

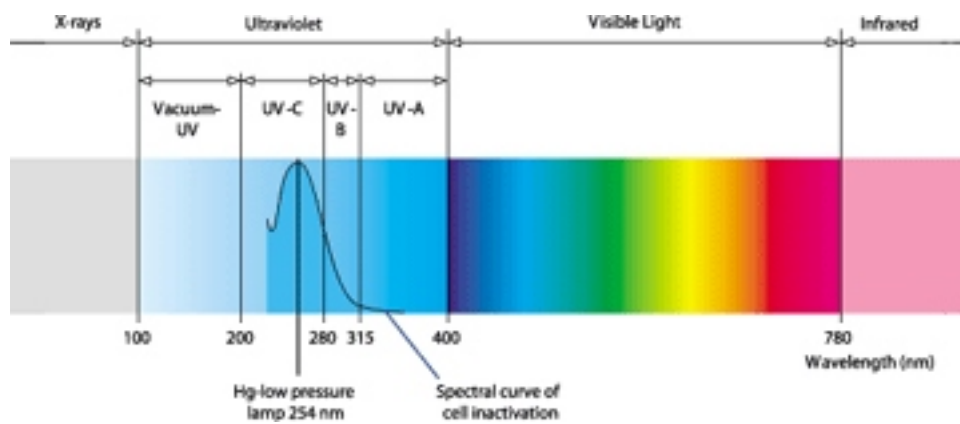
# A closer look at UV Systems

## Fundamentals of ultraviolet disinfection

Ultraviolet energy causes permanent inactivation of micro-organisms by disrupting DNA so that they are no longer able to maintain metabolism or reproduce.

The maximum effectiveness occurs at between 240nm and 280nm, with the most effective wavelength typically at 254nm.

All bacteria, spores, viruses and protozoa (including Cryptosporidium and Giardia oocysts) are permanently inactivated by UV.



## UV Dose

**UV Dose (J/m<sup>2</sup>) = Intensity of UV radiation (W/m<sup>2</sup>) x retention time (s)**

UV dose is probably the most critical success factor for UV disinfection.

- No microorganisms are known to be immune to UV-C radiation. UV-C radiation is effective against bacteria, moulds, fungal spores, viruses and yeasts
- The dose of UV radiation required to achieve 90% reduction of a specific microorganism is called the D10 i.e. the dose at which only 10% of the microorganisms survive.
- Doubling the D10 dose achieves an overall 99% reduction in the microorganism.
- D10 dosage values are known for most pathogenic microorganisms.
- Good quality UV systems are generally designed to eliminate at least 99.99% of the targeted microorganisms.

- UV systems can also achieve more than 99.99 % elimination of the targeted microorganism.
- Achieving 99.99% kill rate (i.e. 4-log inactivation) requires dosage of 4 x D<sub>10</sub> for the targeted microorganism.
- The following table shows an example of the relationship between UV dosage and kill rate of E-coli.

### **Relationship between UV dosage and elimination of E - coli**

UV dose delivered	% E - coli eliminated	Dose (mWs/cm <sup>2</sup> )
1 x D <sub>10</sub>	90 %	5.4
2 x D <sub>10</sub>	99 %	10.8
3 x D <sub>10</sub>	99.9 %	16.2
4 x D <sub>10</sub>	99.99 %	21.6
5 x D <sub>10</sub>	99.999 %	27

UViFLO UV systems provide minimum 300 J/m<sup>2</sup> dosage @94% T & rated flow rate.

## **Evaluating a UV system**

Not all UV systems are alike and it pays to understand exactly what you are buying and how it meets your requirements.

### **1. UV dose delivered**

UV dose and its reliability across flow rates is one of the most important features of a UV system.

Inadequate UV dosage will result in partial disinfection, defeating the purpose of installing a UV system in the first place.

A key assumption for UV dose calculation is the %T of the water (the % transmissivity to UV-C radiation).

### **2. Total no of UV lamps**

All other things being equal, a UV system with lower no of UV lamps tends to have lower operating cost compared to a UV system with a higher no of lamps.

### **3. UV lamp quality**

UV lamps can be classified into the following 3 types

- Low pressure Low intensity (Low Low)
- Low pressure High intensity (Low High)
- Medium pressure High intensity (Medium High)

Other important lamp considerations are:

- %T of the lamp glass:
  - Some types glass used for lamp construction tend to absorb a considerable % of the UV radiation, thus reducing the UV intensity and hence UV dose.
- UV energy output of the lamp
- Energy efficiency of the lamp
- Effective lamp life:
  - The UV output of a lamp drops with usage and it is important to base UV dose calculations on the UV output at the end of useful life of the lamp.
  - Rate of lamp ageing (drop of UV intensity with usage)
    - A lamp with longer effective life tends to be more effective and economical.

#### **4. Quartz sleeve quality**

The higher the %T of the quartz sleeve to UV-C radiation, the higher is the UV intensity and hence the higher the UV dose.

Any material (e.g. Teflon or low quality glass) that does not transmit a high amount of UV-C radiation reduces the UV intensity and hence the UV dose.

#### **5. Materials of construction**

Electro-polished stainless steel 316 is considered the best material for construction of UV systems.

Electro-polished SS 316 offers the following advantages over other materials like Aluminium and plastics:

- Hygienic and easy to clean
- No adverse health effects unlike Aluminium
- Longer life
- High corrosion resistance

SS 316 offers higher corrosion resistance compared to SS 304. Electro-polishing further enhances the corrosion resistance of SS 316.

#### **6. Pressure rating**

A well built UV system provides sturdy construction, adequate sealing and min. 10 bar pressure rating.

#### **7. Optional extras**

Various additional features can add value to a UV system only if your application requires them. Common features are:

- UV monitor
  - It is important to differentiate between a device that merely senses UV radiation, as against a device that actually measures the intensity of UV radiation (W/m<sup>2</sup>)
  - Lamp fail alarm and its variations
    - A useful feature if the alarm will be acted upon immediately
  - Quartz sleeve wipers, etc.