Electro-catalytic Reduction of Aqueous Nitrates using Cu-Sn and Cu-Pd Cathodes

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Water treatment systems are used globally to reduce environmental impacts or to provide potable water, thus fulfilling established water quality standards. Electrocatalytic nitrate removal is a promising tool to address upcoming problems related to nitrate contamination. This study compares the employment of a low cost CuSn6 based catalyst with a noble metal Cu - Pd catalyst in a laboratory and a continuously operating pilot apparatus to treat nitrate contaminated water from a well. In contrast with common applications, a saturated carbonic acid was used as the anolyte solution, which stabilized the pH in the anode compartment as well as in the cathode compartment. The best performance, as determined by nitrate removal and nitrogen transfer into the gas phase, was reached with a specific current of 1.16 A m⁻² for the laboratory apparatus and 1.53 A m⁻² for the pilot plant apparatus. However, other parameters such as pH (influenced by anolyte solution) and catalyst selection also had an impact on the nitrate reduction performance with the consequence that process optimization should be realized on-site while running a pilot plant. Process gas analysis by mass spectroscopy revealed the presence of hydrogen, which suggests that a combination of the system with heterogeneous catalysts should be used for additional nitrogen reduction at potential free surfaces.

Keywords: Copper-tin electrode; Carbonic acid; Palladium-Copper Catalyst; Groundwater

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