Development of Nitrogen-Removal Bioreactor
− Practical Application to Thermal Power Plants and Various Uses −

Background

Nitrogen compounds are a cause of eutrophication in lakes and coastal waters. In order to apply our bioreactor (Fig. 1) removing the nitrogen to thermal power plants, we have to clarify nitrogen-removal performance and stability of the bioreactor on a large scale. On the other hand, a simplified and miniaturized bioreactor is effective for various uses, such as water treatment system for an aquarium.

Objectives

Wastewater containing nitrogen is treated by a large-scale version of our bioreactor to clarify that our bioreactor can treat various kinds of wastewater derived from thermal power plants. For application of our bioreactor to various uses, nutrition for used bacteria is examined to miniaturize the bioreactor.

Principal Results

1. Construction of a large-scale system of nitrogen-removal bioreactor

The packed gel envelopes used in the bioreactor consisted of two nonwoven fabrics attached with polymeric gel containing two kinds of bacteria. A large-scale system (Photo.1), which was equipped with a reactor tank (2.1m^3 volume) containing the thirty packed gel envelopes, pH controller, supply unit of ethanol as nutrient of used bacteria, was installed in Takehara thermal power station managed by Electric Power Development, Co., Ltd.

2. Wastewater treatment by large-scale system of nitrogen-removal bioreactor in thermal power plant

Wastewater containing nitrogen, which occurred regularly in the power station, was continuously treated by the system for over one year. The system could remove 95% of nitrogen from the wastewater on condition that hydraulic retention time was adequate to treat the wastewater with the thirty packed gel envelopes. Total nitrogen concentration of treated waster was kept below 10mg-N/L, which is the severest regulation (Fig.2). The system could also treat the other wastewater containing nitrogen, which occurred irregularly in the station, though we had to adjust pH of the irregular wastewater and dilute with the regular wastewater.

3. Miniaturization of nitrogen-removal bioreactor

Poly-lactic acid as biodegradable plastics instead of ethanol was used as nutrient for used bacteria. The bioreactor using the biodegradable plastic maintained nitrogen-removal performance, which was similar to that using ethanol, for over 100 days (Fig.3). This suggested that we could make a simple and compact bioreactor without additional pumps for ethanol supply.

Electric Power Development, Co., Ltd cooperated with parts of these researches.

Future Developments

The large-scale system of our bioreactor will be further modified to apply the bioreactor to thermal power plants and various uses.

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Reference

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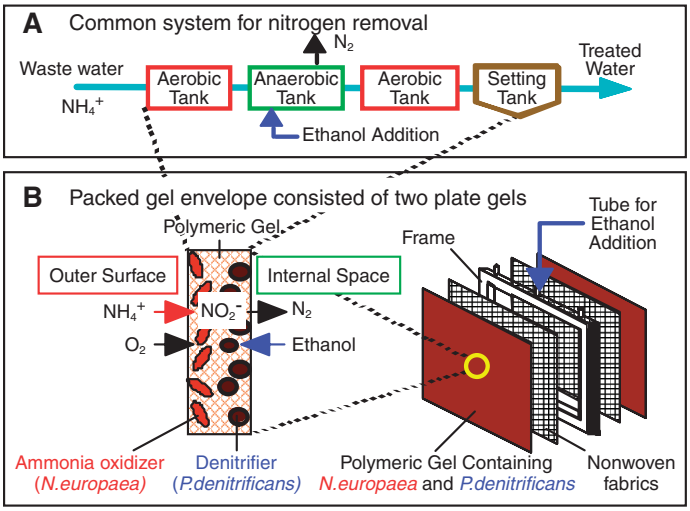
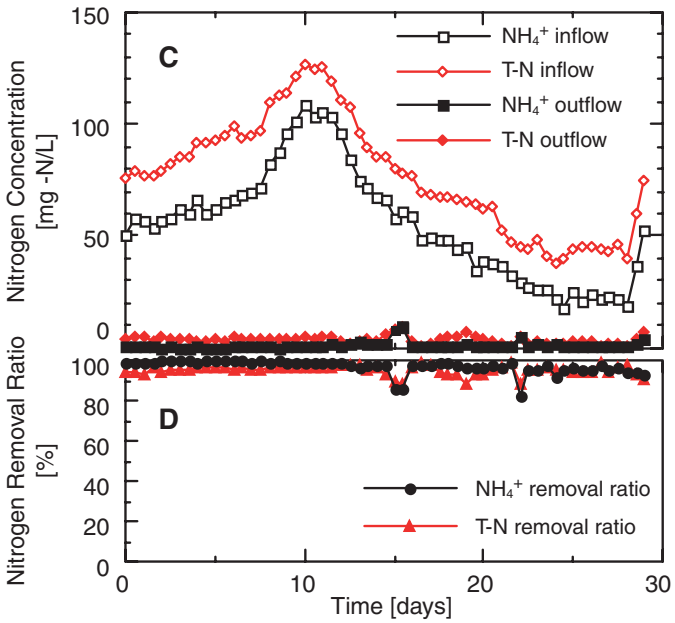


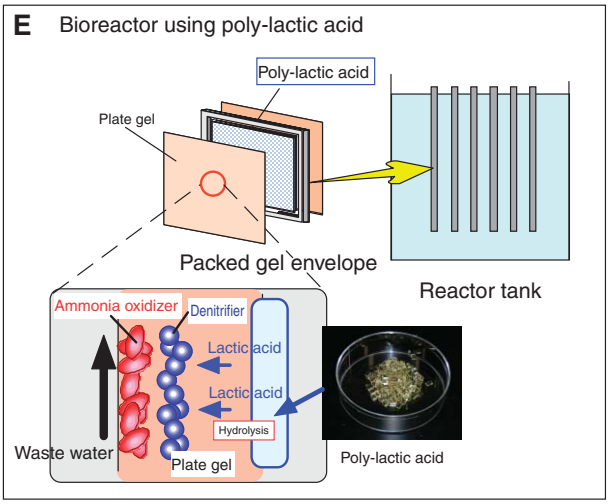
Fig.1 Common system for nitrogen removal(A) and our system using packed gel envelopes(B)

Photo.1 Large-scale system installed in thermal power plant



The common system (A) requires a large space for four complicated operations. Our packed gel envelopes can remove nitrogen in a single reactor tank, since both aerobic nitrification and anaerobic denitrification simultaneously occur in the envelope. Wastewater containing nitrogen in a thermal power plant was continuously treated with a large-scale system using the envelopes (Photo.1). The system could remove nitrogen for over one year.

Fig.2 Time-dependent changes of nitrogen concentrations(C) in inflow and outflow and nitrogen removal ratio(D) in ammonia-containing actual wastewater that occurred regularly



The compact bioreactor using poly-lactic acid is suitable to various uses, since it can remove nitrogen without additional pumps for ethanol supply.

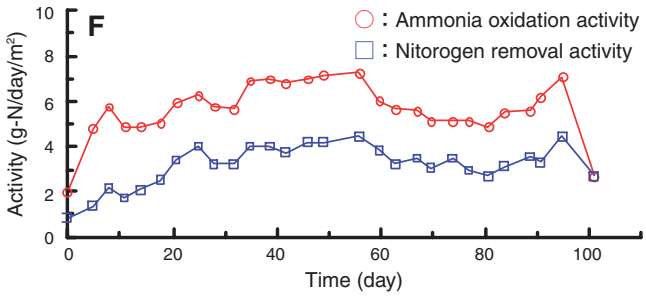


Fig.3 Bioreactor consisted of plate gel with poly-lactic acid(E) and time-dependent changes of activities of the plate gel(F)