

# Inspection of Prebaked Carbon Anodes Using Multi-Spectral Acousto-Ultrasonic Signals, Wavelet Analysis and Multivariate Statistical Methods

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## Abstract

Reduction cell operation in primary aluminum production is greatly influenced by the baked anodes properties. Producing consistent anode quality is more challenging nowadays due to the increasing variability of raw materials. Taking timely corrective actions to attenuate the impact of raw material fluctuations on anode quality is also difficult based on the core sampling and characterization scheme currently used by most anode manufacturers because it is applied on a very small proportion of the anode production (about 1%), and long-time delays are required for lab characterization. The objective of this work is to develop rapid and non-destructive methods for inspection of baked anodes. In past work, it was shown that acousto-ultrasonic signals collected from anode parts at different frequencies were sensitive to anode defects (pores and cracks) and this was validated qualitatively using X-ray computed tomography. This work attempts to improve the method by using multi-spectral excitation signals and by establishing quantitative relationships between the acousto-ultrasonic signals and defects extracted from tomography images using Wavelet Transforms and Partial Least Squares (PLS) regression. This results in shorter acquisition time and a more specific and robust model for anode inspection. The method performance is illustrated using samples collected from industrial scale anodes.

**Keywords:** Non-destructive testing; acousto-ultrasonic signals; CT-Scan images; PCA; PLS.