少电解槽的早期破损。

关键字： 铝电解；电热场；焦粒焙烧；仿真；优化

Simulation and optimization of thermal field during coke preheating process in 300 kA aluminum reduction cell

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Abstract:A three-dimensional transient thermo-electric finite element model of 300 kA quarter aluminum reduction cell was developed to study the thermal field of carbon cathode during the heating-up process by using the same resistivity coke bed. Many defects such as high difference in temperature in the cathode, non-uniform temperature among the cathode surface, non-uniform temperature among the cathodes at different positions, the arerage temperature in the end cathode carbon block 1 to 3 lower than 900 ℃ and too fast heating-up rate during the process were found. In order to solve this problem, an optimization using increasing resistivity coke bed from the side of the cell to the center to preheat the cell was carried out. The results show that the temperature difference is decreased by more than 8% at the end cathode carbon block 1 to 3 and that in the center cathode carbon block 4 to13 more than 30%. The heating-up rate is decreased by 12% in cathodes. The risk of early failure of the cell lining can be reduced by this optimum scheme.

Key words: aluminum reduction; thermo-electric field; coke bed preheating; simulation; optimization

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