

# Aquaculture

Ultraviolet Systems  
for Water Disinfection



# Biosafety is the Formula for Your Success in Production

Aquaculture is the fastest growing industry in the global food production.

However, the rapidly increased aquaculture livestock comes with the risk of pathogen outbreaks which have already caused serious economical and ecological disturbances in many countries.

To avoid the risks of introducing and spreading of infectious diseases, aquaculture should be grown under controlled water quality conditions. Therefore a high level of biological safety is the key priority for the aquaculture industry. The current biosafety programs aim at eliminating pathogenic microorganisms from the aquaculture environment. Biosafety programs in aquaculture can offer two main approaches to protect aquatic population:

- External barriers which prevent intrusion of infectious microorganisms into the aquaculture plant or prevent infection from a farm to the environment;
- Internal barriers which block the spread of pathogens within the aquaculture plant.

UV disinfection is one of the basic components of the water safety system providing both external and internal barriers for treatment of:

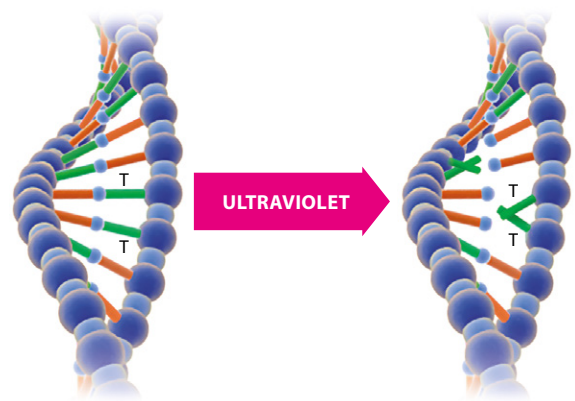
- make-up water
- circulating water in recirculating aquaculture systems (RAS)
- aquaculture wastewater including quarantine pools
- process- and production wastewater

According to the UNO today almost 50% of the consumed fish and seafood are farmed.

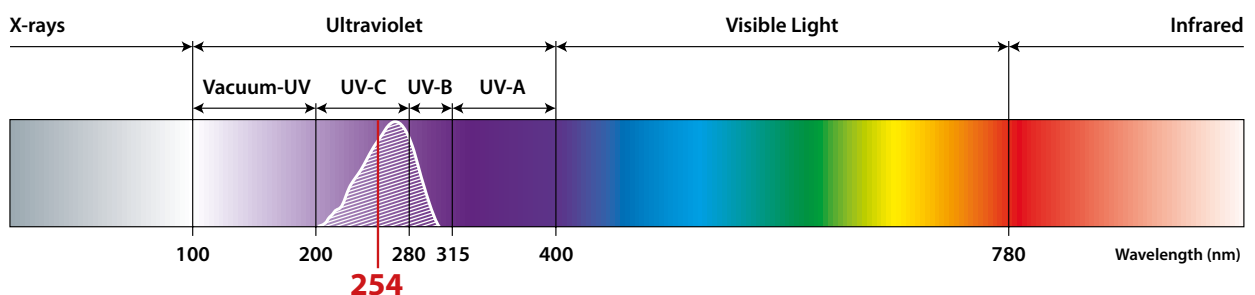
**!** In 2016, Early Mortality Syndrome (EMS) affected the Thailand aquaculture throwing the country from the first to the fourth place in shrimp production volume. The mortality of EMS outbreaks can exceed 70%. Annually losses caused by EMS amount to about one billion US dollars.

## How does the UV Technology Work?

Ultraviolet is a physical method of water treatment which achieves the required level of disinfection and does not add any substances or chemical agents to the water. UV photons are absorbed by DNA and RNA chains of pathogens preventing their reproduction and the spread of infections.



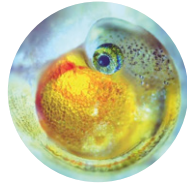
### Ultraviolet in Electromagnetic Spectrum



## LIT UV Systems Operate at



Aquaculture farms



Hatcheries



Live fish carrier



Fish-processing plant

## Your Challenges – Our Solutions

Challenge	Risks and Consequence	LIT UV Solution
<ul style="list-style-type: none"> <li>Infection of livestock through water</li> </ul>	<ul style="list-style-type: none"> <li>mass mortality of young stock</li> <li>decreased growth rate, damage of appearance</li> <li>increased mortality rate of adult stock</li> </ul>	<ul style="list-style-type: none"> <li>UV technology ensures an effective disinfection of all kinds of infectants including chemical resistant microorganisms such as protozoa cysts</li> <li>stable microbial level, reduced mortality of young stock, increased production volumes</li> </ul>
<ul style="list-style-type: none"> <li>Space-limited breeding conditions</li> </ul>	<ul style="list-style-type: none"> <li>stress and increased susceptibility to diseases</li> </ul>	<ul style="list-style-type: none"> <li>reduces risks of infection spread even when stock density is high</li> </ul>
<ul style="list-style-type: none"> <li>Use of antibiotics and other drugs, vaccination</li> </ul>	<ul style="list-style-type: none"> <li>toxic lesion of liver, kidneys and other organs of cultured aquatics</li> <li>risk of overdosing</li> <li>high cost of medications</li> <li>superinfection and new microorganisms resistant to antibiotics</li> <li>negative impact on the environment and human health</li> </ul>	<ul style="list-style-type: none"> <li>no side-effects and no risk of overdosing</li> <li>savings on vaccination and antibiotics</li> <li>possibility to produce organic products</li> </ul>
<ul style="list-style-type: none"> <li>Use of oxidants (ozone and others)</li> </ul>	<ul style="list-style-type: none"> <li>gills destruction</li> <li>lesion of internal organs and livestock death</li> </ul>	<ul style="list-style-type: none"> <li>avoids the negative effects of oxidation technologies</li> </ul>
<ul style="list-style-type: none"> <li>Wastewater of farms and fish-processing plants</li> </ul>	<ul style="list-style-type: none"> <li>infection of the environment</li> <li>high fines</li> <li>business reputation risks</li> <li>advanced costly wastewater treatment required to comply with discharge limits</li> </ul>	<ul style="list-style-type: none"> <li>UV disinfection systems have an instant effect against a broad spectrum of microorganisms and viruses including chlorine resistant ones</li> <li>no risk of overdosing and no by-products</li> <li>no need for storage and handling of disinfectants.</li> <li>no impact on the environment</li> <li>does not require removal of pharmaceutical residuals from the wastewater</li> </ul>

## Advantages of LIT UV Systems

- High level of disinfection (3-4 logs reduction) without chemical agents, no change of water properties, no risk of overdosing and no formation of by-products or toxins
- compact design and easy operation, unlimited capacity
- made of stainless steel AISI 304, 316, 316L, duplex, superduplex
- equipped with LIT high-output power efficient low pressure amalgam lamps (up to 1000 W) with UV c efficiency ~ 40% and lamp life of 16,000 hr
- certified according to the international standards ÖNORM, DVGW, US EPA, Norwegian Veterinary Institute.

### LIT UV systems operate in

- fresh water
- brackish water
- sea and salt water

### LIT UV systems disinfect

- make-up water
- circulating water
- process water
- wastewater

## Criteria for Effective Disinfection

### Microorganisms

When selecting a UV system, it is essential to know the potential disease which UV disinfection is intended to prevent.

### UV dose

The required UV dose depends on the type of a pathogenic microorganism and indicates the amount of UV power necessary for effective disinfection. That is why the applied UV doses in aquaculture ranges widely. An applied UV dose of 45 mJ/cm<sup>2</sup> is according to the Norwegian standard, which is effective against the development and spread of the common aquaculture pathogens. More resistant pathogens require higher UV doses (45-320 mJ/cm<sup>2</sup>).

The UV dose can vary during operation due to fouling of quartz sleeves, fluctuation of the flow rate and water quality. For that reason the equipment should be designed to provide the required dose when all unfavorable factors are present (peak design flow rate, minimum UV transmittance, maximum sleeve fouling at the end of the effective lamp life).

### Maximum Design Flow Rate (capacity)

To assure a continues disinfection process, it is necessary to consider the peak design hourly flow rate.

### UV transmittance (UVT)

UV transmittance (UVT) is used to define water transparency at the UV spectrum. The UV transmittance can be derived from some water quality parameters or measured by special UV measurement devices. The UV transmittance of water in aquaculture applications generally varies from 50% to 95%. The minimum value of the UV transmittance should be used for the UV system selection.

When considering this disinfection design philosophy, safe water is assured in all cases.

Microorganisms	UV dose, mJ/cm <sup>2</sup>	Vulnerable
<b>Bacteria</b>		
<i>Aeromonas salmonicida</i>	5	Salmons
<i>Pseudomonas fluorescens</i> (Fin Rot)	5	Carps, perchs, salmons
<i>Yersinia ruckeri</i>	5	Salmons
<i>Listeria monocytogenes</i>	45	Salmons
<i>Streptococcus</i> sp. (seawater)	45	Perciforms, salmons
BKD (Bacterial Kidney Disease)	60	Salmons
<i>Flavobacterium psychrophilum</i> (Salmonid Bacterial Coldwater Disease)	126	Salmons
<i>Vibrio</i> sp. (oyster)	155	Molluscs, crustaceans, salmons, cods
<i>Vibrio parahaemolyticus</i> (EMS)	240	Shrimps
<b>Protozoa</b>		
<i>Ceratomyxa shasta</i>	30	Salmons
<i>Trichodina</i> sp.	35	Carps, salmons
<i>Myxobolus cerebralis</i> (TAMs, Whirling Disease)	40	Salmons
<i>Sarcina lutea</i> ( <i>Micrococcus luteus</i> )	45	Salmons
<i>Perkinsus marinus</i> (dermo disease)	45	Bivalvia
<i>Ichthyophthirius multifiliis</i> (Freshwater White Spot)	100	Fresh-water fish
<i>Amyloodinium ocellatum</i>	105	Perciforms, mullets
<i>Trichodina nigra</i>	159	Many species
<i>Cryptocaryon irritans</i> (Marine White Spot)	280	Many species
<i>Costia necatrix</i>	318	Carps
<b>Viruses</b>		
CCV (Channel Catfish Virus)	5-20	Catfishes
ISA (Infectious Salmon Anemia)	10	Salmons
VHS (Viral Hemorrhagic Septicemia)	10	Fresh- and sea- water fishes of the Northern hemisphere including rainbow trout and other salmons
IHNV (Infectious Hematopoietic Necrosis)	10	Salmons
OMV (Oncorhynchus Masou Virus)	20	Salmons
KHV (Koi Herpesvirus)	45	Carps
CSV (Chum Salmon Virus)	100	Salmons
AHNV (Atlantic Halibut Nodavirus)	105	Flatfishes
IPNV (Infectious Pancreatic Necrosis Virus)	125-246	Salmons
WSS (White Spot Syndrome)	300	Shrimps
<b>Fungi</b>		
<i>Saprolegnia diclina</i> (zoospores)	45-170	Cods, salmons

## Equipment Selection, Design and Operational Aspects

In our technical solutions we rely on the company's long-term experience and global trends in aquaculture. We realize that each enterprise is unique and our team will provide the best UV solution.

LIT UV system designs focus on the principles of easy installation, operation and maintenance. Our priority is to provide equipment which can easily be integrated in your water treatment processes.

The better and most common place of installation of a UV system is right after the filters, degasifiers and just before water supply to the breed culture. This approach provides the required disinfection level with minimum costs.

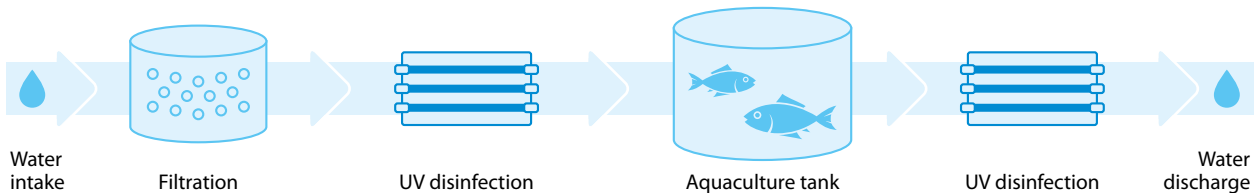
Small head losses make it possible to integrate UV equipment into water supply lines, both pressurized or gravity flow. The UV equipment is suited for various types of water supply systems including direct flow and recirculating aquaculture systems (RAS).

UV systems can be installed into existing and new aquaculture plants. UV disinfection is the final stage for wastewater treatment (after secondary and tertiary treatment). During UV installation air pockets should be avoided (air-vent may be used after the UV system). Also make sure that the necessary service area is available for access to the UV equipment and stop valves, in order to replace UV lamps and quartz sleeves. Using the UV system equipped with an UV sensor provides control of the disinfection process.

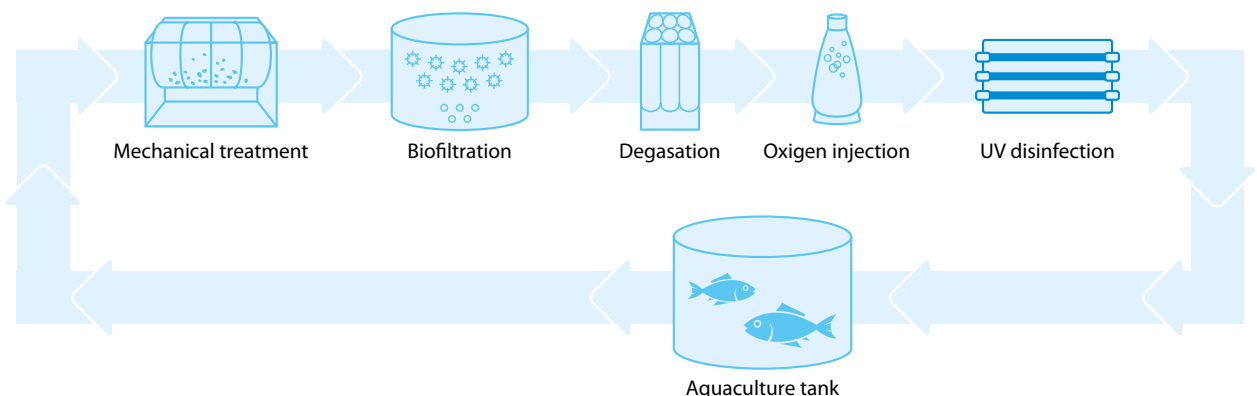
Operating costs usually imply UV lamp replacement once every 1,5-2 years. Lamp replacement is a simple procedure which generally can be easily handled by plant personnel.

## UV System Installation

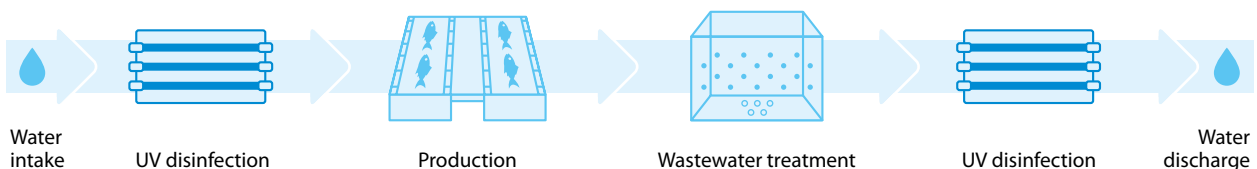
### Flow systems/ Direct flow systems



### Closed systems/ Recirculating aquaculture systems (RAS)



### Fish processing



# UV Systems for Aquaculture Farming and Fish Processing

## DUV-N Series



- make-up, circulating, process and wastewater
- closed vessel UV systems with maximum capacity up to 420 m<sup>3</sup>/hr
- UV systems are made of special corrosion-proof steel for salt and sea water
- certified monitoring system, mechanical cleaning system, control panel with touch display, remote control and monitoring suited for SCADA, dose pacing system are optional
- amalgam UV lamps with lamp life of 16,000 hr

## DUV-B, DUV-E, DUV-K Series



- make-up, circulating, process and wastewater
- closed vessel UV systems with maximum capacity up to 3,200 m<sup>3</sup>/hr equipped with certified monitoring system
- UV systems are made of special corrosion-proof steel for salt and sea water, considering chlorides concentration in water
- mechanical cleaning system, control panel with touch display, remote control and monitoring suited for SCADA, dose pacing system are optional
- amalgam UV lamps with lamp life of 16,000 hr

## DUV-A Series



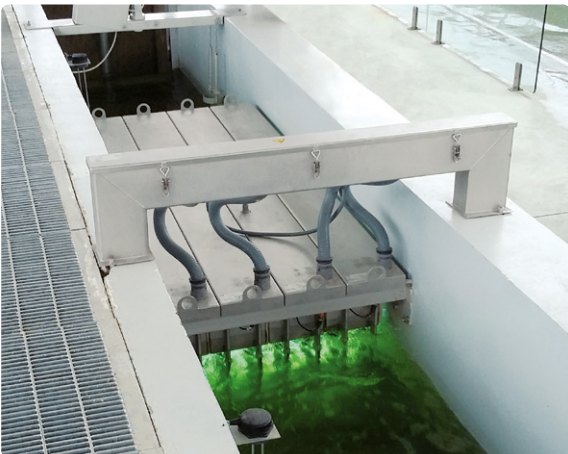
- make-up, circulating, process and wastewater of high quality (UVT > 85%)
- closed vessel UV systems with maximum capacity up to 620 m<sup>3</sup>/hr equipped with certified monitoring system
- UV systems are made of special corrosion-proof steel for salt and sea water, considering chlorides concentration in water
- mechanical cleaning system, control panel with touch display, remote control and monitoring suited for SCADA, dose pacing system are optional
- amalgam UV lamps with lamp life of 16,000 hr

### MLV Series



- make-up, circulating, process and wastewater in gravity (horizontal) water supply lines
- vertical UV lamps arrangement
- open channel module UV systems with low headloss are equipped with mechanical cleaning system and unique monitoring system
- UV systems are made of special corrosion-proof steel for brackish, salt and sea water
- control panel with touch display, remote control and monitoring suited for SCADA, dose pacing system are optional
- amalgam UV lamps with lamp life of 16,000 hr

### MLP Series



- make-up, circulating, process and wastewater in gravity (horizontal) water supply lines
- horizontal UV lamps arrangement
- open channel module UV systems equipped with mechanical cleaning system and certified monitoring system
- UV systems are made of special corrosion-proof steel for brackish, salt and sea water
- control panel with touch display, remote control and monitoring suited for SCADA, dose pacing system are optional
- amalgam UV lamps with lamp life of 16,000 hr



### LIT UV is the Best Choice

LIT is a global expert in application of UV technologies for water disinfection. Over 8,000 large-scale LIT UV systems are installed in 42 countries world wide.

LIT owns Research Centers for development and improvement of UV sources and UV systems, as well as Production Centers for manufacturing of amalgam UV lamps and UV equipment.

LIT R&D and Design Departments enable us to customize standard equipment and produce tailor made equipment upon your request.

By purchasing LIT UV systems you get safe and reliable world-leading equipment certified according to the international standards ÖNORM, DVGW, US EPA, Norwegian Veterinary Institute.

We provide consulting for equipment selection, technical support during the operation and service. Also, we provide individual training on the supplied UV equipment and the particular project features for secure water supply.

LIT's experts select all necessary UV equipment and provide the optimal layout to assure the most reliable and cost effective solution for your specific project. Please contact us for secure water supply.

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