ECOSET

EOL Series OPEN CHANNEL UV DISINFECTION SYSTEM

NEP 신제품인증 NEW EXCELLENT PRODUCT

ECOSET "A leading company of high-tech environmental engineering"

Ecoset developed open channel low-pressure, high-output ultraviolet (UV) disinfection system equipped with cleaning device operated by submersible rodless cylinder (EOL-HA Series) in 2005 and obtained Excellent Performance Certification from Korean government agency in 2009. Since then, Ecoset has installed UV system at many wastewater and reclaimed wastewater treatment plants in Korea.

In 2010, Ecoset has been conducting independent laboratory, called Hanyang University Applied Aerodynamics Lab, to produce optimal design of UV reactors through computational fluid dynamics (CFD) modeling and developed open channel low-pressure, high-output amalgam UV disinfection system with a motor-driven cleaning device (EOL-HM Series). In 2013, bioassay was validated in compliance with internationally recognized standard, Title 22 of California Water Recycling Criteria, and approved by California Department of Public Health (CDPH). Then, Ecoset obtained New Excellent Product (NEP) Certification by Korean government agency. With our Research & Development (R&D) expertise, we have completed all the required testing, including but not limited to quartz sleeve fouling and lamp aging tests, to prove performance of our UV disinfection system.






Title 22 Validation

· 2012. 08.	Completed Performance Verification Test at Fresno-Clovis Water Reclamation Plant in CA, USA
· 2013. 10.	Obtained approval from CDPH

CFD Modeling

· 2011. 05. ~ Present.	Conducted a third-party CFD laboratory
· 2011. 12.	Optimized UV System through CFD modeling

Fouling & Aging Test

· 2013. 11.	Completed Quartz Sleeve Fouling Test
· 2013. 12.	Completed Lamp Aging Test

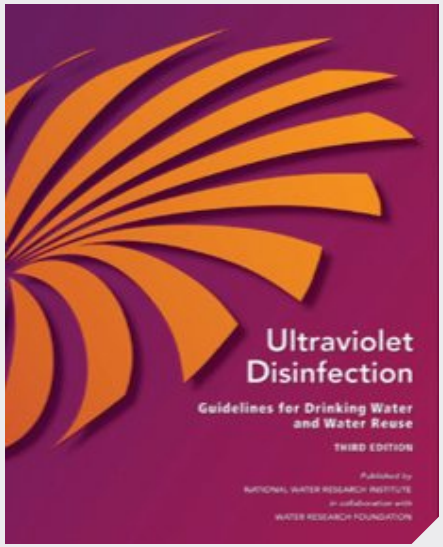
Patents

· 2011. 05.	Obtained a Patent for Open Channel UV Disinfection System
· 2014. 09.	Obtained a Patent for Open Channel UV Disinfection System with a Motor-Driven Automatic Wiper
- Present.	Many Other Patents

01

Title 22 Bioassay Field Test

- Complied with the latest 2012 NWRI Ultraviolet Disinfection Guidelines, Third Edition (20% more stringent than the previous edition).
- Validated bioassay in compliance with globally recognized guidelines and standards, such as NWRI UV Guidelines and Title 22 of California Water Recycling Criteria.
- Proved performance of UV reactor by achieving inactivation rate of non-pathogenic indicator microorganisms, T1 and MS2.
- Completed Title 22 validation for open channel UV disinfection system as the 4th UV disinfection system company in the world with an accredited engineering firm.
- Acquired NOL-HM Series conditional approval by CDPH in August 2013.



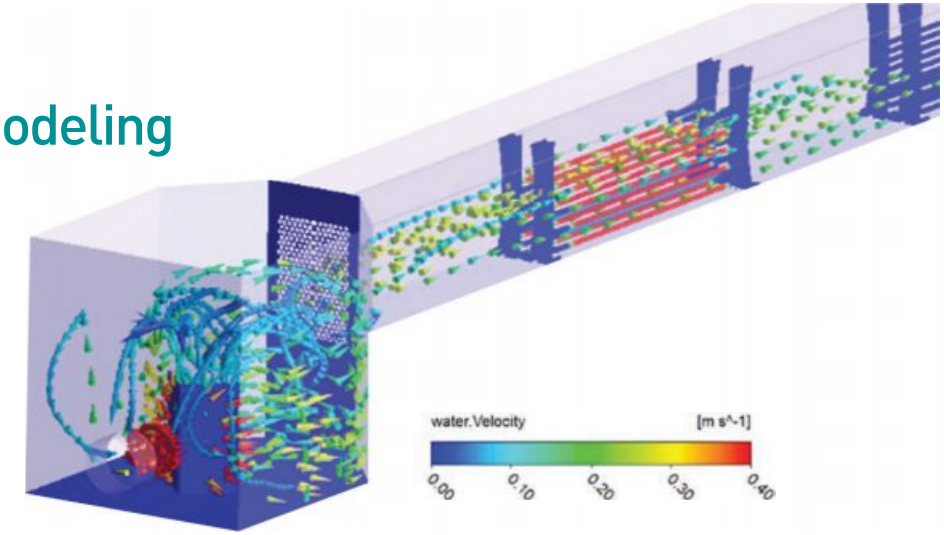
❶ NWRI Guidelines

❷ CDPH Approval Letter

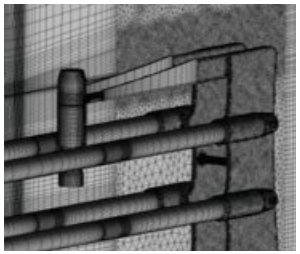
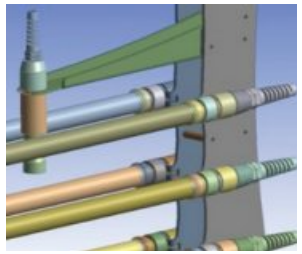
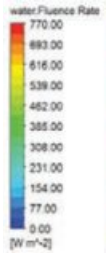
02

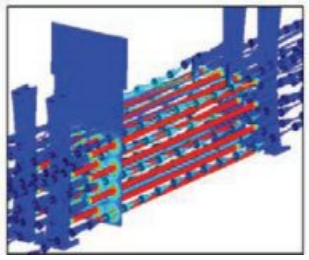
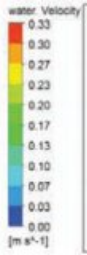
Computational Fluid Dynamics (CFD) Modeling

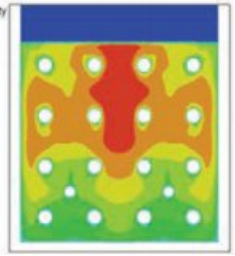
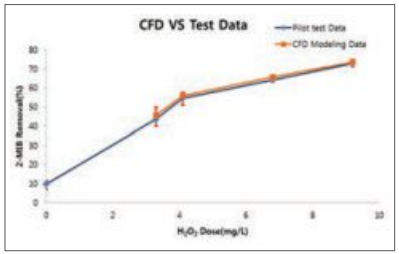
- Precise hydraulic calculation in numerical methods.
- Optimized UV disinfection system design through UV intensity, the lamp arrangement and angle, the module structure, baffle shape and position, the removal rate of target material simulation.
- Minimized head loss with CFD-based system design
- Proven optimized system design through comparison with the bioassay test results



Reactor Shape & Flow Rate → **CFD Analysis :** Fluent Analysis & Grid Generation
Lamp Output Water Conditions → **UV Analysis :** UV Fluence Calculation
→ Particle Tracking → Particle Dose Calculation → RED Calculation → Comparison with Validated Bioassay Test Results

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Fouling & Aging Factor Test

• Fouling Factor (FF) is the estimated fraction of UV light passing through a fouled sleeve as compared to a new sleeve.

FF = transmittance of a used quartz sleeve / transmittance of a new quartz sleeve

• Aging Factor or End of Lamp Life (EOLL) is the fraction of UV light emitted from aged sleeves and lamps compared to new sleeves and lamps

EOLL = UV intensity at the end of lamp life / UV intensity of a new lamp

• Design UV Dose = Reduction Equivalent Dose (RED) / Validation Factor (VF), where VF accounts for biases and experimental uncertainty

= Validated UV Dose (from bioassay test) x FF x EOLL

- Minimized fouling on sleeves using highly-effective automated cleaning device (mechanical or mechanical/ chemical automated wiping system).
- Long lamp life with low-pressure, high-output amalgam UV lamps.
- Excellent cleaning performance and lamp efficiency with FF of 0.92 and EOLL of 0.95 (completed by a third-party testing facility).
- Complete fouling factor and aging factor testing facilities.

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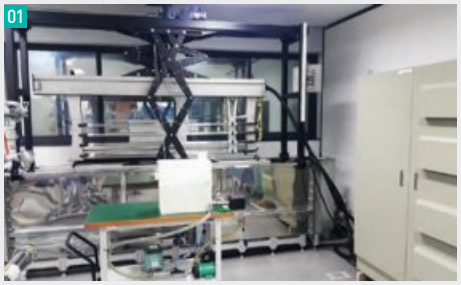

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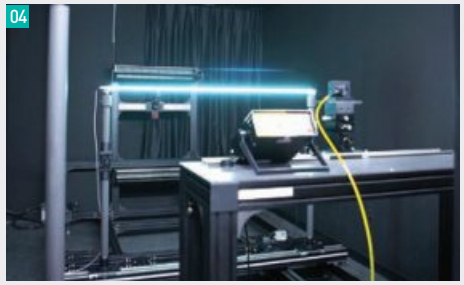

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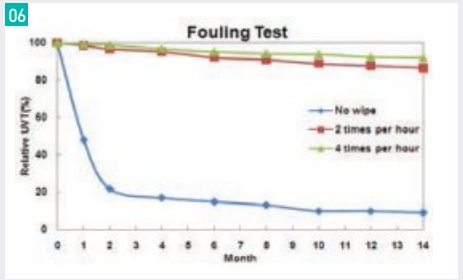

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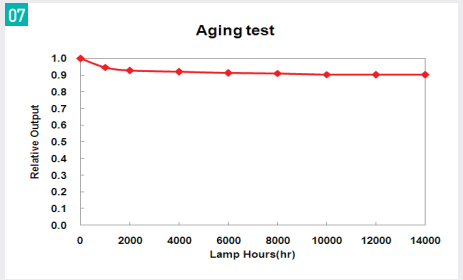
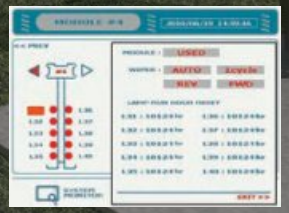


01. Fouling Factor Test Facilities
02. Quartz Sleeve Measuring Equipment
03. Aging Factor Test Facilities
04. Lamp Measuring Equipment
05. Test Report
06. Fouling Measurement Data
07. Aging Measurement Data

ECOSET UV EOL-H Series®

❶ System Control Panel(SCP)

The SCP enclosure contains devices required to control and monitor the overall system. It is equipped with PLC, user interface, input/output connections, communication devices, and other electric components. PLC integrates and processes all the data from each part of the system through user interface and/or readings of sensors and monitors, and controls the functions of the system including automatic sleeve wiper mechanism, level control system and dose pacing (automatic power level control).



❷ Power Supply Panel (PSP)

The PSP enclosure contains electronic ballasts to supply power to the arc tubes in the modules. It is placed either next to SCP or close to the modules spanning the open channel, depending on the site condition and design. Typically a bank of modules accompanies one PSP.

❸ Variable Output Electronic Ballast

BallastThe adaptive control of lamp output by intelligent electronic ballast enables the system to maintain the design dose regardless of changing flow rate or wastewater quality.

❹ On-Line UV Transmittance Monitor (Optional)

MonitorIn conjunction with intelligent electronic ballast, On-Line UV Transmittance Monitor enables the system to self-control the output coping with varying effluent quality. On-line transmit tance monitor measure the T10 value of effluent and transmit the signal to SCP for adjustment of electronic ballast output.

❺ Module Lift

LiftFor easy maintenance of module.

❻ Ultrasonic Level Sensor

Ultrasonic Level Switch monitors and water level and transmit the signal real-time to SCP so the system can control the LCS to maintain the water level within allowable limits.

❼ Level Switch

Level switch senses the water level beyond upper or lower limit and triggers alarm.

❽ UV Module

One or more UV modules mounting the arc tubes are installed in the open channel. Arc tubes are enclosed in the quartz sleeves so that the arc tubes do not contact water directly. Quartz sleeves are placed parallel to water flow. The number of lamps in a module and the number of modules per bank are optimized depending on water quality and quantity, and other site conditions.

❾ UV Intensity Sensor

Typically one bank of modules is equipped with one UV intensity sensor. This UV intensity sensor is positioned submerged above the top raw of arc tubes in a module. The intensity signal from the sensor is transmitted to UV intensity monitor in SCP, then converted into an analog signal for user interface and output connections. The submerged sensor probe is continuously wiped along with quartz sleeves by automatic sleeve wiper mechanism.

❿ Level Control System (LCS)

LCS is used to control the water level above the arc tubes to prevent either the excessive water depth above the top raw of arc tube breaking through the UV system untreated or too low water level causing bare arc tube above the water surface.

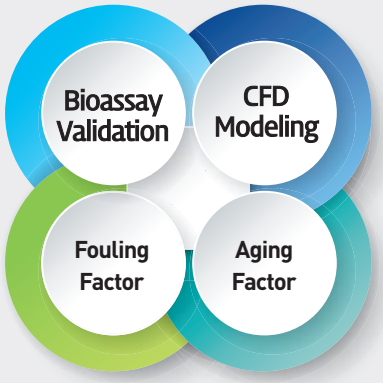
⓫ Automatic Sleeve Wiper Mechanism

Surfaces of quartz sleeves are bound to be contaminated by photochemical deposition. A mechanical sleeve wiper system is equipped in each module to clean the surfaces of quartz sleeves periodically. The cleaning frequency is adjustable through the user interface at SCP. Cleaning is achieved by the wiper ring that scrapes depositions off the quartz surface while the wiper body travels up and down the quartz sleeve. Wiper body is actuated by a motor driven lead screw.

04

UV System Design

- UV dose calculation from validated bioassay test data
- Optimized lamp arrangement through CFD modelling
- Complete system design with extracted test data of aging & fouling factor
- Wide range of design parameters from varying operating conditions such as range of flow rates, effluent quality.



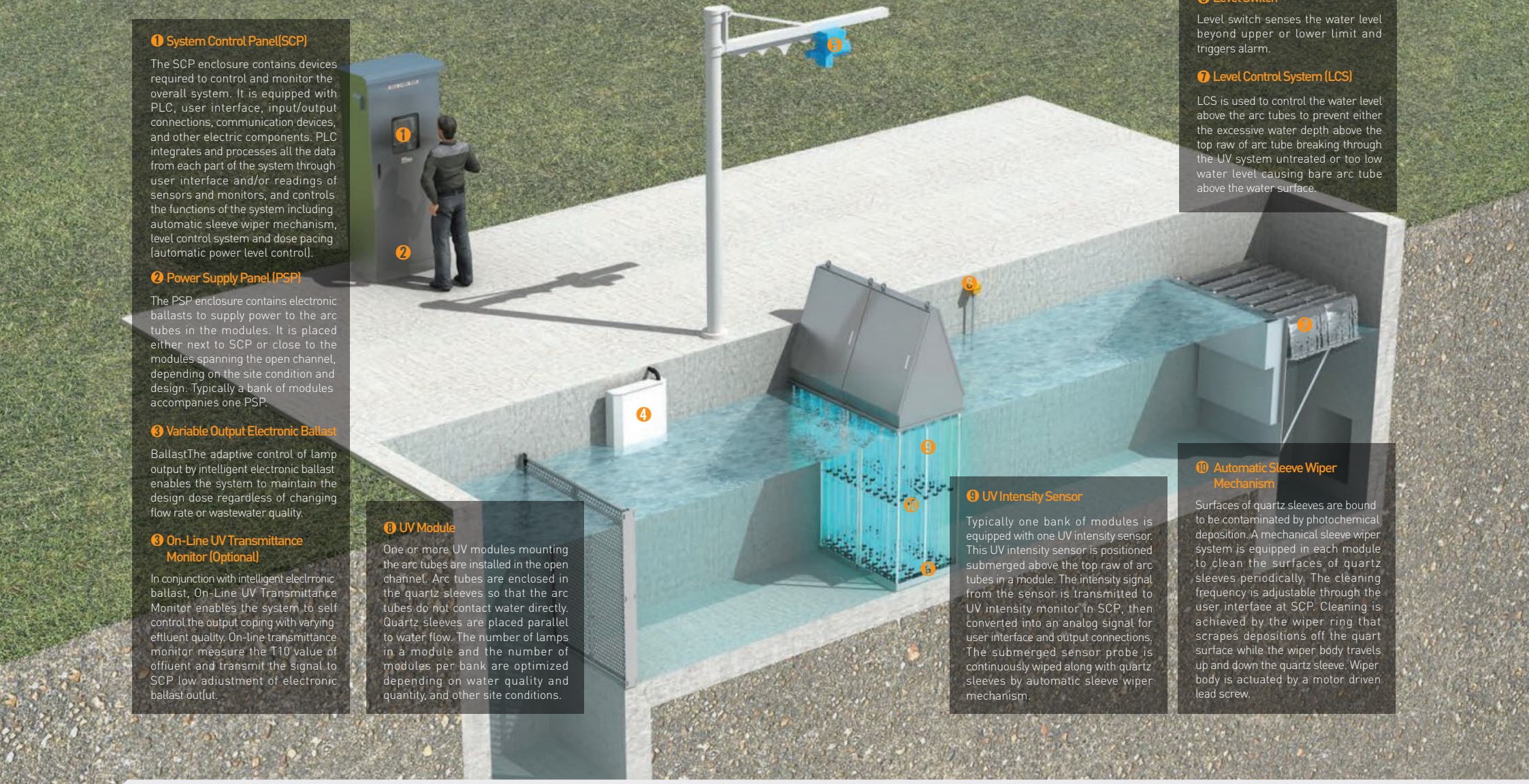
Optimal UV System Design

STANDARD FEATURES OF ECOSET UV EOL Series

	ECOSET EOL-H Series®	ECOSET EOL-V Series®
System General Features		
Typical Application	Small to large plants	Small to medium plants
Lamp Configuration	Horizontal, Parallel to flow	Vertical, Perpendicular to flow
Module Configuration	2 to 16 lamps per module	
Bank Configuration	Up to 15 modules per bank	Up to 2 modules per bank
Banks in Series	Up to 4 banks per channel	Up to 8 banks per channel
Water Level Control (Optional)	ALC(Counterbalanced Level Control Gate) or Motorized Weir Gate or Fixed Weir	
Module Specification		
Material	STS304 / STS316 / STS316L	
Lamp Type / Input power pe	Low Pressure, Amalgam / 320 Watts	Low Pressure, Amalgam / 240 Watts or 320 Watts
Cleaning System	Electric Motor-driven Automatic Wiper Mechanism with Limit Switches (Optional pneumatic wiper mechanism available)	
Monitoring Device	UV intensity monitor, level sensor	
Operating Water Temperature	+5°C- +45	

	ECOSET EOL-H Series® / V Series®
System Control Panel (SCP)	
Material	Painted Steel, STS304, STS316
Protection Rating	IP54/NEMA 4
Controller	PLC
Customer Inputs	4-20 mA flow signal for flow pacing
Typical Outputs	Lamp status, Module status, Alarms, Analog UV intensity, UV dose and RS485 communication
Voltage / Frequency	220V, Single phase, 2wire / or 120V, Single phase, 2wire / 50/60Hz
Operating Temperature	+0°C-+50°
Location	Indoor or outdoor
Power Supply Panel (PSP)	
Material	Painted Steel, STS304, STS316
Protection Rating	IP54/NEMA 4
Ballast Type	Variable output electronic ballast
Cable Length PSP to Module	Max. 5m
Operating Temperature	+0°C-+50°
Location	Indoor or outdoor

ECOSET EOL-V Series®



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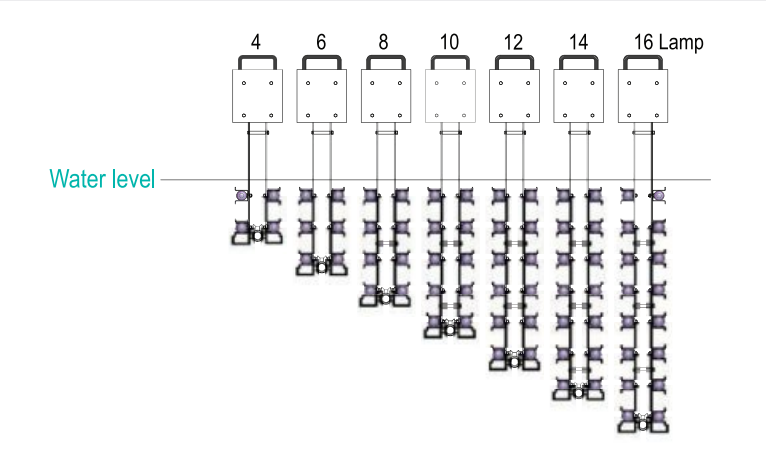
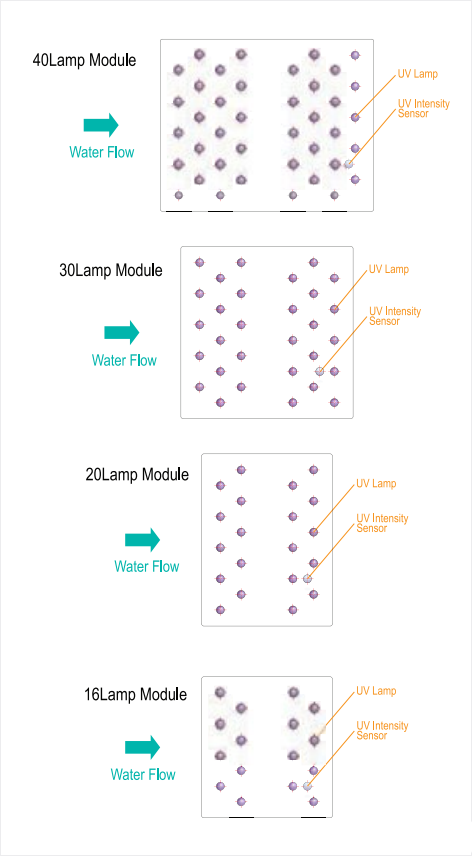
05

Structure of Open Channel UV Disinfection System Module

ECOSET EOL-H Series®



ECOSET EOL-V Series®



06

Reference Lists

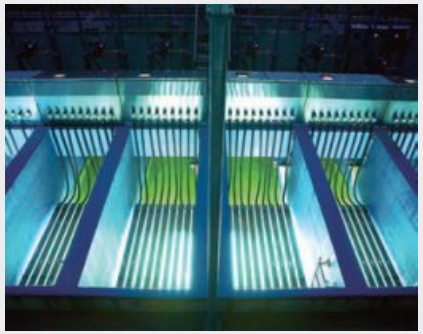
※ More than 1,000 installation records

Year	Project	Capacity	Year	Project	Capacity
2022	• Godeok WTP Stage 2 • KEPCO KPS AOP • Giheung Lespia STP • Granbury WWTP • 95 other sites	75,680㎥/day 60,000㎥/day 13,640㎥/day	2012	• Gwangju WTP 1st 2nd Stage • Jinyoung Cleear Water Circulation Center • Geumwang Industrial Complex • 155 other sites	750,000㎥/day 19,000㎥/day 4,320㎥/day
2021	• Jeonju WTP • ILSAN UV-AOP • Port Douglas WWTP(Australia) • 100 other sites	303,000㎥/day 125,000㎥/day 10,379㎥/day	2011	• Daegu Dalseocheon WTP • Kyungsan WTP • 91other sites • Gwanggyo New Town Water Circulation System	141,700㎥/day 40,000㎥/day 35,000㎥/day
2020	• Sihwa MTV Turtle Island Swimming Pool • Gaya Public Sewage • Gajo STP • 95 other sites	43,000㎥/day 10,000㎥/day 5,500㎥/day	2010	• Gapcheon Water Circulation • Yesan STP • Dunpo STP • 121 other sites	30,000㎥/day 22,000㎥/day 2,900㎥/day
2019	• Seoksu STP • Geomdan WTP • Grapevine STP • 90 other sites	225,000㎥/day 69,000㎥/day 47,000㎥/day	2009	• Danghyeoncheon Stream (Seoul) • Jaundae STP • Seocheon Janghang STP • 106 other sites	36,000㎥/day 9,600㎥/day 4,000㎥/day
2018	• Joongang WTP (Busan) • Timberlands STP (USA) • Santo Doming STP (Ecuador) • 100 other sites	120,000㎥/day 21,000㎥/day 20,000㎥/day	2008	• Jinju WTP • Kyeongju WTP • Samcheonpo WTP • 86 other sites	150,000㎥/day 110,000㎥/day 43,000㎥/day
2017	• Suyoung WTP Steps 1 and 2 • Gumi Expansion Complex WTP • Jangnyang STP (Pohang) • 64 other sites	240,000㎥/day 14,300㎥/day 6,000㎥/day	2007	• Jinju Daegok WTP • Gonggeun STP • Chinsori STP • 64 other sites	2,600㎥/day 1,560㎥/day 1,000㎥/day
2016	• Anyang Bakdal WTP • Godeok WTP • Haeundae WTP • Bonham Taxas WWTP • 83 other sites	250,000㎥/day 101,938㎥/day 65,000㎥/day 27,256㎥/day	2006	• Naju WTP • Inju Industrial Complex • Nammyeon STP • 56 other sites	22,500㎥/day 3,000㎥/day 1,000㎥/day
2015	• Hyundai Steel Water Supply and Drainage Building • City of Waverly, Rocky Mount • Ocean Power - Kunyi (China) • 65 other sites	140,400㎥/day 1,893㎥/day 1,080㎥/day	2005	• Yeoju WTP • Namak New Town WTP • Daecheon Beach WTP• 45 other sites	15,000㎥/day 12,000㎥/day 11,000㎥/day
2014	• Gumi WTP • Wood heights(USA) • Gumi WTP • 102 other sites	330,000㎥/day 7,500㎥/day 3,000㎥/day	2004	• Suncheon WTP • Yangsan WTP • Hwado WTP • 65 other sites	130,000㎥/day 117,000㎥/day 25,000㎥/day
2013	• Zhengzhou (China) WTP • Gumi WTP 4th Stage • Yongin Respia WTP • las lajas Puerto rico SWT • 95 other sites	130,000㎥/day 50,000㎥/day 48,000㎥/day 5,600㎥/day	2000~2003	• Anyang WTP • Dogye WTP • Gurye WTP • 95 other sites	37,500㎥/day 10,000㎥/day 5,500㎥/day

07

Sewage & Wastewater Treatment

Gwangju (KOR)



SYSTEM DESIGN PARAMETERS

Peak Design Flow : 200 MGD
Model : 320W x 16 Lamp x 64 Module
UV Transmittance (UVT) : > 70% UVT
Disinfection Limit : Non-detect E.Coli

Bonham, TX (US)

SYSTEM DESIGN PARAMETERS

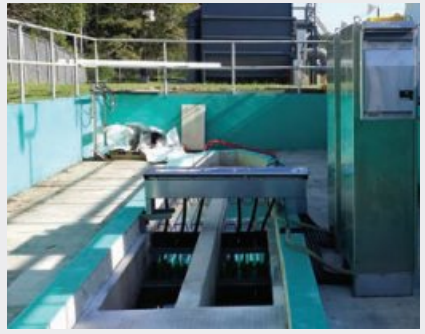
Peak Design Flow : 7.2 MGD
Model : 320W x 16 Lamp x 6 Module
UV Transmittance (UVT) : > 65% UVT
Disinfection Limit : 34mJ/cm2

Gumi (KOR)

SYSTEM DESIGN PARAMETERS

Peak Design Flow : 87.2 MGD
Model : 320W x 14 Lamp x 30 Module
UV Transmittance (UVT) : > 70% UVT
Disinfection Limit : < 1,000 MPN/ml

Pas Lajas, PR (US)



SYSTEM DESIGN PARAMETERS

PeakDesignFlow : 1.5 MGD
Model : 320Wx6Lampx6Module UV
Transmittance (UVT) : > 80% UVT
Disinfection Limit : 40mJ/cm2

Dec 2022

www.ecoset.co.kr

ECOSET

본사 | 서울특별시 송파구 문정동 642-3 문정에스케이브이원지엘메트로시티 5층 517호 **T** 02-3018-5000 **F** 02-517-5378
연구소 및 제 1공장 | 경기도 안산시 단원구 엠티브이1로 163번길 15
제 2공장 | 충청남도 당진시 석문면 산단3로4길 22
제 3공장 | 대구광역시 달성군 구지면 응암리 1282-9 (대구국가산업단지 물산업클러스터)