273b Electrolysis of Ammonia Effluents: a Remediation Process with Co-Generation of Hydrogen

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Introduction

There are negative effects on the environment that are the result of poorly applied technological procedures such as waste water treatments that release toxic and dangerous chemicals. Chemical compounds used in the waste water treatment process are detrimental to the normal environmental conditions. One of the common compounds present in waste water (chemical processes, agricultural run off) or sewage plants is ammonia (NH_3). Ammonia is present in the waste water plants in low concentrations (0.5-2 mmol/L)[1,2]. The technology being studied will remove ammonia from waste water during sewage treatment to produce hydrogen while returning clean water to the environment. A previous study in the Electrochemical Engineering Laboratory at Ohio University used high concentrations of ammonia in alkaline media and low temperatures (25-60°C) to electrolyze ammonia[3]. The objective of this paper is to evaluate the technical and economical feasibility of implementing this process (electro-oxidation of ammonia) for the removal of ammonia and the cogeneration of hydrogen. In order to simulate waste water treatment plant conditions, low concentrations of ammonia are been evaluated in an alkaline solution of potassium hydroxide (KOH) and the same temperature range. The electrolysis of ammonia is environmentally sound as it produces pure hydrogen as a product which can be used in fuel cells, and releases nitrogen without any hazardous consequences.

Results and Discussion

Preliminary results for higher concentrations of ammonia (1M NH_3) in alkaline media (1M KOH) were obtained for a Raney Nickel-Platinum electrode design[4,5]. Using an electrode designed for higher concentrations of ammonia, preliminary results have been obtained for low concentrations of ammonia. Modifications will be made to the electrode to increase the current response. The research pursues the optimization of the electrode design for use in waste water treatment plant conditions, particularly low ammonia concentrations. The electrode will be designed to produce a high reactivity catalyst process in the effluent stream conditions. Current experiments are being developed with Carbon Fiber Electrodes plated with noble metals in order to increase their surface area. Figure 1 shows a cyclic voltammogram for different electrodes in order to analyze the effect of the catalyst compositions on the oxidation of ammonia. Characterization tools will be used to analyze the surface of the electrodes, such as Scanning Electron Microscopy (SEM) and Energy Dispersion Spectroscopy (EDS). The electrochemical performance of the electrode will be measured using cyclic voltammetry and galvanostatic polarization techniques. The optimized design of the electrodes as well as their performance in low ammonia concentrations will be reported. Other parameters such as temperature between 25 and 60°C will be study, as well as the effect of the contaminants present in the waste water treatment samples. An economics analysis of the technology will be presented.

References

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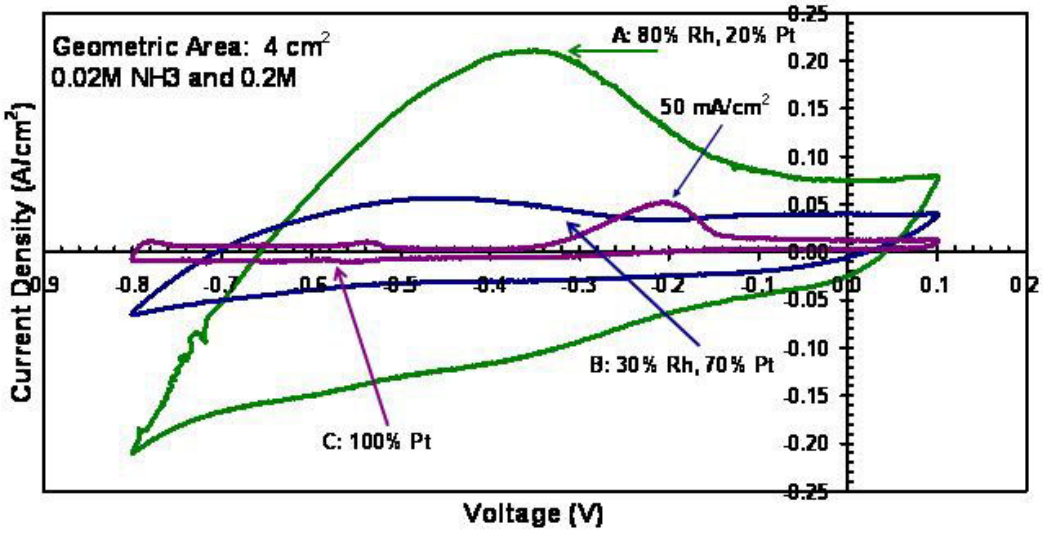

Figure 1. Effect of Electrode Composition on the Oxidation of Ammonia. Electrode C (100% Platinum) presented the best performance showing the reaction of ammonia electrolysis associated to the peak at a current of 50mA