Evolution of Anode Porosity under Air Oxidation: The Unveiling of the Active Pore Size

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Abstract

Carbon anode, used in the aluminum electrolysis (Hall-Héroult process) is overconsumed by air oxidation. Several anode features may affect this overconsumption such as the impurity content, the graphitization level and the anode porosity (e.g. apparent density, porosity, pore size distribution). The two first parameters are basically related to the quality of the raw materials and the coke calcination conditions. The anode porosityis however affected by the anode manufacturing conditions, thus possible to be modified, to some extent, by adjusting the anode recipe and the processing parameters. This work aims at investigating the effect of anode porosityon its air reactivity. The porosity was characterized in several pore size ranges, measured by mercury porosimetry. Anode samples, in particle form, were then gasified at different levels under air at 525°C. The volume variation of each pore range versus carbon conversion was assessed and used to determine the size of the most active pores for air oxidation. Limitation of this pore size range could be used as an additional guideline, along with other targets such as high homogeneity and density, to set the optimum anode manufacturing parameters.

Keywords: Air reactivity; pore size distribution; active pore size; apparent density; gasification.