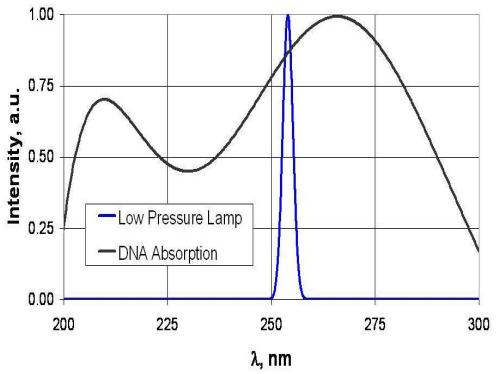
Sterilization with UV Flash Lamps

1. Conventional CWUV sterilization.

The conventional UV sterilization with CWUV mercury lamps (254 nm) is known as Germicidal Inactivation (UVGI):

254 nm (4.9 eV) photons at a sufficient UV Dose J/cm² disrupt DNA chains making micro-organisms inactive. It is possible because this UV line is near the maximum of the DNA absorption and because it energy exceeds the electron binding energy in DNA:

However, DNA has a programmed ability to repair this damage with time, known as a recovery time. The recovery can be minimized both by the UV dose (in mJ/cm²) and by the UV intensity (mw/cm²). Below are data for 1 log (90%) sterilization doses (254 nm line, a CWUV Mercury lamp) for selected micro-organisms:

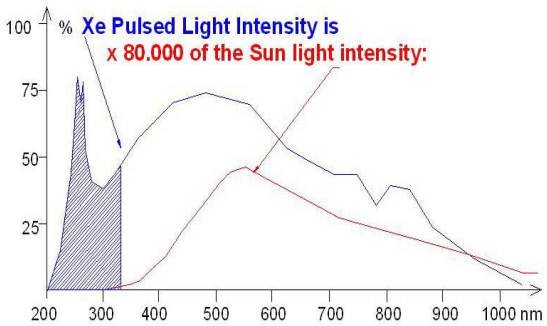


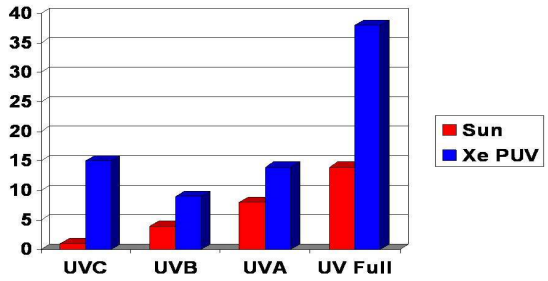
Bacteria	mJ/cm²	Viruses	mJ/cm²
	2 – 6	Phage	2 - 35
Escherichia Coli	5 – 40	Hepatitis	2 - 6
Salmonella			
		Cryptosporidium	2 – 10
Spores			
	20 - 36	Yeasts	100 - 500
Bacillus Subtilis	20 – 80		
Aspergillus Niger			

2. Pulsed UV sterilization.

The effective temperature of a pulsed discharge in a flash lamp reaches 10,000°K to 20,000 °K! It´s maximum spectral output is in the UVC-UVB region with a visible light output similar to that of the Sun.

pulsed UV and sun-light spectra:



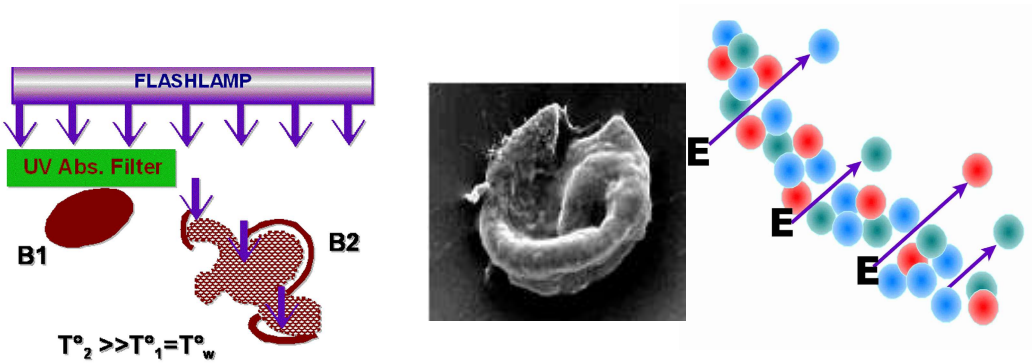


The Solar UV has significantly less UV because the effective visible temperature of the Sun is also far less: 5780°K.

Sterilization actions by intense Pulsed UV Light: UVC fluxes of 1 to 3 kw/cm² at a product level far exceed those of CWUV mercury or excimer lamps and cause a massive germicidal damage, where the DNA recovery programm is no longer effective:

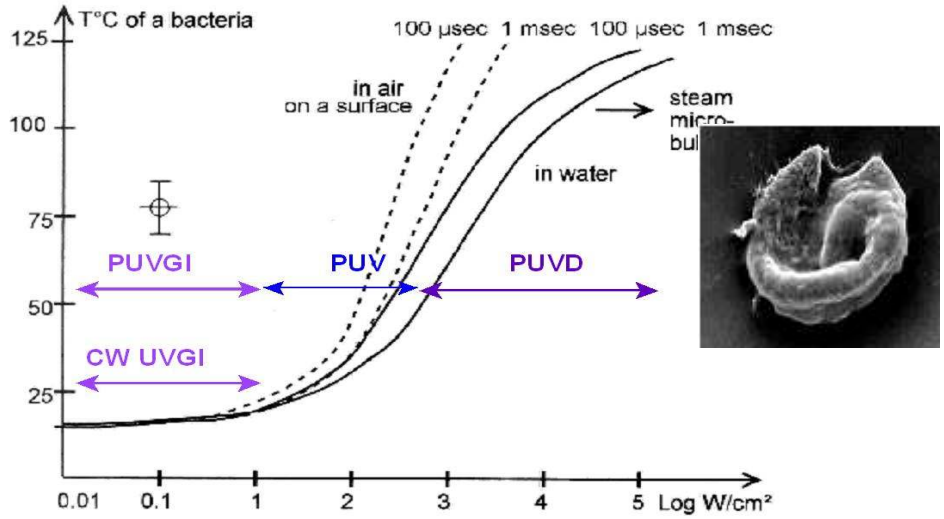
See details in "Our Publications: Alex Wekhof, PDA J. of Pharmaceutical Sci. & Techn. May 2000:

In UV transparent media at high photon fluxes in kw/cm² range micro-organisms are destroyed through an instant overheating:



Three Regions of Pulsed UV Sterilization:

- PUVGI: the same germicidal inctivation (GI) as with mercury lamps.
- PUV: accelerated germicidal inactivation not possible with UV mercury lamps.
- PUVD:disintegration,possible only with intense pulsed UV from flash lamps, first described by Dr-. Wekhof in PDA (200) and then experimentally proved by a joing work with Fraunhofer (Aachen Freizing), published at *Report to the 1-st IUVA Congress, 2001, USA*.see INFO for down loading.

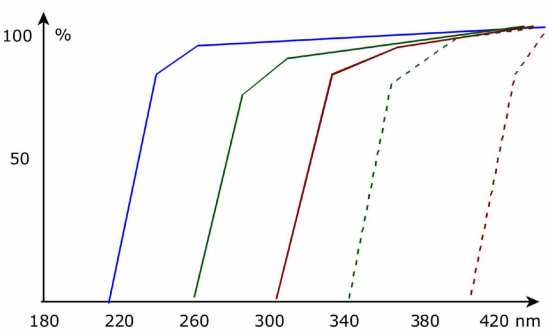


Practical Note: Pulsed UV sources have no advantage in the PUVG region when

- the full pulse energy is too small (e.g. 10 Joules for a 10 cm lamp)
- a pulse duration is too long (e.g. a few msec)
- samples are too far from a flash lamp (geometrical – optical losses)

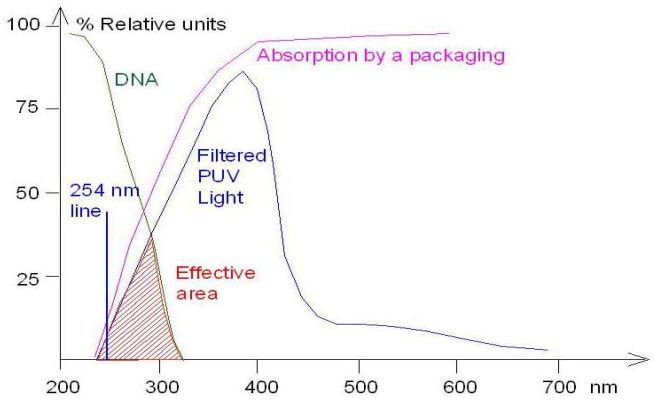
In this case the PUV action is identical to work of a simple CWUV Mercury lamp! See our section "comparison of UV sources" for further info.

Working with clear plastic foils as wraps (PP, PE, etc):



on the left is a relative UV absorption by 0.2 – 0.5 mm thick materials such as (left to right:

- Clear Teflon, UV glass,
- Topas, Nylon, LDPP and PE,
- Pyrex,
- PET, standard glass,
- Makrolon.

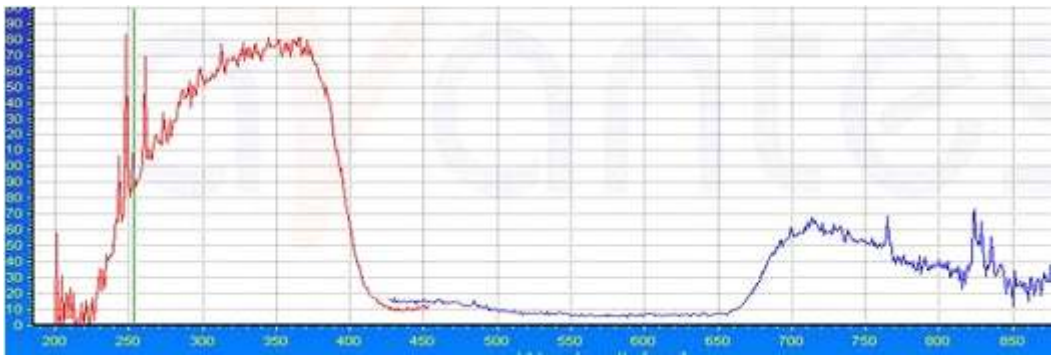


On the left is the effective sterilization emission through a UV-semi-transparent packaging material (on the right):

Resume: sterilization is possible with the Pulsed UV light, and it is not possible with the 254 nm line!

Moreover, it is possible to have a broad filtered UV or UVB + UVA light, where the visible and IR light are filtered out. This is very useful for many applications, where extra heating and bleaching have t be suppressed.

Examples of the Filtered "Cold" full UV (200-400 nm) light:



UVA and UVB + light: (310-400 nm)

Unique benefits of Pulsed UV Sterilization:

- One to 3 pulses can fully (6 logs!) sterilize a product;
- Flexible adaptation to fast computerized conveyer lines;
- Sterilization through UVC / UVB transparent packaging;
- Effective both for UV- and thermal resistant micro-organisms;
- No warm-ups, an instant UV sterilization action,
- No heat or structural DAMAGES to a product ;
- Low operating costs per a sterilized item;
- No Mercury - it is safe and environmentally friendly,
- FDA approved and requires no labeling unlike e-beams or cobalt gamma sources).

One of SteriBeam Systems' technical advantages in the engineering of its systems is the use of state-of-the-art HV switching technology and effective Pulse Forming Networks to assure the maximum energy transfer into UV light at various treatment geometries.

SteriBeam Systems also offers its expertise in the installation of any necessary diagnostic instrumentation and consultation relating to the evaluation of test studies.

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Please inquire for evaluation tests to find optimal conditions for your application.