

Biosafety Technical Bulletin: Ultraviolet Lights in Biological Safety Cabinets

Ultraviolet (UV) germicidal radiation is a sterilization method that uses ultraviolet (UV) light at sufficiently short wavelength to break down microorganisms. It is used in a variety of applications, such as food, air and water purification. UV has been a known mutagen at the cellular level for more than one-hundred years. UVGI utilizes the short wavelength of UV that is harmful to microorganisms. It is effective in destroying the nucleic acids in these organisms so that their DNA is disrupted by the UV radiation. This removes their reproductive capabilities and kills them. The application of UVGI to sterilization has been an accepted practice since the mid-20th century. It has been used primarily in medical sanitation and sterile work facilities.



A UVGI system is designed to expose environments to germicidal UV. Exposure comes from germicidal lamps that emit germicidal UV electromagnetic radiation at the correct wavelength, thus irradiating the environment. The forced flow of air or water through this environment ensures the exposure.

Regulations and Guidelines

The Occupational Safety and Health Administration (OSHA) does not have a permissible exposure limit for UV radiation. Guidelines on UV radiation exposure have been established by the International Radiation Protection Association (IRPA) and adopted by the American Conference of Governmental Industrial Hygienists (ACGIH). The ACGIH does have a threshold limit value (TLV) table for UV radiation and relative spectral effectiveness, which is published in the Threshold Limit Values (TLV) booklet annually.

Installation of Ultraviolet (UV) lamps is not permitted in biological safety cabinets at the NIH. The NIH, CDC, NSF/ANSI, and the American Biological Safety Association all agree that ultraviolet (UV) lamps are not recommended nor are they necessary. NSF Standard 49, the industry testing standard for all biohazard cabinetry, does not provide any performance criteria for UV lighting and specifically states in Section 4.24.2 “UV lighting is not recommended in Class II (laminar flow) biohazard cabinetry.” Numerous factors affect the activity of the germicidal effect of UV light, which require regular cleaning, maintenance and monitoring to ensure germicidal activity. In addition, there are safety hazards associated with UV light exposure, which include cornea burns and skin cancer.

Effectiveness

The Centers for Disease Control (CDC) and the National Institute of Health (NIH) agree that UV lamps are not recommended nor required in biological safety cabinets. NSF Standard 49, the industry testing standard for all biohazard cabinetry, does not provide any performance criteria for UV lighting and specifically states in Section 4.24.2 “UV lighting is not recommended in Class II (laminar flow) biohazard cabinetry.” The activity of UV lights for sterilization/decontamination purposes is limited by a number of factors:

- **Penetration** – In a biological safety cabinet, UV light is not penetrating. Microorganisms beneath dust particles or beneath the work surface are not affected by the UV irradiation. UV lamps must be turned off when the room is occupied to protect eyes and skin from UV exposure. If the cabinet has a sliding sash, close the sash when operating the UV lamp. UV irradiation can cause erythema (redness of the skin) that may damage both the skin and eyes of laboratory personnel. Eyes and skin are primarily involved because UV does not penetrate deeply into tissue. These effects are generally not permanent but can be quite painful.
- **Relative Humidity** – Humidity adversely affects the effectiveness of UV. Above 70% relative humidity, the germicidal effects drop off extremely.
- **Temperature and Air Movement** – Optimum temperature for output is 77-80°F. Temperatures below this optimum temperature result in reduced output of the germicidal wavelength. Moving air tends to cool the lamp below its optimum operating temperature and there results in reduced output.

- **Cleanliness** – UV lights should be cleaned weekly with an alcohol and water mixture as dust and dirt can block the germicidal effectiveness of the ultraviolet lights.
- **Age** – UV lamps should be checked periodically with a UV meter (approximately every six months) to ensure the appropriate intensity of UV light is being emitted for germicidal activity. The amount of germicidal wavelength light emitted from these bulbs decreases with age and bulb ratings may vary by manufacturer.

Effects of Overexposure to Humans

Biological effects from UV radiation depend on wavelength, exposure level, and duration of exposure. Skin exposure to germicidal wavelengths of UV light can produce sunburn and, in some cases, skin cancer. Exposure of UV alone can produce this reddening, but only at very high radiant exposures. Exposure of the eyes to this UV radiation can produce extremely painful inflammation of the cornea and temporary or permanent vision impairment, up to and including blindness in some cases. UV can damage the retina of the eye. A sensation of “sand in the eyes” and reddening of facial skin usually occurs within 6-12 hours of exposure, with the symptoms and discomfort lasting up to 48 hours.

Recommendations

- Retrofitting any equipment (e.g. UV lights) into a biological safety cabinet may alter the air flow characteristics of the cabinet and could invalidate any manufacturer warranty and is not recommended.
- It is the current opinion of the American Biological Safety Association (ABSA) that UV lights are not recommended for use in Biological Safety Cabinetry.

References:

Class II Type B2 Laminar Flow Biological Safety Cabinets at Ordering Criteria for the National Institutes of Health (September 2010):

http://www.ors.od.nih.gov/sr/dohs/Documents/B2_BSC_Specifications.pdf

BMBL 5th ed: http://www.cdc.gov/biosafety/publications/bmb15/BMBL5_appendixA.pdf

www.ors.od.nih.gov/sr/dohs/Documents/B2_BSC_Specifications.pdf - 03-15-2011

American Biological Safety Association (ABSA) Position Paper on the Use of Ultraviolet Lights in Biological Safety Cabinets:

<http://www.absa.org/abj/abj/061104burgener.pdf>

National Institute for Occupational Safety and Health. (2008, April), NIOSH eNews, 5(12). Retrieved September 10, 2008, from

<http://www.cdc.gov/niosh/enews/enewsV5N12.html>