Crystal IS
High Performance UVC LEDs

MINI-WHITEPAPER:

Advantages of UVC LEDs in Instrumentation:

Lifecycle Costs

Advantages of UVC LEDs in Instrumentation Lifecycle Costs

A key trend driving overall market growth and innovation in spectroscopic instrumentation is the need for cost effective instruments. In this analysis, we will show that replacing UV lamps with LEDs enables instrument manufacturers to develop new cost-effective products to target existing customers or new market segments which cannot afford a UV lamp solution.

To examine the full impact of replacing UV lamps in instrument systems with LEDs, a lifecycle cost analysis needs to be conducted, which includes analysis of:

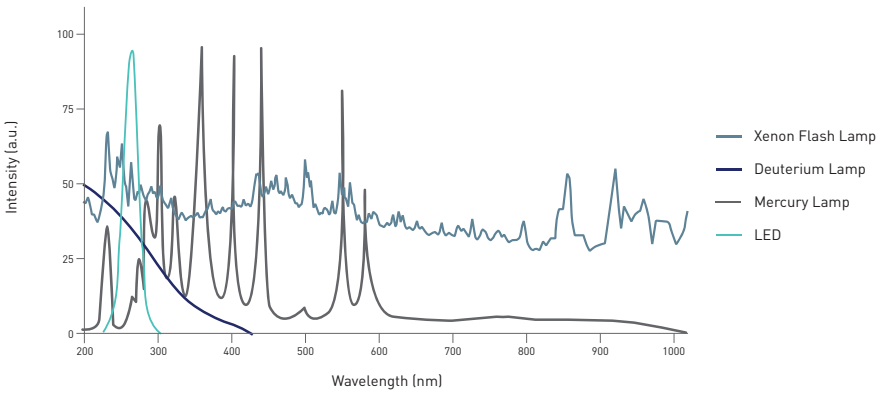
- Initial System Cost
- Operating Cost
- Maintenance Cost
- Replacement Cost
- Disposal Cost

The UV lamps predominantly used in instruments are deuterium, xenon flash lamps and occasionally mercury lamps. Because of comparable lifetimes and wall plug efficiencies, the operating, maintenance and replacement costs for deuterium, xenon lamps and LEDs are currently fairly similar. (It is to be noted that LEDs are easier to install and replacement costs are expected to decrease as UV LEDs show a performance improvement trajectory like visible LEDs.) However, there are significant differences in the initial system costs for instruments using UV LEDs instead of UV lamps.

Initial System Cost

Spectral profile of light sources plays a key part in determining initial system cost and here the monochromaticity of LEDs is a significant advantage.

Traditionally used UV lamps in instrumentation such as xenon flash or deuterium, generate ample light across multiple wavelengths.

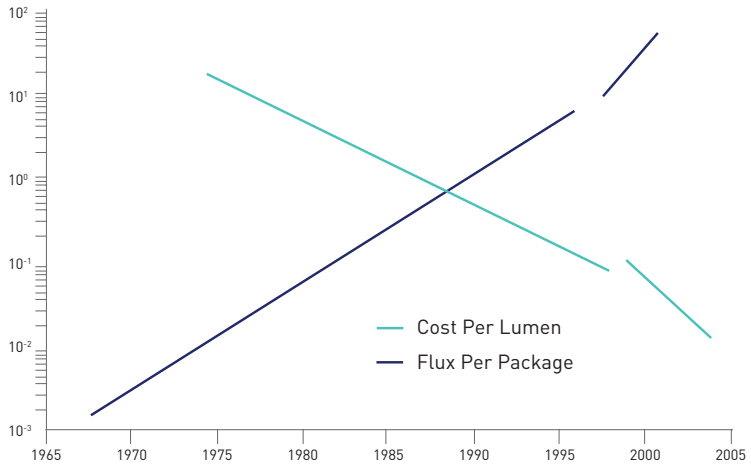


The broad spectra drives up system cost significantly as additional optical elements such as filters and mirrors are required to screen out unwanted spectra before the UV light enters the sample. Alternatively, photodiode arrays are used to separate the broad spectrum UV light after it exits the sample. In contrast, the monochromaticity of LEDs results in a simpler design with fewer optical elements and lower system cost. The system cost is expected to decrease further, if the increase in UV LED performance and the corresponding decrease in UV LED cost follows the progression observed in visible LEDs.

THE USE OF LED BASED SOURCES HAS ENABLED MANUFACTURERS OF DIVERSE PRODUCTS SUCH AS DNA PURITY MEASUREMENT INSTRUMENTS, WATER QUALITY MONITORING PROBES TO REDUCE PRICES BY AS MUCH AS 50 PERCENT.

Progression of LED Performance and Cost

Haitz's Law observes that every 10 years the price of visible LEDs (measured in cost per unit of flux) decreases by a factor of 10, while the performance (measured in flux per package) increases by a factor of 20.



A second major consideration in initial system cost is the cost for power supply and associated electronics. Conventional UV lamps have complex requirements for power supplies and ancillary electronics, which lead to increased complexity and cost for ensuring safe operation. Xenon flash lamps require high voltages and increased shielding of electronics during lamp ignition. Deuterium lamps require multiple power supplies: one to trigger the discharge, a second supply to supply the optimal current and a third supply to keep the lamp at constant temperature. In contrast, LEDs require lower currents and have relatively inexpensive drivers which regulate the current through the LED.

Thus, by going from the traditional UV lamp configuration to LEDs, instrument makers can eliminate expensive diffraction gratings and photodiode arrays and replace expensive lamp power supplies with less costly constant current LED drivers. For example, the use of LED based sources has enabled manufacturers of diverse products such as DNA purity measurement instruments, water quality monitoring probes to reduce prices by as much as 50 percent.

Cost Comparison for Spectrophotometer Configurations with Different Light Sources

	Deuterium Lamp	Xenon Flash Lamp	UVC LED Systems
Light source cost	Higher	Higher	Lower
Other optical components	Monochromator + photodiode or monochromator + photodiode array	Monochromator + photodiode or monochromator + photodiode array	Photodiode
Power supply	Multiple high voltage power supplies	Shielding	Single low voltage constant current driver
Total system cost	>2X	2X	X

Thus, UVC LEDs optimize performance and lower overall system costs by allowing design of instruments with as few, or as many, features required for end user applications. This has enabled instrument manufacturers to displace traditional broad spectrum UV lamps in a wide range of applications and provide end users with cost effective spectroscopy instruments.

We invite you to learn more about our UVC LEDs.

Crystal IS™
High Performance UVC LEDs

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