



UltraLED Water/Bi-F 2560/1 system

“MODULAR AND MULTIFUNCTIONAL REACTOR SYSTEM FOR THE BREAKDOWN OF VIRUSES AND BACTERIA IN WATER AND FOR THE ELIMINATION OF PFAS AND CHEMICAL POLLUTANTS.

An innovative solution for sanitizing drinking and waste water with

UV-C/PHOTOCATALYSIS technology

This proposal illustrates a technological innovation aimed at solving a major problem with a direct impact on public health and economic efficiency related to the quality of drinking water and agricultural and industrial wastewater. The system consists of a modular, multifunctional continuous-flow reactor that uses ultraviolet radiation emitted by UV-C/UV-A LEDs with a basic "octagonal barrel" hydraulic configuration to achieve:

1. Destroys 99.9% of viruses, bacteria and all other pathogens present in water.
2. Destruction of chemical pollutants by 92% (Perfluoroalkyl substances such as PFAS, Pharmaceutical residues such as Antibiotics, Hormones and Anti-inflammatories, Pesticides and Herbicides such as glyphosate and other organic compounds used in agriculture, carcinogenic endocrine disruptors that mimic hormones and damage the human and animal reproductive system, chlorination by-products such as THMs (also carcinogenic) present in aqueous solutions using Advanced Oxidation Processes (AOP) technologies . AOP **technologies exploit** the operational synergy between UV-C/UV-A ultraviolet radiation and specific special materials to achieve photocatalysis.
3. The reactor has an “Octagonal Barrel” hydraulic configuration

UltraLED Water/Bi-F 2560/1 reactor contains 56 heads with 96 LEDs each, capable of generating wavelengths of 365 nm UV-A, 280 nm UV-C and 265 nm UV-C.

After treatment, the drinking water, with a transmittance of 95%, is sanitized with the elimination of nano-microplastics and viruses/bacteria.

UltraLED Water/Bi-F 2560/1 system currently in the “patent pending” and “CE pending” phase , it is a “disruptive” solution for the sanitization of drinking and waste water in medium and large capacity systems .

Ultra LED-Water/Bi-F 2560/1 system for water sanitization

CHLORINE

- a) It is classified as a carcinogen by the WHO, there is no minimum safe quantity for humans even if incomprehensibly the current legislation allows the use of a maximum dose of 5 mg/l.
- b) The phenomenon of chlorine resistance, as is the case with antibiotic resistance, has made some viruses and bacteria impossible to eliminate with the chlorination of drinking water, and their number can only increase over time.

PFAS

- a) It is classified as a carcinogen by the WHO and can also cause hormonal disruption. They are considered external pollutants.

1. Introduction to the System

UltraLED Water/Bi-F 2560/1 system It is based on solid-state technology for the sanitization of water with **transmittance from 70 to 95% on 1 cm** and flow rates of **100 L/s (360 m³/h)** . The system guarantees a total microbiological barrier against **nano-microplastics, viruses and bacteria** .

2. High-Density LED Array Technological Architecture

The system is based on an industrial-grade **UV-C/UV-A LED matrix**.

- 2.1 **Spectral Target:** The system's LEDs operate with a peak emission at **265 nm UV-C** , which is the wavelength with maximum germicidal effectiveness (DNA/RNA absorption) and **365 nm UV-A, 280 nm UV-C** and for photocatalysis.
- 2.2 **Optimized Geometry:** the arrangement of the radiation sources and the characteristics of the materials used minimize spherical dispersion, concentrating the energy where it is most needed.
- 2.3 **Modular Configuration:** The system consists of one independent base module for water channeling, measuring 2560 mm in length, 600 mm in width, and 600 mm in height. It can be positioned, for example, at the inlet of the water mains feed pump. The system is scalable for flow rates of less than or greater than 100 L/s. This can be decreased by simply adjusting the power according to the flow rate, and increased by up to +30%, again with power adjustment. Beyond this flow rate increase, multiple independent base modules must be installed in series.
- 2.4 **Performance and Biological Safety:** in compliance with **Regulation (EU) 2020/741** for waste water and **Directive (EU) 2020/2184** implemented by Italy with Legislative Decree 18/2023 on the obligation to guarantee the microbiological compliance of drinking water . The **UltraLED Water/Bi-F 2560/1** system is sized to guarantee, **with a flow rate of 100 l/s, water transmittance of 95% on 1 cm a volumetric mean UV-C dose of 57.3 mJ/cm²** in every part of the treated water and a volumetric mean UV-A dose **of (365nm) in AOP of 132mJ/cm²** with 11.5 kW input.

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- 2.5 **Uniformity of Irradiance:** The uniformity of irradiance is **80%** , without any "shadow zone", the uniformity in the water mass is **90%** .
- 2.6 **Average Volumetric Dose:** ultraviolet radiation strikes pathogens (bacteria, viruses) and pollutants (PFSA) from multiple directions, this feature makes the system exceptionally effective in its sanitization action.
- 2.7 **UltraLED Water/Bi-F 2560/1 system** It delivers an average volumetric UV-C + UV-A dose (Fluence) of **189.3 mJ/cm²** , offering a safety factor higher than the dose required by law for the destructuring of viruses and bacteria and the activation of photocatalysis, all to guarantee correct functioning even in the presence of pollution peaks or variations in water turbidity.
- 2.8 **Efficiency and Sustainability (Advanced Photonics):** the extraordinary efficiency is also given by the application of the principles of advanced photonics, i.e. in the treatment of the internal surfaces surrounding drinking water.
- 2.9 **Thermal Management:** the independent UV-C/UV-A LED modules exploit the principle of **integrated passive thermodynamics** , which keeps the LEDs at ideal operating temperatures, guaranteeing a useful life of over **50,000 hours** with an efficiency of the emitted ultraviolet radiation always higher than 80% of the nominal value.

3. System excellence

- 3.1 **Eco-sustainability and Safety:** UVC lamps are completely free of mercury. No risk of contamination in the event of accidental breakage, making the technology safe for people and the environment (Eco-Friendly) .
- 3.2 **Elimination of chlorine** normally used to sanitize drinking water which, when combined with the elements normally present in water, is carcinogenic and harmful to health.
- 3.3 **Instant start and adjustment:** no warm-up time; the system reaches 100% power in milliseconds and manual or automatic adjustments are made in real time.
- 3.4 **Dimming:** possibility of automatically adjusting the power in the range 0-100. The system is configured to support power increases of up to + 50% if external factors require it.
- 3.5 **IP68-20 robustness:** the UV-C/UV-A LED modules are designed to operate up to 20 metres deep.
- 3.6 **Integrated passive thermodynamics:** each UV-C/UV-A LED module is integrated with special radiators whose exchange surfaces are in **direct contact with the water flow** to exploit the natural temperature of drinking water (7-12 °C) to obtain immediate and constant heat reduction.
- 3.7 **Zero-Failure Reliability:** The absence of external pumps and cooling circuits makes the system particularly reliable . Cooling cannot be affected by external factors. as water is always present, ensuring that the LEDs always operate in an exceptionally low temperature *range* with the maximum Tj of the LEDs at 25°C guaranteeing a lifespan of more than 50,000 hours.

- 3.8 Photonic Flux Stability:** By keeping the LED junction at extremely low temperatures of 25 °C, the emission efficiency remains at nominal operating levels, avoiding the natural power decay that occurs in systems operating at high temperatures or even overheating.
- 3.9 Total Independence of the Modules:** Each module is electrically and thermally self-sufficient. This modular design allows each unit to manage its own ultraviolet radiation emission and heat separately, drastically simplifying the system architecture and reducing installation and maintenance costs , with the sole exception of cleaning the photocatalysis mechanics.
- 3.10 Elimination of routine maintenance interventions:** the careful design , the particular quality of the components used, the absence of thermal delta with respect to the water of all the components in contact with it allow for the absence of routine maintenance interventions for five years from the entry into service of the system.
- 3.11 Remote control:** the system is equipped with remote control for real-time monitoring of applied UVC/UVA radiation and water velocity in the duct. Based on changes in these two measurements, the TLC automatically dims the power supplies to always provide the right amount of power, optimizing energy consumption and even shutting down the system if there is no water supply.

4. Technical Specifications of the UltraLED Water/Bi-F 2560/1 system consisting of 6 basic modules equipped with 56 UVC irradiation heads

Parameter	Specification
Nominal flow rate	100 l/s (360 m ³ /h)
Water speed / Dwell time	0.54 m/s / 4.68 s
Dimensions	2560 x 600 x 600 mm
Ultraviolet source	UV-C LED (265/280 nm) UV-A LED (365 nm)
Ultraviolet Power	1190W UVC/UVA
Volumetric mean dose (Fluence)	189.3 mJ/cm ² UV-A/UV-C
Water transmittance	95%/cm
Electric Power	11500 W
Cooling	Integrated passive thermodynamics

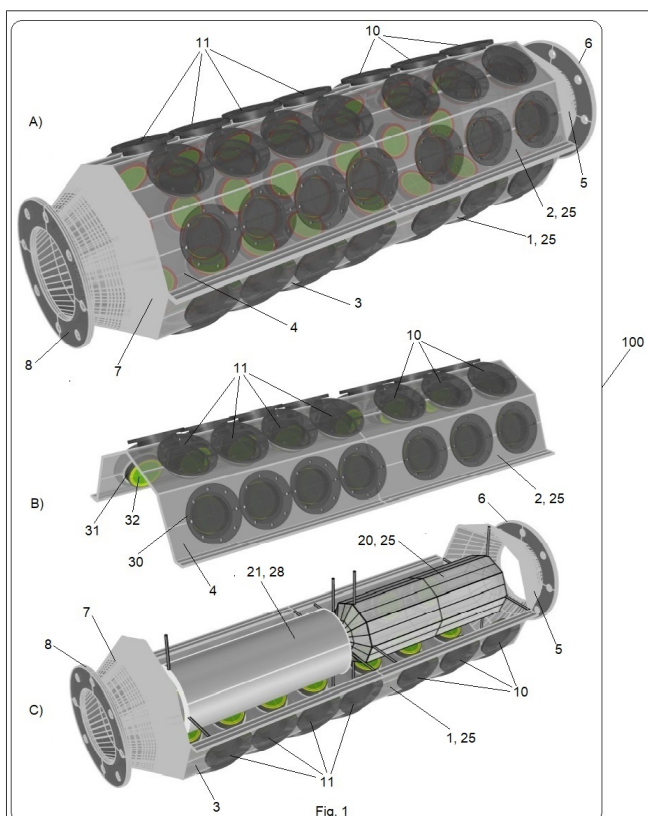


Fig. 1 - Bi-functional reactor for the sanitization/mineralization of pathogens/nano-micro plastics with an "octagonal barrel belly" hydraulic configuration

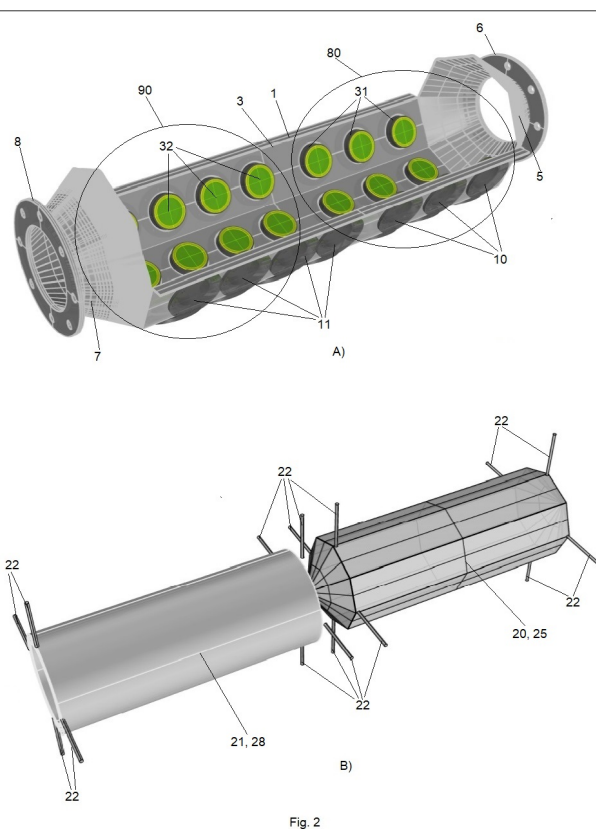


Fig.2 - Three-dimensional open shape of the bi-functional reactor and three-dimensional shape of the octagonal composite nose-cone structure

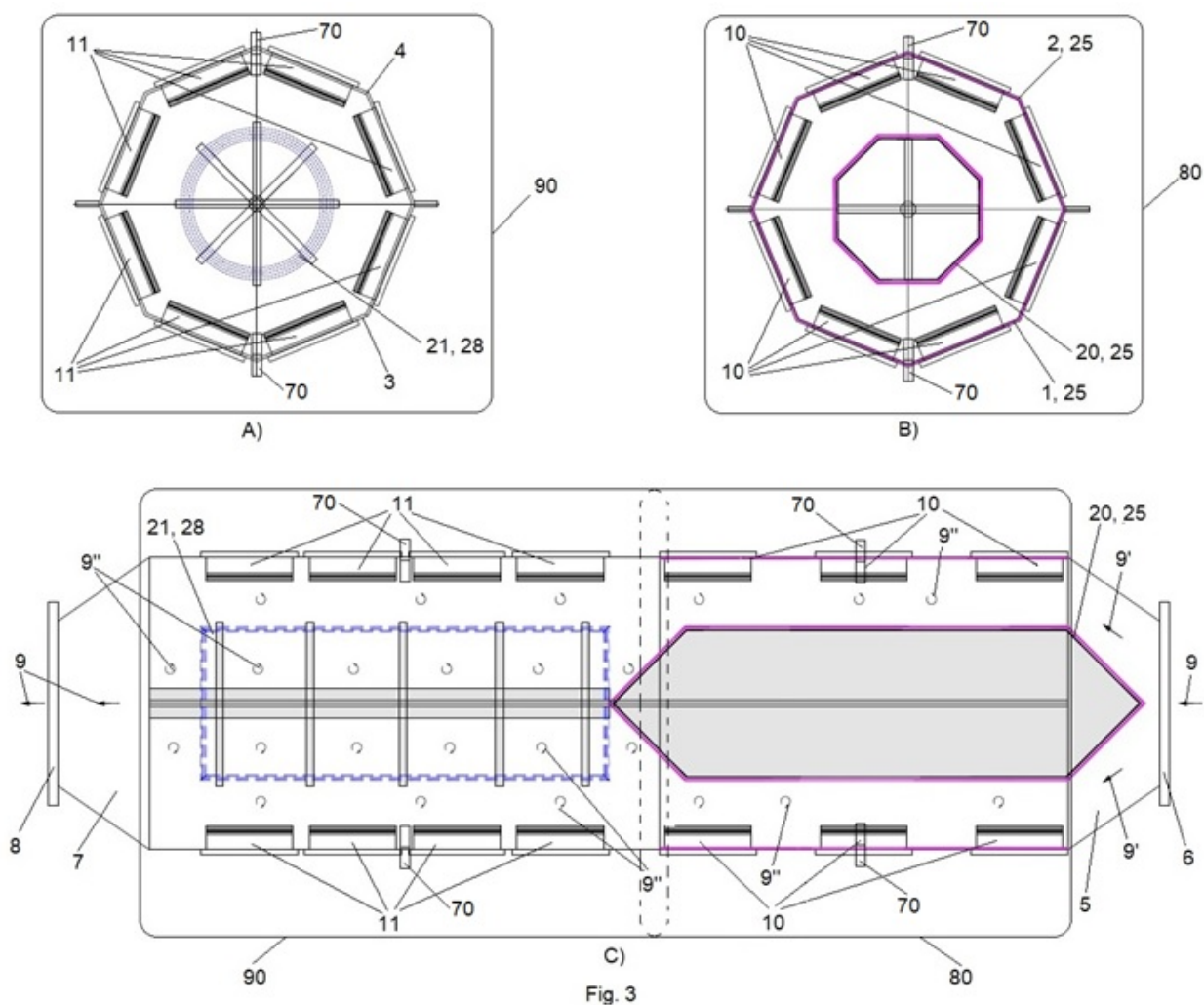
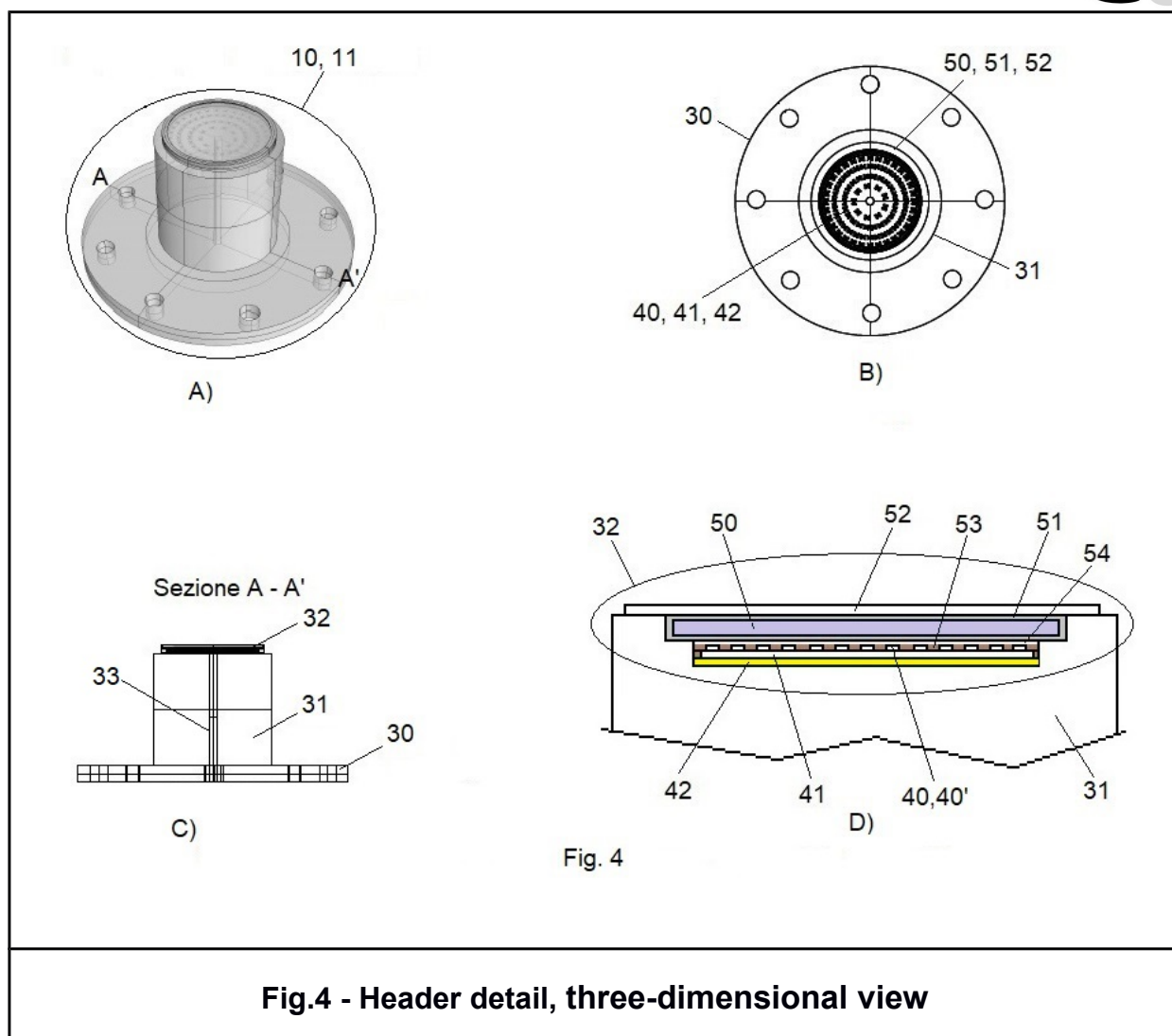


Fig.3 - Transversal and longitudinal sections of the operational part



System configurations depending on water flow rate

Table: Maximum Guaranteed Flow Rate for Mineralization > 92%

Objective: Complete degradation of polymer chains and compliance with TOC removal protocols.

AOP Section Length (mm)	Maximum Flow Rate (Q)	Permanent Time AOP (tres)	UV-C Physical Dose (MicroB)	Sanitization Status
1,250	100 l/s	3.12 s	46.2 mJ/cm ²	Log 3.5
1,000	80 l/s	3.12 s	57.7 mJ/cm ²	Log 4.2
800	64 l/s	3.12 s	72.2 mJ/cm ²	Log 5.0
500	38 l/s	3.30 s	121.5 mJ/cm ²	Overkill (Log 7+)