Mercury-vapor lamp or LED?

Small guide for the configuration of rheometer accessories for UV measurements

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Using high-intensity ultraviolet (UV) radiation, photochemical-induced curing offers several advantages over conventional industrial processes. Photosensitive materials are characterized by faster curing reactions or better surface properties. In addition, the use of solvents and the resulting environmentally harmful vapors can be discarded. Thanks to these and other properties, UV-curing is becoming increasingly important in many areas, such as the paint, coatings, and adhesives industries. Photochemical curing is also the basis for various additive manufacturing processes. Rheology is an established measurement method to investigate the change of sample properties before, during, and after such photolytic curing reactions and support new material development.

High-pressure discharge lamps based on mercury, so-called mercury vapor lamps, are often used as UV radiation sources for rheological measurements. LED lamps are also establishing themselves as a popular alternative due to major advances in diode technology.

This document is intended to provide an overview of the advantages and disadvantages of each technology. Use this as a resource when selecting the right UV light source as well as the necessary accessories for the required application at hand.

Mercury-vapor lamp

The operating principle of mercury vapor lamps is based on the vaporization of mercury as a result of an ignition. This leads to the emitting of a broad spectrum of different wavelengths. Specific wavelength ranges can be selected from this spectrum using optical filters. For example, an Omnicure S2000 UV light source can cover wavelengths from 320 nm to 500 nm. Other filters are available on request. Figure 1 shows the advantages and disadvantages of mercury vapor lamps.

UV LED light sources

UV LED light sources are based on semiconductor components that emit an almost monochromatic wavelength spectrum when applying an electrical current. The emitted spectrum is specific to the semiconductor material used. As a result, UV LED lamp heads like the DELOLUX 50 can be used to cure photosensitive materials at specific wavelengths of 365 nm, 400 nm, and 460 nm. Lamp heads with further wavelengths are available on request. Figure 1 shows the advantages and disadvantages of UV LED lamp systems.

Available accessories

When mercury-vapor lamps are used, the UV-light generation usually occurs within the lamp module itself. Therefore, an additional light guide is necessary to guide the UV light into the rheometer and to the sample. These light guides are available in two different designs. Liquid light guides are less expensive but can only be used up to a temperature of 60 °C. In addition, a fiber optic light guide is required to cover the entire temperature range of the HAAKE MARS temperature control modules.

In the case of most UV LED light sources this light guide is not required, since the UV light is generated directly at the LED lamp head. However, the lifetime of the LEDs decreases significantly during operation at elevated temperatures over a longer period.

In addition, it is necessary to use suitable anti-reflective glass plates to ensure sufficient transmission of UV radiation emitted by the light source. When working with UV light, suitable protective safety glasses are crucial.

Recommended accessories - Radiometer

To set and control the desired UV light intensity in the measuring gap of the rheometer, it is recommended to use a suitable intensity measuring device. Such radiometers are specifically available for mercury-vapor as well as LED light sources and should only be used for the light source they have been designed for to ensure an accurate intensity reading.

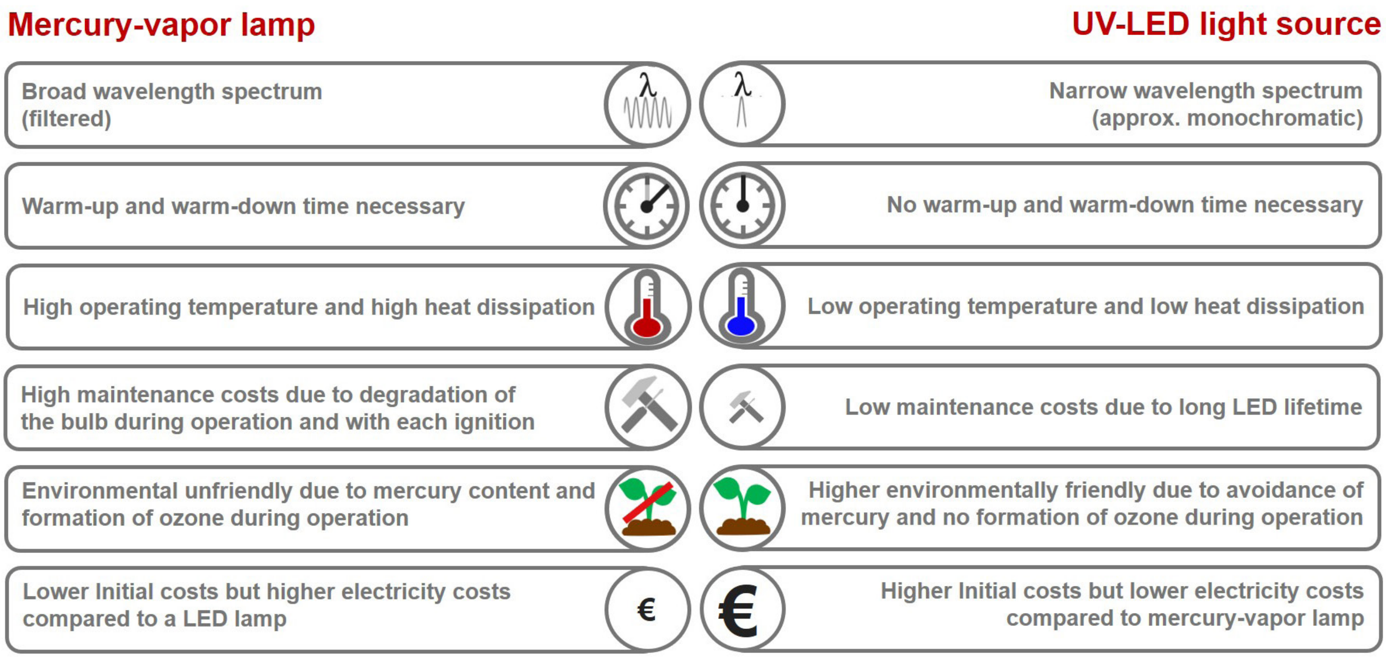

Figure 1. Advantages and disadvantages of mercury-vapor lamps and UV LED lamps.

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