Bioelectrochemical denitrification based on mediator regeneration system

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Abstract

To remove nitrate, bioelectrochemical denitrification system was introduced. In this system, biological denitrification reactions are coupled with electrode reactions, so electrons from the electrode are transferred to bacterial enzymes via mediator as electron carrier.[1,2] In this study, denitrification reaction was attained by permeabilized *Ochrobactrum anthropi* SY509 containing denitrifying enzymes such as nitrate reductase, nitrite reductase and nitrous oxide reductase. And methyl viologen was used as mediator. When electrons are supplied from the electrode via mediator, electrons can be reached enzyme directly without undergoing complicated electron transfer pathway. Therefore, denitrification can be achieved without carbon source such as glucose. In the case of permeabilized cells, permeability barrier of the cell membrane could be lowered and energy consumption for the cell growth could be avoided.[3] Because of this advantage, permeabilized cell can be applied successfully to electrochemical denitrification system using electricity instead of nutrient. Results of this study could be summarized as following. First, electron transfer from the electrode to enzymes in bacterial cells was certified by cyclic voltammetry. Second, biocatalytic activities for the bioelectrochemical denitrification reaction were compared between intact and permeabilized cells, and higher efficiency of permeabilized cells was showed. Finally, permeabilized cells were immobilized to the carbon felt electrode using graphite powder-modified calcium alginate matrix. Bioelectrochemical denitrification system using this electrode modified with immobilized cells resulted in similar efficiency with system using free cells.

References

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