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Characterization of activated carbon from a water treatment filter using acoustic emission analysis

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Statement of the Problem: Granular activated carbon (GAC) is one of the most widely applied adsorbent for removing pollutants from water. Normally, after its use it is removed from filters and replaced for virgin (expensive) material. Proper GAC characterization demands special equipment and high-tech lab infrastructure. Acoustic emission analysis (AEA) represents an emergent technique to characterize GAC, using the sound produced by bubbles escaping from the GAC pores. The purpose of this study is to determine the exhaustion profile in a water treatment filter using AEA leading to the optimization in the GAC management.

Methodology & Theoretical Orientation: The AEA analyses were performed in a frequency range of 3.5-25.6 kHz. Minnaert equation was used to estimate the diameter of the bubbles produced from the GAC structure. Gilbert transform in time domain was used to process the acoustical signals. TGA, ash content, XRF and CHNS-O Elemental analysis were used to correlate AEA.

Findings: Based on the acoustic parameters of the obtained signals such as the area under the envelope curve and their maximum peaks, the exhaustion profile of the GAC in the water filter was calculated, thus demonstrating an incorrect management strategy due to part of the GAC in the industrial filter still having adsorptive capacity which can be reused.

Conclusion & Significance: AEA emerges as a trustable analytical tool to enable a better GAC management strategy by including a proper adsorbent saving and in a possible AC regeneration process, also economic, social and environmental advantages can be obtained by optimizing the industrial AC exploitation. The proposed AEA can be performed in an easier, less expensive and time consuming way in comparison with classical techniques. Recommendations are to implement the AEA as a rapid and accurate method for the determination of the exhaustion level of the GAC in water treatment filters.