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UV-C LEDS AT THE TIME OF COVID-19

Market & Technology Report - September 2020

In the current context of health crisis due to the SARS-CoV-2 virus, the need to prevent contagion through disinfection has become a major issue. Like other coronaviruses, this new virus can be destroyed by UV-C radiation. With the emergence of UV-C LEDs, the question of the relevance of using this technology to stop the current epidemic arises.

REPORT CONTENT

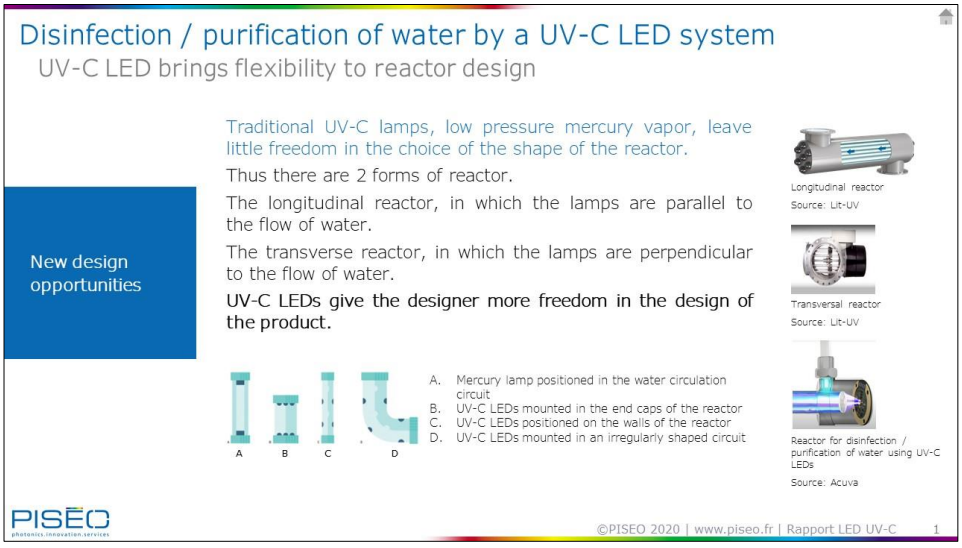
- Applications of artificial UV-C radiation.
- Principles of disinfection by UV-C radiation.
- State of the art of UV-C LED technology and the outlook for performance changes, compared to traditional UV-C sources.
- Identification and analysis of the offer of UV-C LED manufacturers.
- Principles for integrating UV-C LEDs and sizing systems for disinfection, in relation to the required doses.
- Doses achievable today and tomorrow by disinfection systems using UV-C LEDs, in conjunction with SARS-CoV-2.
- Presentation of devices currently marketed for different applications.
- UV-C LEDs market and their trends.
- Regulation and standardization in Europe.

DISINFECTION BY UV-C RADIATION

The disinfection ability of UV-C radiation, known for several decades, is no longer to be proven and its germicidal effect is thus used for applications of disinfection and purification of water, air and surfaces.

However, the use of UV-C radiation for disinfection requires knowledge, in particular to determine the necessary dose for the inactivation of a microorganism (the dose depending on a certain number of parameters related to the application, to the environment, etc.), but also in order to take into account the risks associated with the use of this technology.

Indeed, the use of UV-C radiation for disinfection presents two major risks: a photo-biological risk (UV-C radiation is dangerous for humans) and a risk of ineffective disinfection (in the case of a disinfection system which has not been designed correctly in relation to its application).



UV-C LED TECHNOLOGY AND MARKET

The technology traditionally used as a source of UV-C radiation is the mercury lamp. In recent years, manufacturers have put UV-C LEDs on the market, this fairly recent technology offers unique advantages (robustness to on/off cycles, does not contain mercury, compactness, etc.) allowing improvements compared to existing systems, but also opportunities for new applications.

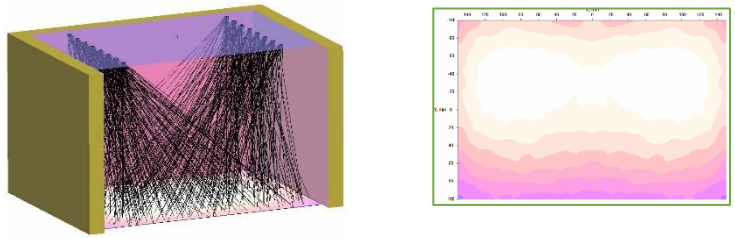
The current low performance and high price are the main brake to wider adoption of UV-C LEDs by the UV-C disinfection market today

However, the analysis of the portfolio and roadmaps of UV-C LED manufacturers confirms the trends observed for several years: a rapid and regular drop in prices and a significant increase in performance (power and efficiency), which should allow UV-C LED to establish itself in the field of disinfection by UV-C radiation, at mid or long term depending on the applications.

UV-C LED technology is more complex than visible LED technology and the market is currently quite small, so there are not so many UV-C LED manufacturers. Late 2019 / early 2020 some major manufacturers have even left the UV-C LED market.

DESIGN AND IMPLEMENTATION OF UV-C LED SYSTEMS FOR DISINFECTION

The design phase of a disinfection system is key to ensure that the microorganism receives the required dose to render it inactive. Concretely, the aim of the design phase is to define the parameters of the UV-C source from the required dose, application parameters (exposure time, size of the target to be treated, etc.) and optical parameters (uniformity, attenuation due to the distance between the source and the target…).



Optical simulations of UV-C radiation and irradiance carried out by Piséo with Light Tools software

The integration of UV-C LEDs has more constraints than for LEDs in the visible range: UV-C radiation degrades materials usually used for optical systems in the visible, the low efficiency of UV-C LEDs has an impact on its thermal integration ...

The replacement of the mercury lamp by the UV-C LED in existing systems is not trivial, for instance the design of a reactor used for disinfection / purification of water must be reworked to be adapted to the properties of LED (optical emission, thermal management, etc.).

REGULATIONS AND STANDARDIZATION

With the Covid-19 epidemic, many UV-C products, mainly for surface disinfection, are appearing on the market. The current regulations and standards cover the safety aspects related to the use of these devices, but do not cover the disinfection aspect (no defined test process that would allow the performance of products to be compared in terms of disinfection, etc.).

For now, manufacturers of disinfection systems generally rely on scientific publications and have their products tested by microbiology laboratories as a guarantee of the quality of their product in terms of disinfection. However, even a laboratory test is not a guarantee for the user, as the test conditions may be different from the conditions of use (type of surface, etc.).

Eventually, faced with the photo-biological risk, countries have decided to ban the sale and use of UV-C disinfection products outside the medical environment.

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COMPANIES CITED IN THE REPORT

Acuva, AquiSense Technologies, Bolb, Corning, Cree, Crystal IS, Dietal, Dowa, Everlight, GoodFellow, HCEN, Hexatech, Hönle, Hytecon, Hyundai, KnightOptical, KoppGlass, Ledil, LG-Innotek, Lite-On, Lumileds, Luminus, MetaWater, Nichia, Nikkiso, Osram, Phoseon Technology, Purion, QD Jason, RayVio, Samsung, San'an Optoelectronics, SeoulViosys, Seti, Signify-Philips, Stanley, Sterilway, Typhon Treatment System, Ushio, UV Photonics, UVRER, Violumas, Watersprint, Yole Développement.

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Matthieu Verstraete has more than 20 years of experience acquired mainly within the Philips group. In the early years, this experience led him to participate in the Netherlands in the development of set-top boxes for digital television and optical DVD playback and burning systems. He was also responsible for the technical specification of the Philips group's portfolio of drivers for LED lighting devices worldwide. Prior to joining Piséo, he was Global System Architect for LED outdoor lighting solutions from Signify (ex Philips Lighting). Within Piséo, he directs and participates in studies of innovative photonic systems for all fields of application. His role as a system architect leads him to analyze applications and propose technical solutions that integrate the most recent photonic and electronic components and software bricks.

Joel THOME- General Manager - Piséo

Joël Thomé has more than 25 years of industrial experience in the field of innovation. For many years, he held international positions in R&D and business line management within the lighting division of the Philips group. He notably participated in the transformation of the company's product portfolio through the integration of LED technology and lighting control functions. Joël Thomé has been managing and developing Piséo since 2013 and regularly conducts market and state-of-the-art technological studies in collaboration with the company Yole Développement.

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PISEO

Piséo is an independent Innovation Center that offers services in technological analysis, design, realization and characterization of illumination, detection and imaging systems operating in UV, visible and infrared.

Specialists in the integration of photonic technologies and their applications: LED, VCSEL, laser diodes, photodiodes, imaging sensors, materials for optics, surface treatment, etc. , we support companies in all sectors in their approach to innovation and optimization..

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- Luminance and color maps of screens, light panels, etc.…
- Electrical measurements
- Temperature measurements
- Characterization of cameras and imaging sensors (VIS, IR): NUC, NETD, responsiveness, MTF …)