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Activated carbon felt and graphite felt as efficient electrode materials for sulfide removal from waste water streams

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Sulfide, a by-product of many industrial processes, causes a wide number of environmental problems. Electrochemical treatment is one of the most emerging techniques used for its removal nowadays since it offers low cost treatment that allows robust removal of sulfide *in situ*. In this study we evaluated the efficiency of low cost electrode materials such as activated carbon felt (ACF) and graphite felt (GF) and proposed the mechanism of sulfide removal. In order to avoid electrode passivation with sulfur, different electrode regeneration strategies were evaluated. Both materials enabled complete removal of sulfide, with ACF requiring lower energy, i.e., $4.6x10^{-3}$ Wh/L compared to GF ($11x10^{-3}$ Wh/L). Also, the mechanism of sulfide removal on ACF and GF was different. Sulfide removal on ACF occurred mostly due to its rapid chemisorption, as a result of which pre-adsorbed HS reacted with oxygen functional group on the ACF surface and formed elemental sulfur. The resulting sulfur was incorporated into the ACF matrix and therefore it was not available for recovery. As for GF, chemisorption also occurred, but it was slower and less efficient due to the smaller surface area of the material, lower concentration of oxygen functional groups at its surface and higher GF hydrophobicity. In addition to chemisorption, other processes contributed to sulfide removal, including electrochemical oxidation of sulfide to elemental sulfur and indirect oxidation to sulphate with oxygen produced on the anode due to parasitic reaction. To recover the GF electrode, electrodeposited sulfur was successfully reduced *in situ* to sulfide/polysulfides. In this study, we confirmed that adsorption governs the process of sulfide removal when ACF is used as an anode, while electro-oxidation likely plays a minor role. GF could be successfully applied for anodic oxidation of sulfide present in wastewater. Moreover, the possibility of *in situ* regeneration of GF electrodes prolongs the lifetime of an electrode and makes its application more sustainable..

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