

# Re-evaluation of Disinfection Technology

(Research of FY 2017–2021)

## 1. Purpose

Ultraviolet (UV) disinfection has no residual effects like chlorination, and this feature has enhanced WWTPs, including large-scale facilities, to adopt UV disinfection for downstream water utilization and ecosystem preservation. On the other hand, the UV system has high power consumption and O&M costs for replacing UV lamps.

UV disinfection has been recognized as technology for small to medium-scale facilities since JS technology evaluation verified it in 1996\*. This study aims to investigate and re-evaluate the technological trend of UV disinfection and its operating procedures to reflect outcomes to technical standards.

\* Evaluation Report of the Latest Disinfection Technology (Japan Sewage Works Agency Technical Committee, 1996)

## 2. Outcomes of This Year

This year, researchers conducted a hearing survey to medium to large-scale facilities adopting UV disinfection for their operational conditions for years and a questionnaire about the technological trend of UV disinfection.

The hearing survey targeted three WWTPs chosen from municipal WWTPs with a treatment capacity of 10,000m<sup>3</sup> per day, which answered the previous year's questionnaire. The survey contained transitions of operational conditions and O&M costs, operation control procedures, and O&M issues.

The questionnaire targeted thirty-nine private companies, members of the Japan Sewage Treatment Plant Constructors Association for technology levels and development trends of UV disinfection. The valid response was seven companies that answered they have UV facilities.

Table 1: Results of hearing survey

	WWTP A	WWTP B	WWTP C
Disinfection facility overview			
Installation location	After sand filtration	After sand filtration	After sand filtration
Water conduction	Immersion at open channel	Immersion at closed conduit	Immersion at open channel
Lamp installation	Vertical, horizontal	Vertical	Vertical, horizontal
Radiation method	Inner illumination	Inner illumination	Inner illumination
Lamp kinds	Low-pressure mercury lamp	Low-pressure mercury lamp	Low-pressure mercury lamp
Number of water channels	12	3	3
Number of units	96	12	27
Design radiation volume (J/m <sup>2</sup> )	300	300	180 & 300
Operation and management status			
Inflow ratio against design inflow	80%	52%	70%
Lamp replacement status	Replace when lamp is dead	Replace when lamp is dead	Replace all lamps every 2 years
Power consumption per unit water volume (kWh/m <sup>3</sup> )	0.008-0.019 (2010-19)	0.018-0.057 (2005-19)	0.009-0.033 (2002-2019)
UV facilities' power consumption rate against the entire facility	1.7% as of 2018	3.6% as of 2017	4.1% as of 2018

(1) A Hearing survey for operational conditions of UV disinfection facilities

- The three WWTPs adopt two kinds of operation control procedures; UV irradiation's automatic control systems depend on the inflow volume and manual adjustment of the numbers of operation units at the low inflow volume.
- The manual adjustment reduced power consumption, which got to 0.008-0.018kWh/m<sup>3</sup>, less than 50% before adopting the manual procedure. Besides, the power consumption of UV facilities accounted for less than 5% of the whole WWTP (Table 1.)
- Three facilities use UV lamps beyond the recommended 1-1.5 durable year set by manufacturers because replacement cost is expensive.

(2) Hearing survey for UV disinfection facilities

- The respondents mentioned making a low-pressure mercury lamp high power and high efficiency as answers for R&D trends.
- Many answers showed that while recently focused Ultraviolet Light Emitting Diode (UV-LED) has been popular among water disinfection, it is too early to use for wastewater because of its low energy efficiency and high cost.

### 3. Future Schedule

The re-evaluation has inspired that UV disinfection system might reduce its power consumption, which is an issue, by adjusting unit numbers. It requires verifying such an operation's effect on the disinfection performance. The collaboration with domestic companies and universities will study the evaluation scheme of the disinfection effect and re-evaluate the technology from now on.

We sincerely appreciate WWTPs and Siset for their cooperation with the survey.

Keywords: **Ultraviolet disinfection, Energy saving, Ultraviolet Light Emitting Diode (UV-LED)**