

Re-evaluation of Disinfection Technology

(Research of FY 2017-2021)

1. Purpose

Ultraviolet disinfection has no residual properties like chlorination. So, from the perspective of water utilization and ecosystem protection in water destinations, many small scale WWTPs have adopted this disinfection system. Recently, more medium or large scale WWTPs are also getting adopting ultraviolet disinfection.

Ultraviolet disinfection technology has significantly improved in energy-saving and space-saving capabilities since technology evaluation of 1998*¹⁾. This study aims to re-evaluate the operating condition and disinfection effects of ultraviolet disinfection at the actual facilities and reflect the results to technology criteria.

2. Outcomes of past years

In 2017, a questionnaire survey was conducted about specifications, operation records of ultraviolet disinfection facilities.

3. Achievement of this year

Researchers conducted a hearing survey relating the operation status of ultraviolet disinfection facilities and investigated water quality to know the disinfection effect. The investigation targets ultraviolet disinfection facilities with a capacity of 10,000m³/day and over. Three WWTPs were selected among facilities adopting CAS or nutrients removal as their wastewater treatment processes except for advanced OD process.

Table 1 shows the results of the investigation.

(1) The result of hearing survey

Each facility sterilizes the whole quantity of treated water aiming to discharge by using low-pressure mercury lamps. Design Guidelines*2) provide the three designed values of ultraviolet radiation value, and coliform inactivity rates adapting each radiation value. In this survey, two WWTPs have ultraviolet radiation values of 150-200J/m² which is coliform

Table 1. Survey results

	Items	Classification	Unit	WWTP A	WWTP B	WWTP C
Results of hearing survey	Amount of discharged water	Actual value	m ³ /day	8,517	9,000	6,000
	Ultraviolet radiation value	Designed value	J/m ²	184	180	465
		Actual value		385	65	775
	Irradiation time	Designed value	Second	1.5	4.9	4.5
		Actual value		3.2	11.6	11.4
	Irradiation intensity	Designed value	W/m ²	120.0	37.1	102.5
		Actual value		120.0	5.6	68.3
	Number of lamps	Installed	piece	48	32	36
		Running		48	8	12
	Result of water quality survey	E.coli	Before disinfection	Piece/cm ³	77	15
After disinfection			36.5		1.5	1.5
Reduction rate			%		55	90
Number of coliform group		Before disinfection	Piece/cm ³	270	225	51
		After disinfection		105.5	8.5	2.0
		Reduction rate		%	62	96
SS		Before disinfection	mg/L	<1	4	3
CODcr		Before disinfection	mg/L	39	32	17
Ultraviolet transmittance		Before disinfection	%	70.6	78.9	81.1

Note 1: All items except for amount of discharged water is the average of 2 water samples

Note 2: E.coli and the number of coliform group describe the result of defined substrate method

inactivity rates of 90% and one WWTP has 300-500J/m² with 99.9%. Each value satisfied the designed value in the Design Guidelines. WWTPs control

ultraviolet radiation value by adjusting the number of running units, output power, or in some cases, adjusting depending on the number of coliform groups in discharged water.

Ultraviolet disinfection facilities have issues such as high costs including lamps, stabilizers, etc. and the reduction of power consumption.

(2) Results of water quality investigation

Disinfection water of each WWTP has UV transmittance of 70% and over which satisfies the standard value of Design Guidelines. Each number of coliform group in discharged water was much below than 3000/cm³, which is the standard of discharged water provided at Sewerage Law.

4. Future plan

Field survey will be continued in the next year to know the practical operation condition of ultraviolet disinfection facilities and collect data of disinfection effects, and re-evaluate ultraviolet disinfection technology.

We appreciate all staff of WWTPS for their cooperation with our field survey.

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

*2) Planning and Design Guidelines of Sewerage Facilities (Japan Sewage Works Association, 2009, 242-247)

Keywords: Ultraviolet disinfection, Radiation value of ultraviolet, Ultraviolet transmittance