Acetate Stimulates Tetracycline Biodegradation Pathways in Bioelectrochemical System

Lean Zhou and Shiquan Sun

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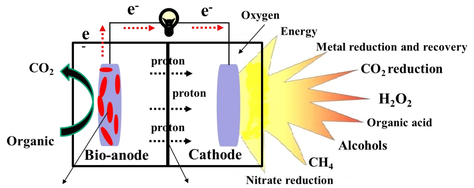
Introduction

BES—Biological Electrochemistry System



- Accelerating microbial electron transfer and removing pollutants by microbial catalytic oxidation / reduction;
- The biotoxicity of antibiotics will inhibit the activity of EAB, which may become the bottleneck to further enhance antibiotic removal;
- co-substrate strategy have potential to minimize the poisoning of toxic pollutants on EAB and enhance the activity of enzymes for EET;

Methodology

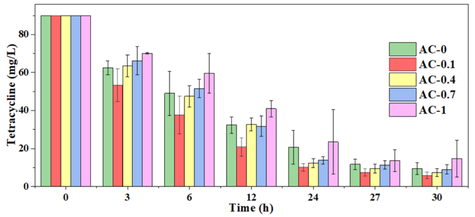
- BESs electrochemical properties were analyzed using time-voltage curves and polarization curves;
- Oxygen was pumped into the system through the cathode (gas diffusion layer) by air free diffusion, and dissolved oxygen (DO) in BESs was determined by microsensors connected to a micromanipulator and a multimeter;
- The TC concentration was detected by a UV−vis spectrophotometer at a wavelength of 357 nm;

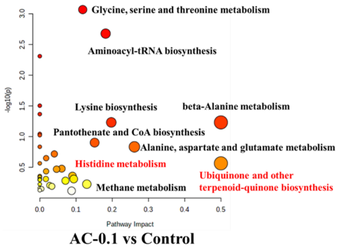
$$\eta_t = \frac{C_o - C_t}{C_o} \times 100\%$$

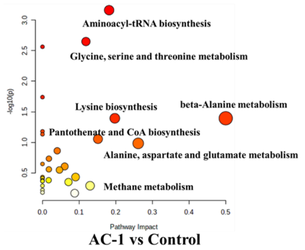
where C_o is the original TC concentration, and C_t is the TC concentration at time t (mg·L^{-1}).

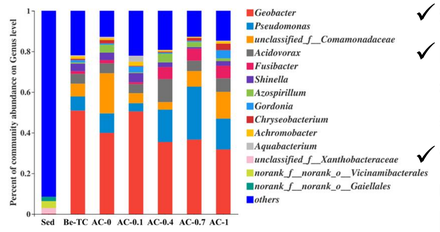
- R was used to assess the relative abundance of bacterial species and classes;
- Metabolites were analyzed using liquid chromatography-mass spectrometry.

Results



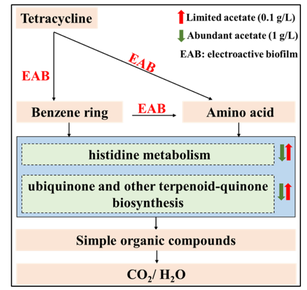






- ✓94% of 100 mg/L TC decomposed within 48 hours;
- ✓Limited acetate as a co-substrate enhanced the removal efficiency of TC by 44% when compared to abundant acetate and controls;
- ✓With the differentiation of the microbial community, ubiquinone and other terpenoid-quinone biosynthesis and histidine metabolism were significantly upregulated in AC-0.1.

Conclusions



- The biodegradation of TC was strongly stimulated by acetate in BESs.
- The limited acetate ensured the abundance of Geobacter (G. sulfurreducens) and enhanced the population of PTDB in microbial communities.
- Limited acetate improved the TC removal efficiency by 44%, which could be due to the upregulation of ubiquinone and other terpenoid-quinone biosynthesis and histidine metabolism.

Acknowledgments

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References

Zhou, L., Yan, X., Yan, Y., Li, T., An, J., Liao, C., Li, N., Wang, X., 2020. Electrode potential regulates phenol degradation pathways in oxygen-diffused microbial electrochemical system. ***Chemical Engineering Journal*** 381, 122663.

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