

## **UltraLED Water 2000/1 System for drinking water and wastewater sanitization**

### **Virus and bacteria disruptor**

*An innovative drinking water and wastewater sanitization solution using UV-C technology*

This proposal illustrates a technological innovation aimed at solving a massive problem with a direct impact on public health and economic efficiency related to the quality of water used for drinking or wastewater for agricultural and industrial use.

The **UltraLED Water 2000/1** system, currently in the "patent pending" and "CE pending" phase, is a "disruptive" solution for drinking water sanitization in medium and large-flow plants that utilizes ultraviolet radiation emitted by UV-C LEDs arranged in a high-density matrix (High-Density led array). It replaces the current systematic use of chlorine and the less widespread treatment systems with mercury UV-C lamps.

#### **Chlorine:**

- a) is classified as carcinogenic by the WHO; there is no safe minimum amount for humans, although inexplicably current regulations allow the use of a maximum dose of 5 mg/l.
- b) the phenomenon of chlorine-resistance, similar to antibiotic-resistance, has rendered some viruses and bacteria un-eliminable through drinking water chlorination, and their number is bound to increase.

#### **Mercury lamps:**

- a) in case of breakage, they can disperse a dangerous pollutant, mercury, into the water.
- b) will be banned from the European market starting from February 2027.

### **1. System Introduction**

The **UltraLED Water 2000/1** system is based on solid-state technology for the sanitization of water with **transmittance from 70 to 95% over 1 cm** and flow rates from **25 L/s (90 m<sup>3</sup>/h) to 100 L/s (360 m<sup>3</sup>/h)**. The system guarantees a total microbiological barrier against bacteria and viruses.

## 2. "High-Density led array" Technological Architecture

The system is based on an industrial-class UV-C LED matrix.

- 2.1 Spectral Target:** the system's UV-C LEDs operate with a peak emission at **265 nm**, which is the wavelength with maximum germicidal efficacy (DNA/RNA absorption); this has allowed it, at equal irradiance, to be 40% more effective than systems operating at 254 nm.
  - 2.2 Optimized Geometry:** the arrangement of the irradiation sources and the characteristics of the materials used minimize spherical dispersion, concentrating energy where it is most needed.
  - 2.3 Modular Configuration:** the system is composed of an independent base module designed to operate individually; it is scalable for Dose and Flow Rate, and if the application requires it, it can form series or parallels of "n" units. The System is functional to water channeling to obtain the required UV-C doses and/or flow rates; the base module creates a water path of 4,012 mm in length, the maximum width dimensions of the system are 350 mm, the height is 1600 mm, and it has an internal diameter of 187 mm. The system can be positioned inside the tank or in the pipeline leading from the tank to the water supply network feed pump.
  - 2.4 Performance and Biological Safety:** in compliance with Directive (EU) 2020/2184 implemented by Italy with D.Lgs. 18/2023 and therefore with the obligation to guarantee the microbiological conformity of drinking water, the reference technical standards UNI EN 14897 and DVGW W 294 (Germany) define a minimum UV-C irradiation Dose for drinking water of 40 mJ/cm<sup>2</sup> at 254 nm, equivalent to 32 mJ/cm<sup>2</sup> at 265 nm. Each base module of the system, named **UltraLED Water 2000/1**, is sized to guarantee, with a water **transmittance of 95% over 1 cm** and flow rates of **25 L/s (90 m<sup>3</sup>/h)**, an **average Dose of 70 mJ/cm<sup>2</sup>** in every part of the treated water and a **volumetric mean Dose (Fluence) of 84 mJ/cm<sup>2</sup>** with **2.016 W** input power.
  - 2.5 Irradiance Uniformity:** irradiance uniformity is equal to **80%**, without any "shadow zone"; uniformity within the water mass is equal to **90%**.
  - 2.6 Volumetric Mean Dose (Fluence):** ultraviolet radiation hits pathogens (bacteria, viruses) from multiple directions; this characteristic makes the system exceptionally effective in the sanitization action.
  - 2.7 Thermal Management:** the independent UV-C LED modules exploit the principle of integrated passive Thermodynamics, which has the characteristic of keeping the LEDs at optimal operating temperatures. Each UV-C LED module is integrated with special radiators, whose exchange surfaces are in direct contact with the water flow, to exploit its natural temperature (7-12 °C) and to achieve immediate and constant thermal reduction.
-

### 3. System Excellence

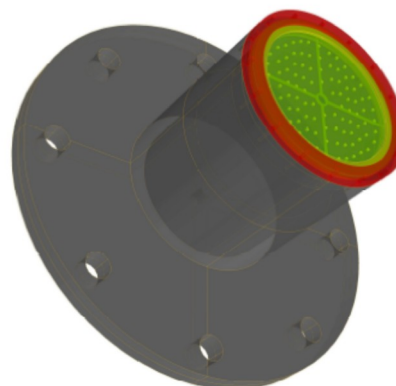
- 3.1 Eco-sustainability and Safety:** total absence of the mercury present in UV-C lamps. No risk of accidental contamination in case of breakage, making it a safe technology for users and the environment (Eco-Friendly). During operation, as there is no UV-C irradiation outside the system, it is compatible with the presence of service personnel.
- 3.2 Elimination of chlorine:** normally used for drinking water sanitization, which by combining with elements present in water is carcinogenic, and furthermore is ineffective for the disruption of chlorine-resistant viruses and bacteria.
- 3.3 Dimming:** self-regulation of power in the 0-100% range; the system is configured to support increases up to +50% should external factors require it.
- 3.4 IP68-20 Robustness:** UV-C LED modules are designed to operate up to 20 meters deep.
- 3.5 Integrated passive thermodynamics:** keeps LEDs at optimal operating temperatures, ensuring a useful life exceeding 50,000 hours, and guaranteeing an efficiency of the emitted ultraviolet radiation always higher than 80% of the nominal value.
- 3.6 Total Independence of Modules:** each module is electrically and thermally self-sufficient.
- 3.7 Integration with the existing plant:** immediate and with minimal need for structural modifications depending on the plant.
- 3.8 Elimination of routine maintenance:** the careful design, the type and superior quality of the components and materials used, the absence of a thermal delta with respect to the water of all the components in contact with it, an operating temperature of the UV-C LEDs always in an exceptionally low range with a maximum  $T_j$  of 25/32° allow for zero routine maintenance interventions for five years from the entry into service of the system.
- 3.9 Remote Control:** the system is equipped with a remote control unit (TLC) for real-time monitoring of values related to the applied UV-C radiation and water speed in the conduit; based on variations in these two measurements, the TLC automatically dims the power supplies to always provide the exact necessary power, optimizing energy absorption up to turning off the system in case of no water supply.

#### 4. Technical Summary Specifications of the UltraLED Water 2000/1 system equipped with 4 UV-C irradiation heads

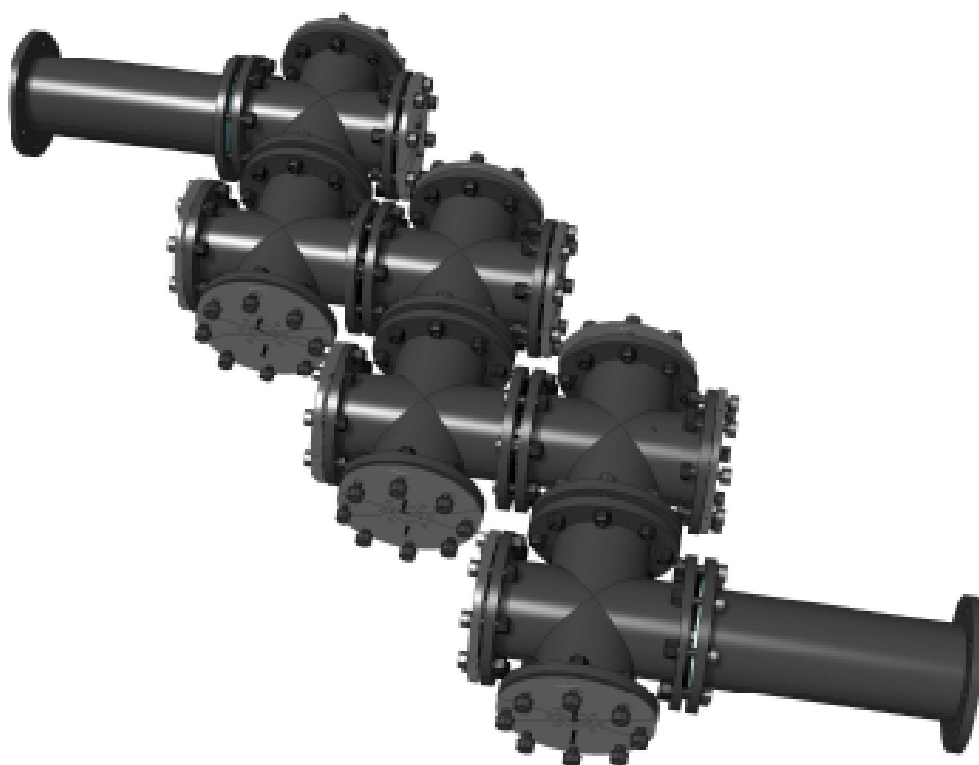
| Parameter                      | Technical Specification System 2000/1 (Base Module) |
|--------------------------------|-----------------------------------------------------|
| Nominal flow rate              | 25 l/s (90 m <sup>3</sup> /h)                       |
| Dimensions                     | 1600 x 1060 x 350 mm                                |
| Ultraviolet source             | UV-C LED (265 nm)                                   |
| Ultraviolet Power              | 141 W UV-C                                          |
| Dose (Minimum)                 | 70 mJ/cm <sup>2</sup>                               |
| Volumetric mean dose (Fluence) | 84 mJ/cm <sup>2</sup>                               |
| Water transmittance            | 95%/cm                                              |
| Electrical Power               | 2.016 W                                             |
| Cooling                        | Integrated passive thermodynamics                   |



**Fig. 1 - UltraLED Water 2000/1 System (Base Module) equipped with 12 UV-C irradiation heads**



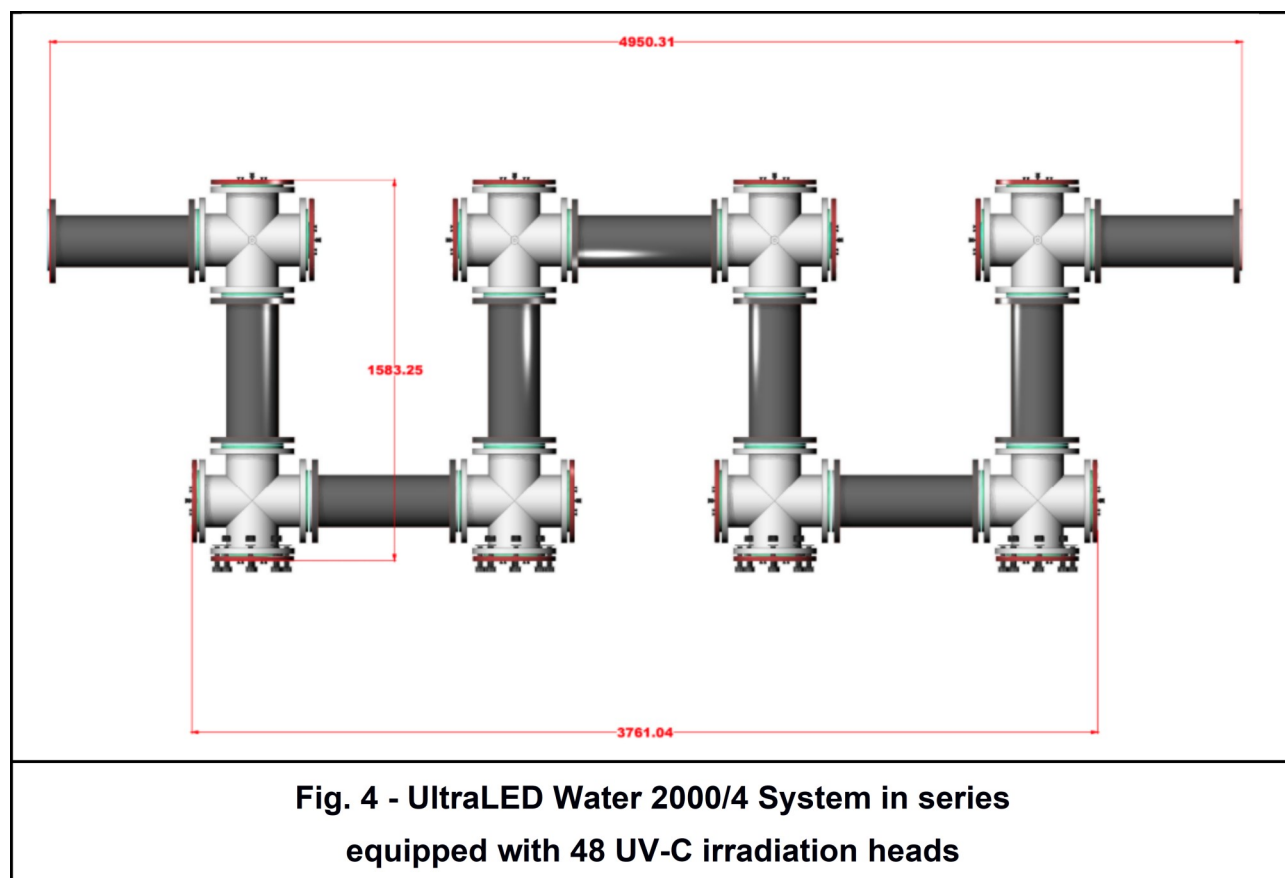
**Fig.2 - UV-C irradiation head**



**Fig. 3 - UltraLED Water 2000/1 System (Base Module)  
equipped with 12 UV-C irradiation heads**

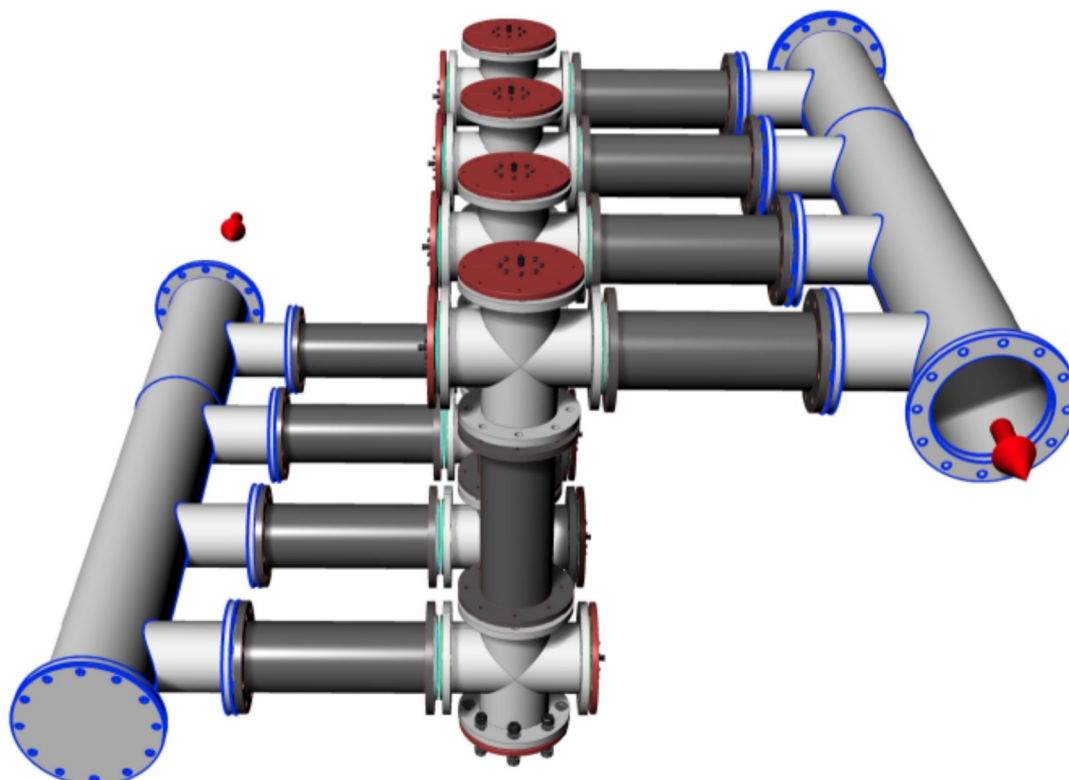
## 5. Technical Summary Specifications of the UltraLED Water 2000/4 system in series equipped with 48 UV-C irradiation heads

| Parameter                      | Technical Specification System 2000/4 in series |
|--------------------------------|-------------------------------------------------|
| Nominal flow rate              | 25 l/s (90 m <sup>3</sup> /h)                   |
| Dimensions                     | 1600 x 4950 x 350 mm                            |
| Ultraviolet source             | UV-C LED (265 nm)                               |
| Ultraviolet Power              | 564 W UV-C                                      |
| Dose (Minimum)                 | 280 mJ/cm <sup>2</sup>                          |
| Volumetric mean dose (Fluence) | 336 mJ/cm <sup>2</sup>                          |
| Water transmittance            | 95%/cm                                          |
| Electrical Power               | 8.048 W                                         |
| Cooling                        | Integrated passive thermodynamics               |



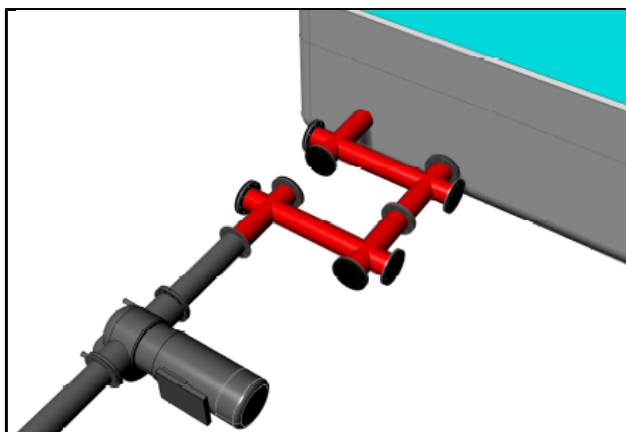
## 6. Technical Summary Specifications of the UltraLED Water 2000/4 system in parallel equipped with 48 UV-C irradiation heads

| Parameter                      | Technical Specification System 2000/4 in parallel |
|--------------------------------|---------------------------------------------------|
| Nominal flow rate              | 100 l/s (360 m <sup>3</sup> /h)                   |
| Dimensions                     | 1600 x 2700 x 3000 mm                             |
| Ultraviolet source             | UV-C LED (265 nm)                                 |
| Ultraviolet Power              | 564 W UV-C                                        |
| Dose (Minimum)                 | 70 mJ/cm <sup>2</sup>                             |
| Volumetric mean dose (Fluence) | 84 mJ/cm <sup>2</sup>                             |
| Water transmittance            | 95%/cm                                            |
| Electrical Power               | 8.048 W                                           |
| Cooling                        | Integrated passive thermodynamics                 |



**Fig. 5 - Installation for UltraLED 2000/4 System in Parallel**

## 7. Example of Installation of UltraLED Water 2000/2 System in series equipped with 24 UV-C irradiation heads



**Fig. 6 - External tank installation for UltraLED Water 2000/2 System**



**Fig. 7 - Internal tank installation for UltraLED Water 2000/2 System**

