

Promoting Further Energy-saving of Membrane Bioreactor (MBR)

(Research of FY 2017–2021)

1. Purpose

This study aims to:

- Develop a new MBR that has an exceeding energy-saving capability compared to the energy-saving target of the 4th public joint research, with less than 0.4 kWh/m³ power consumption unit per treated wastewater volume
- Establish the evaluation scheme of MBR performance, including energy-saving capability, required performance levels, and cost estimation methods

2. Outcomes of This Year

(1) Demonstration of MBR applied a new membrane cleaning method and treatment flow

Joint research on MBR system development for energy savings continued from the previous year. The demonstration has been completed, including MBR saving energy and costs by new membrane cleaning techniques with ozone water, and enabling a nitrogen removal rate of 90% or more with multiple-stage treatment flow.

(2) Defining the energy-saving performance of MBR

The results of the four joint research projects preceding

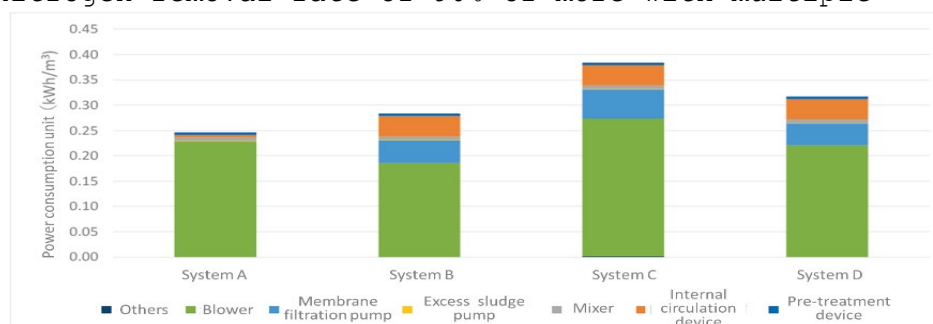


Figure 1: Estimation results for the energy consumption unit of four types of energy-saving MBRs

the above demonstration were integrated to clarify MBRs' energy-saving performance. The results are as follows.

- The conventional energy-saving method is to reduce the power consumption of mainly blowers.
- The estimation for the WWTP with 5,000 m³/d treatment capacity resulted in the electricity consumption per unit of treated wastewater ranging from 0.25 to 0.38 kWh/m³ under the condition of the average daily wastewater treatment volume, and MBR that can operate at 0.3 kWh/m³ or less becomes a reality (Figure 1).
- Longer membrane length and integration rate improvement are expected to reduce energy consumption and the construction cost of mechanical and electrical facilities.

(3) Collection and organization of MBR's membrane replacement history

A questionnaire survey was conducted targeting contractors of 15 MBR facilities that have operated for ten years to clarify the MBR's membrane replacement expense, which accounts for much of the costs.

The results are as follows.

- Seven facilities had not replaced their membrane ten years after starting operation. It became eleven when facilities with less than 10% accumulated replacement rate against footprints were included.
- Five facilities have replaced their membrane units 11 to 16 years after installation, based on the manufacturer's recommendation or average service life.

(4) Implementation of the third technical evaluation

The JS technical evaluation committee evaluated MBR for the following four points and published "The third report on the Membrane bioreactor: MBR's energy-saving performance and flow fluctuation adaptability."

① MBR's energy-saving performance

- ② MBR's adaptability to the flow fluctuation
- ③ Performance evaluation method of MBR
- ④ Membrane replacement history/records

3. Summary of the five years' research

In the five-year study, MBR systems enabling further energy-saving or highly efficient nitrogen removal were developed. Besides, to promote the practical application of MBR, the profitability evaluation conditions or consideration methods were studied, and a technical evaluation was conducted to determine its energy-saving ability and clarify the technical performance of MBR at this moment.

Keywords: **Membrane bioreactor, MBR, Energy-saving**