1 Dulcodes UV Systems

1.1 General Notes On UV Treatment

Disinfection is a fundamental step in modern water treatment. UV disinfection is being used to an ever increasing extent here, as a safe, chemical-free and reliable disinfection process. Extensive research projects and numerous trouble-free operational systems prove the safety and reliability of UV disinfection.

With UV disinfection, the water to be disinfected is irradiated with ultraviolet light, which involves a purely physical, chemical-free process for water disinfection.

UV-C radiation in particular, with a wavelength in the 240 to 280 nm range, attacks the vital DNA of the bacteria directly. The radiation initiates a photochemical reaction and destroys the genetic information contained in the DNA. The bacteria lose their reproduction capability and are destroyed. Even parasites such as Cryptosporidia or Giardia, which are extremely resistant to chemical disinfectants, are efficiently reduced.

The initiation of photochemical reactions is utilised in other applications too. The undesirable combined chlorine in swimming pool water is reduced by UV radiation, as a result of which enormous fresh water savings are achieved. Oxidants such as ozone, chlorine or chlorine dioxide are reliably reduced in the production water used in the food and beverages industry, avoiding the need for costly activated charcoal filters.

Special version systems with special lamps and special composition of the radiation chamber can be used for reduction of TOC (Total Organic Carbon) in the treatment of ultrapure water.

UV disinfection has many advantages:

- Immediate and safe destruction of the bacteria without addition of chemicals
- Photochemical reduction of undesirable substances
- No THM or AOX formation, no formation of other undesirable substances
- No impairment of odour or taste of the water
- No storage and handling of chemicals required
- Effect is independent of pH
- No reaction vessel or reaction tank required
- Low space requirement
- Low investment and operating costs with high reliability and efficiency

1.2 Applications Of Dulcodes UV Systems

A large number of UV disinfection systems have been supplied worldwide, for the most diverse applications:

- **Own source water suppliers and municipal water works**
  for disinfection of drinking water
- **Food and beverages industry**
  to destroy the bacteria in the water needed for food and beverages production and for disinfection of service water
  to reduce the chlorine dioxide in the production water
- **Pharmaceuticals and cosmetics industry**
  to maintain the high microbiological requirements of the production water
  to destroy residual ozone in the production water without use of activated charcoal filters
- **Reverse osmosis plants**
  for permeate disinfection
- **Municipal sewage plants**
  for reduction of the bacterial count in the sewage plant outflow
  for reduction of the bacterial count in the industrial water extracted from the sewage plant outflow
- **Horticulture**
  for disinfection of the irrigation water
- **Spa pools and swimming pools**
  for disinfection of the pool water
  for chloramine reduction in the pool water
- **Semiconductor industry**
  for reduction of TOC and to maintain the high microbiological requirements of the production water

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Basically, Dulcodes UV disinfection systems consist of:

- High-quality radiation chambers made from stainless steel (DIN 1.4404 or ANSI 316 Ti) or UV-resistant plastic
- Lamp protection tubes made from high-quality quartz, easily removable for cleaning purposes
- Lamps with a particularly high UV output in the 254 nm range, ensuring an outstanding disinfection characteristic
- Highly selective UV sensors with good long-term and temperature stability
- UV system controllers and modern electronic ballasts fitted in a control cabinet

The special features of our Dulcodes UV disinfection systems are:

- Even irradiation of the entire water flow through optimised system hydraulics, so ensuring outstanding disinfection results
- Flow-optimised inlet zone
- Longitudinal flow against UV lamps with high turbulence
- Use of UV lamps with long service life and high UV-C output
- Automatic cleaning system for the sleeve of medium-pressure lamps
- System controller with comprehensive monitoring and reporting functions
- Display of all important operating parameters and reporting of faults in plain text
- Trend display of the variation of the UV sensor signal with time
- Analogue output sensor signal and alarm relay
- Use of modern electronic ballasts with bus technology for lamp-friendly ignition and operation
- Individual lamp monitoring
- Direct control of automatic isolation and flushing valves

1.3.1 Dulcodes UV Lamps

Standard low pressure lamp

Robust low-pressure mercury lamp with a life expectancy of approx. 10.000 to 14.000 operating hours. The operating temperature of the lamp is 30-50 °C, so its use is limited to water temperatures between 5 and 40 °C. The output is approx. 100 W per metre of arc length.

High-Flux low pressure lamp

Low pressure amalgam lamp with a life expectancy of approx. 8.000 operating hours. The operating temperature of the lamp is 100-130 °C, so that it can also be used with water temperatures up to approx. 70 °C. The output is approx. 200 W per metre of arc length and is independent of water temperature.

Opti-Flux low pressure lamp

Doped high-performance low pressure amalgam lamp with a life expectancy of approx. 14.000 operating hours. The operating temperature of the lamp is 100-130 °C, so that it can also be used with water temperatures up to approx. 70 °C. The output is approx. 300 W per metre of arc length and is independent of water temperature.

Powerline medium pressure lamp

Mercury medium pressure lamp with a life expectancy of approx. 8.000 to 10.000 operating hours. The high output of this lamp (up to 10.000 W per metre of arc length) enable very large flows to be treated. Their broad range spectrum makes the lamps particularly suitable for photochemical processes too. The operating temperature of the lamp is 650-850 °C. Powerline medium pressure lamps are normally operated with a mechanical wiper system, so their use is limited to water temperatures up to approx 40 °C.

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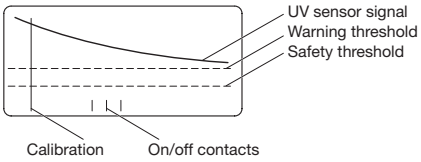
1.3.2 Dulcodes UV Controllers



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Compact controller

Compact unit for control of all basic functions of the UV system. The large graphical display shows the current UV-C output, the operating hours and the number of lamp switch-ons. With the fixed-setting warning and safety threshold levels, a warning signal is generated and a relay output (230 V / 0.2 A) for operation of an isolation valve is actuated if the UV output is too low. Alternatively, this output can also be used as a common alarm relay (230 V / 2.5 A).

De luxe controller

The Dulcodes de luxe controller features a large integrated graphical display for display of the UV-C sensor signal. Shown as a trend display, this allows lamp ageing, any build up of deposits on the lamp protection tube or a change in water quality to be detected. The safety and warning thresholds – both freely-programmable – are also displayed, as number of lamp switch-ons and the times they occurred. All operating and fault messages are outputted in plain text. Setting of the operating parameters is made easy by the clear menu guidance.

The controller is linked to the ballasts via a BUS system, enabling each lamp to be monitored. This also allows the controller to be physically positioned at a considerable distance from the radiation chamber and the lamps and ballasts.

Various additional functions, such as automatic flushing of the system in a freely-programmable free flushing time, control of an isolation valve and a circulating pump are integrated as standard. Two 230 V / 0.2 A voltage outputs and a 230 V / 2.5 A switching output are available for this.

The UV-C sensor signal can be monitored online via a 0/4-20 mA output signal output. Infringements of the warning and safety threshold levels are signalled externally via two relay outputs (230 V / 2.5 A). All other faults are outputted via a common alarm relay (230 V / 2.5 A).

3 volt-free control inputs allow the controller to be linked to external information: for example, the fault input can be used for an external temperature monitor, operation of the system can be interrupted at regular intervals with the pause input, and the flow monitoring is helpful in connection with flushing procedures.

Powerline de luxe controller

This type of controller also offers the additional option of controlling the output via an external 0/4-20 mA signal (not with the Dulcodes M 2 kW). In this way, control of the systems can be made flow-dependent, or the lamp output automatically adjusted to a defined UV-C sensor signal. This achieves lower energy costs combined with longer lamp service life.

In addition the controller provides display and monitoring of the radiation chamber temperature, together with freely-programmable control of the mechanical wiper system for automatic cleaning of the lamp protection tube.

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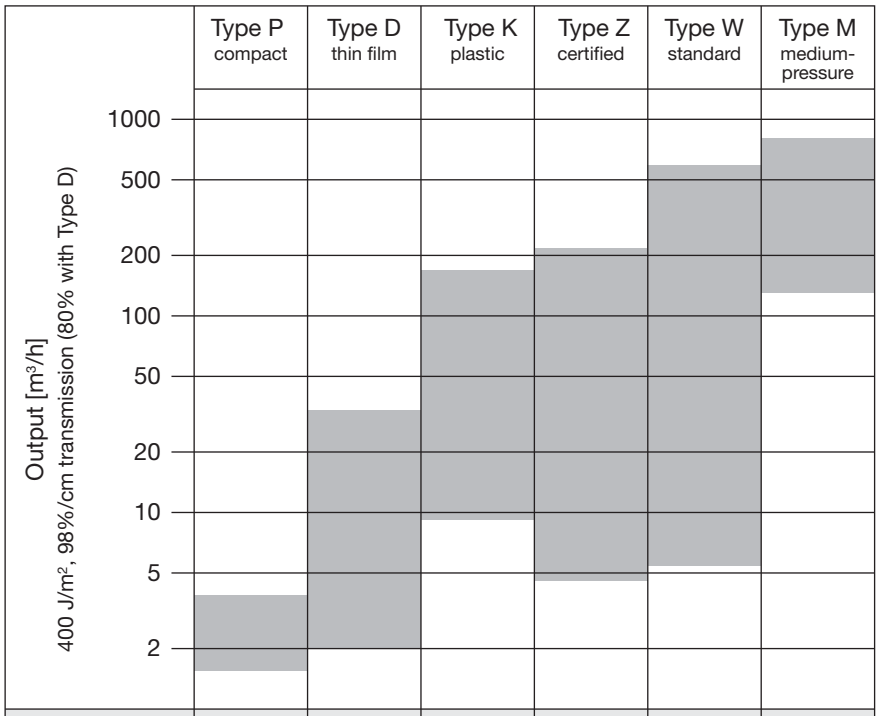
1.3.3 Performance Overview Of Dulcodes UV Systems

ProMinent offers a wide range of UV systems for the most diverse applications. The following overview shows the output and main applications of our standard systems:



	Type P compact	Type D thin film	Type K plastic	Type Z certified	Type W standard	Type M medium-pressure
Drinking water	✓			✓	✓	✓
Utility water	✓	✓	✓	✓	✓	✓
Swimming pool water			✓		✓	✓
Wastewater		✓				
Salt water			✓			

We offer a full advisory service covering everything required for safe use of a Dulcodes UV system:

- Assessment of the situation on site by trained, competent field employees.
- All water parameters needed for an optimal system design can be measured in our water laboratory.
- Design and planning of the system.
- Commissioning and system maintenance by our trained service technicians.

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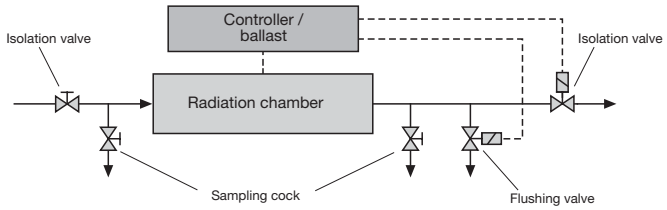
1.3.4 Notes On Planning And Designing An UV System

- The system must always be designed for the greatest water flow.
- The system must always be designed for the worst anticipated UV transmission.
- Fireproof sampling cocks for microbiological tests must be provided before and after UV disinfection systems.
- A manual isolation valve must be provided before the UV system to isolate the system for maintenance work.
- With drinking water disinfection and similar applications, an electrically-controlled isolation valve must be provided after the UV disinfection system, which also closes automatically on mains failure (solenoid valve, automatic closing flap valve or similar).
- With service water disinfection, it is normally sufficient to provide a manual valve to isolate the system for maintenance work, instead of the electrically-controlled valve.
- With drinking water disinfection and similar applications, a flushing valve must be provided after the UV disinfection.
- It must be ensured that there is sufficient space available for removing the lamp protection tube and lamp replacement.
- Modern electronic ballasts only allow a limited cable length between ballast and lamp, so that the control box with the ballasts must be positioned close to the lamp. On the other hand, the controller can be fitted in a control area, for example. However, the maximum cable lengths specified by us must not be exceeded in this case.



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Typical installation schematic of a UV disinfection system

The following details are required for design of a UV system:

- Application of the system
- Maximum water flow
- Minimum UV transmission of the water

The UV transmission must be determined by means of a laboratory measurement of the absorption at 254 nm.

A full water analysis gives important conclusions on the operating conditions of the system. The following questionnaire provides our project engineers with the information needed to design an appropriate system.

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Questionnaire For Designing A UV System

Application of the UV system:

☐ for disinfection of

- ☐ drinking water
- ☐ production water in the food industry, cosmetics or pharmaceuticals
- ☐ utility water
- ☐ wastewater
- ☐ salt water or brackish water
- ☐ _____

☐ for photochemical reduction of

- ☐ _____ ppm ozone
- ☐ _____ ppm chlorine dioxide
- ☐ _____ ppm chlorine
- ☐ _____ ppm chloramine

Water data:

Maximum water flow _____ m^3/h

Minimum UV transmission at 254 nm _____ %/1 cm _____ %/10 cm _____ SAC 254 nm

Turbidity _____ FTU _____ NTU

Suspended particles content _____ mg/l

Water quality ☐ constant ☐ fluctuating

Total hardness _____ mmol/l _____ °dH

Carbonate hardness _____ mmol/l _____ °dH

Chloride _____ mg/l

Manganese _____ mg/l

Iron _____ mg/l

Water temperature _____ °C

Other requirements:

_____

_____

_____

_____

_____