

# 主論文の要約

論文題目 **Anaerobic Autotrophic Metabolism using Humin as an Extracellular Electron Mediator**  
(細胞外電子伝達物質として腐植ヒューミンを利用する嫌気性独立栄養代謝)

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## 論文内容の要約

The thesis answers the research question of sustainable bioremediation by use of humin through quantitative analysis as the extracellular electron mediator (EEM) for autotrophic metabolism via CO<sub>2</sub> respiration for PCP reductive dechlorination. The overview of the chapters are summarized as below:-

In Chapter 2, the literature review is presented to discuss the scope of bioremediation in anaerobic environments where organic substrates limitation exists. This chapter focused primarily on humin-dependent PCP dechlorinators, reductive acetogenesis via CO<sub>2</sub> respiration, and methanogenesis as the three anaerobic metabolism as witnessed in the study. The chapter also laid the importance of the extracellular electron transfer involved in anaerobic environments, and the potential of electron mediation using microbial electrosynthesis.

In Chapter 3 of the thesis, the study focused on homoacetogenic metabolism of CO<sub>2</sub> reduction using hydrogen as the inorganic electron donor to produce acetate. The acetate produced as a result was used to eliminate the requirement of external organic substrate addition for reduction of humin for use by the humin-dependent dechlorinators. The study therefore, substituted the need for pulse, or continuous

feeding system of organic substrate addition for bioremediation.

In Chapter 4 of the thesis, the study found that humin could in itself act as the sole source of energy in complete absence of any form of external electron addition for CO<sub>2</sub> respiration to produce acetate as the metabolic product. The study therefore put forward new insight to the use of humin as the naturally abundant OMC as an alternate electron donor for autotrophic metabolism by the humin-dependent acetogens.

In Chapter 5 of the thesis, the study focused on bioelectrochemical application to produce acetate by use of humin as the interface. Here, the study looked at continuous supply of electrons through electricity where humin could be recharged as EEM for anaerobic metabolism. It was found that the electrons transferred via humin could be used by the humin-dependent acetogens to produce acetate.

Chapter 6 of the thesis answers the research questions, and discusses the potential of naturally abundant material like humin as an EEM that could be used by different microorganisms for anaerobic respiration in substrate deficient environments. The chapter also highlights the different issues of the study and the future direction of research that could help better understand microbe-humin interactions.