Treatment of Thiosulfates as Mining Pollutant Through Electron Fenton Process

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Introduction

Thiosulfate is a common pollutant found in the mining industry that is known to be challenging to remove from wastewater. Thiosulfate reactivity is complex and dependent on pH, temperature, oxygen and the presence of other microorganisms (Brillas, 2017). This research utilizes the process of Electron-Fenton (EF) in removing thiosulfate by transforming it into sulfate. Although EF is a process commonly used to remove organic pollutants; this research is aimed to understand the feasibility and efficiency of EF process in degradation of thiosulfate.

Aim

To investigate the feasibility and efficiency of Electron-Fenton method as a green technology for treatment of thiosulfate.

Fundamental Concept

EF process is based on the cathodic production of H_2O_2 by its reduction of dissolved O_2 through a carbon electrocatalyst (1) . Carbon material is chosen due to its abundance, cost and non-toxicity (Zhou, 2017). The process in which EF work is when cathodic H_2O_2 decomposed by catalytic Fe^{2+} that produces *OH (2). The process of EF is also efficient due to the fact that only a small amount of Fe^{2+} is needed since it is continuously generated in the cathode anode material (3). The material boron doped diamond (BDD) is the best material for anodic oxidation of organics and utilizing it in EF process has increased the efficiency and effectiveness of the process (Dios, 2014). However, in this research the use of dimensionally stable anode (DSA) is used to compare the effectiveness between the two electrodes.

$$O_2 + 2H^+ + 2e^- \rightarrow H_2O_2 \quad (1)$$

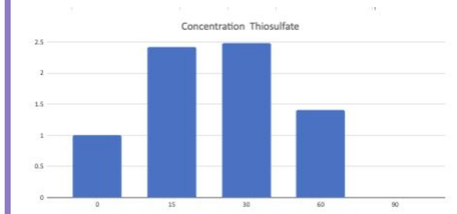
$$Fe^{3+} + e^- \rightarrow Fe^{2+} \quad (2)$$

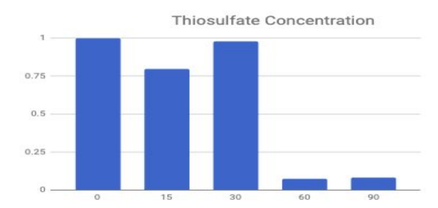
$$Fe^{2+} + H_2O_2 + H^+ \rightarrow Fe^{3+} + H_2O + {}^{\bullet}OH \quad (3)$$

Methods

Three different thiosulfate solution are made with different concentrations, they are: 1g/L, 1.5g/L and 2g/L. The method of EF is first through the set-up where a carbon brush is connected to the cathode which is plugged into a power source and a cathode that is connected to the electrode either BDD or DSA. For the experiment, the volume that is used for the concentration of thiosulfate in the beaker is 500ml. To measure the degradation of thiosulfate as well as its pH trend, a time interval from 0 minute, 15 minutes, 30 minutes, 60 minutes and 90 minutes is used. The amount of concentration is injected to be analyzed using ion chromatography instrument. The injection varies with the dilution factor depending on the time interval.

Results & Data





A. 1.5g/L - BDD Electrode

Time	Area	Current Area	Concentration	pH
0	0.3706	3.706	1	6
15	0.895	8.95	2.415002698	4.18
30	0.9211	9.211	2.485429034	3.8
60	0.5226	5.226	1.41014571	3.6
90	0	0	0	3.2

B. 1g/L - DSA Electrode

Time	Area	Current Area	Concentration
0	4.2856	21.428	3.169822485
15	1.1515	5.7575	0.8517011834
30	0.5101	2.5505	0.3772928994
60	0	0	0
90	0	0	0

Conclusion

In conclusion, EF is a method that is simple and economically feasible in removal of thiosulfate. This method has successfully become an efficient tool for this action as proven by the results of thiosulfate experiment. It has also been proven that the removal of thiosulfate in EF method is by turning it into sulfate as seen in all of the graphs for the different concentration that the trend for sulfate increases over time. Overall, EF is an efficient method to remove thiosulfate as pollutant in wastewater.

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References

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