

研究主論文抄録

論文題目

Studies on COD removal using poly(vinyl alcohol)-gel beads as biomass carrier in UASB reactor

(PVA ゲルビーズを微生物担体として使う UASB 法による COD 除去に関する研究)

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主論文要旨

Low-strength wastewater is identified with COD concentrations below 1000 mg/L. Its main sources are cesspit leakage, septic tank, sewage treatment plant, industrial process water, rainfall runoffs, agricultural drainage, etc. Such wastewaters are large in quantity and being discharged into water bodies without treatment in many developing countries. Over the past forty years, upflow anaerobic sludge blanket (UASB) was introduced by Dr. Lettinga in Netherlands. It has become one of the most popular anaerobic wastewater treatment processes because of low energy demand, simple construction and high removal efficiency. The application of UASB reactor for industrial wastewater treatment indicated a number of reports about the treatment of high-strength wastewater and medium-strength wastewater. Only a small fraction of papers focused on low-strength wastewater, because such wastewater is poor in recoverable materials, therefore treating them brings insignificant returns. It becomes crucial to treat low-strength wastewater with less input of energy and other resources.

Sludge granulation is considered as the key success of UASB process. To enhance these granules, an inert material can be used as biomass carrier. In our experiments, poly(vinyl alcohol) (PVA)-gel beads were employed. This functional resin has a reticulate structure that can trap and carry microorganisms. PVA gels have been used in hundreds of industrial water treatment systems in Japan. PVA gels have also been

applied for lab-scale anaerobic bioreactors, including packed-bed, anammox and UASB. Zhang et al. (2009) carried out his experiments with UASB using PVA gels treating high-strength wastewater. The treatment of low-strength wastewater is crucial in many developing countries, this study therefore focused on UASB treating low-strength wastewater.

My dissertation consists of six chapters:

Chapter 1 – Literature review on studies on low-strength effluents by UASB bioreactors and the application of PVA-gel as biomass carrier for wastewater treatment.

Chapter 2 – The performance of a cuboid-shaped UASB reactor treating low-strength wastewater under mesophilic (35°C) to psychrophilic (15°C) conditions. The operational strategy was keeping the stable influent COD concentrations and accelerating hydraulic retention time (HRT) to below 1 hr. A stepwise increase of organic loading rates was achieved, excluding requirements for time and space of experiments. The acceptable organic loading rates and the effect of temperature decrease on COD removal were discussed.

Chapter 3 – The comparison of COD removal efficiencies and the dominant microbial species in two identical UASB reactors using PVA-gel carrier and poly(ethylene glycol) (PEG)-gel carrier in treating low-strength wastewater.

Chapter 4 – The operation of a cylinder-shaped UASB reactor using PVA-gel carrier at 15°C and under short hydraulic retention times. The analyses on microbial population and substrate removal kinetics were discussed.

Chapter 5 – The feasibility of applying a swim-bed reactor as post-treatment of UASB effluents.

Chapter 6 – Conclusion remarks and recommendation for future work.