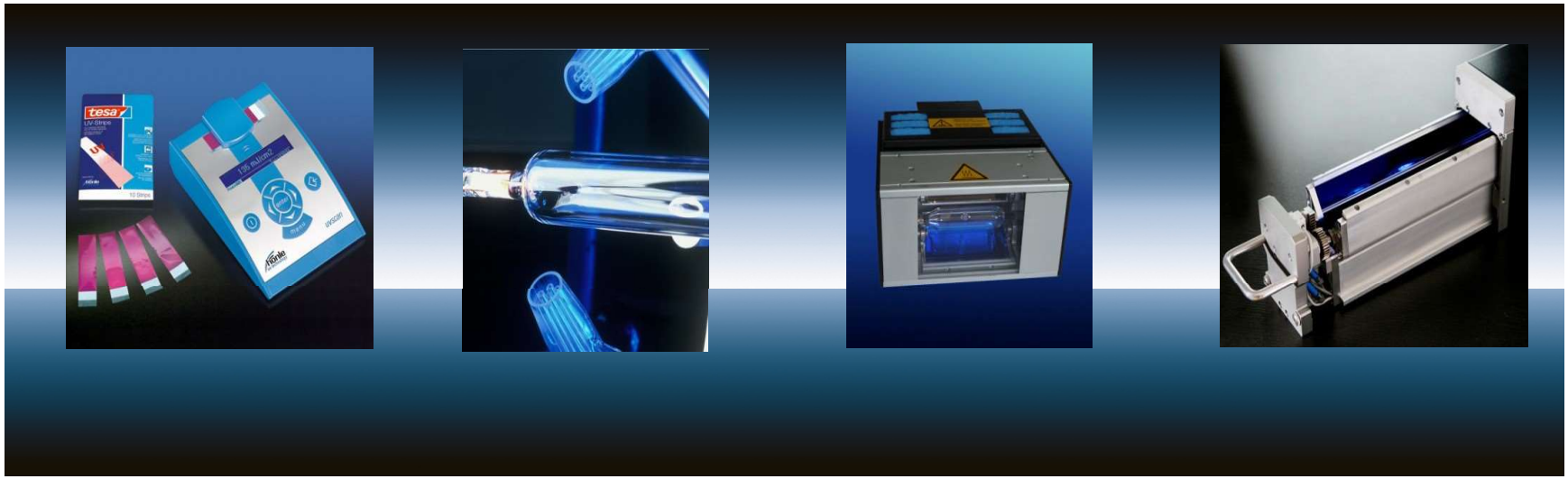
ULTRAVIOLET (UV) IRRADIATION FOR DISINFECTION



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ULTRAVIOLET (UV) IRRADIATION FOR DISINFECTION

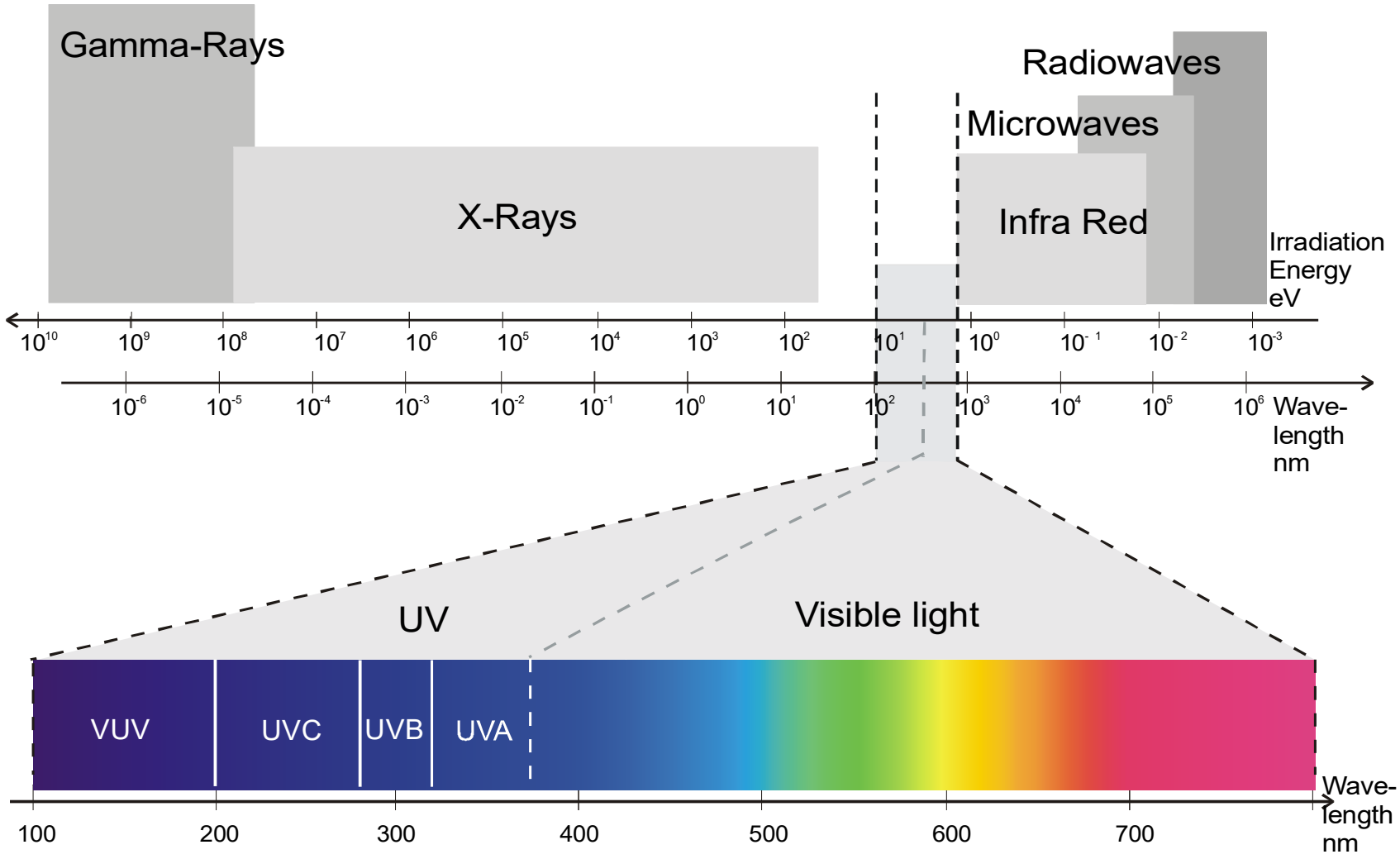
AGENDA

1. UV Radiation Basics
2. UV Disinfection
3. UV Technical Data
4. Applications
5. Results
6. Questions

UV RADIATION - BASICS

Most of the natural UV light people encounter comes from the sun. However, only about 10 percent of sunlight is UV, and only about 1/3 of this penetrates the atmosphere to reach the ground, according to the National Toxicology Program (NTP). Of the solar UV energy that reaches the equator, 95 percent is UVA and 5 percent is UVB. No measurable UVC from solar radiation reaches the Earth's surface because ozone, molecular oxygen and water vapor in the upper atmosphere completely absorb the shortest UV wavelengths.

UV Radiation as a Part of the Electromagnetic Spectrum



UV HIGH PERFORMANCE DISINFECTION MODULE

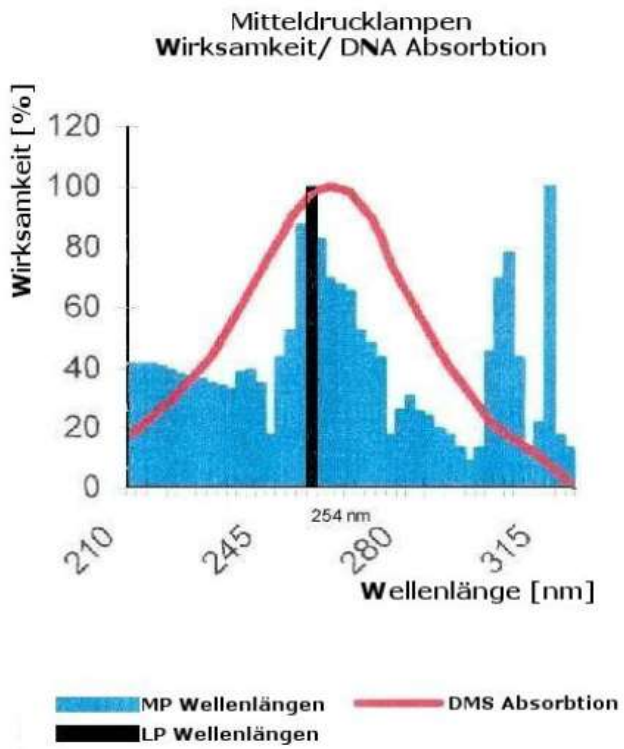
Surface disinfection through UVC irradiation is a reliable and environmentally compatible alternative to chemical methods.

The disinfection module has a CAD-optimised reflector geometry and guarantees the highest irradiance possible, which ensures very good inactivation rates for even very high resistant micro-organisms. The irradiation times required are generally +/- 1 second. Thanks to the compact and slender design as well as to the high UV yield modules can be adapted to very different specifications.

UV - Disinfection

UV radiation has enough energy to break chemical bonds. Due to their higher energies, UV photons can cause ionization, a process in which electrons break away from atoms. The resulting vacancy affects the chemical properties of the atoms and causes them to form or break chemical bonds that they otherwise would not. This can be damaging to materials and living tissues. This damage is beneficial for disinfecting surfaces.

How does it work?



Disinfection Mechanism of UV-C Radiation

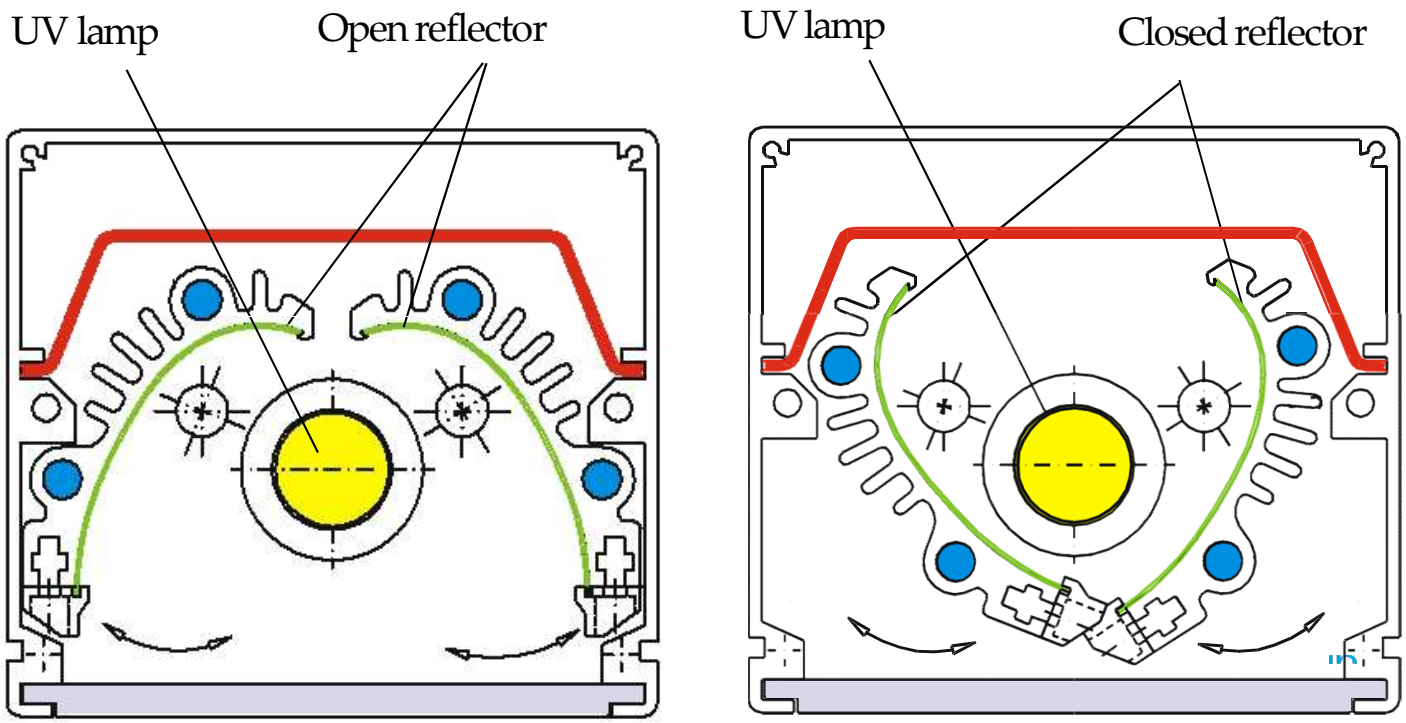
- High energy UV-radiation 200 -280 nm sets off photochemical reactions
- Absorption by cell DNA acids
- The lesion, or damage to the cell DNA, inhibit the normal replication of the genome and result in inactivation of the microorganisms
- The Medium pressure mercury lamp emits UV- C spectrum corresponding with spectral efficiency curve of cell inactivation

Technical Features

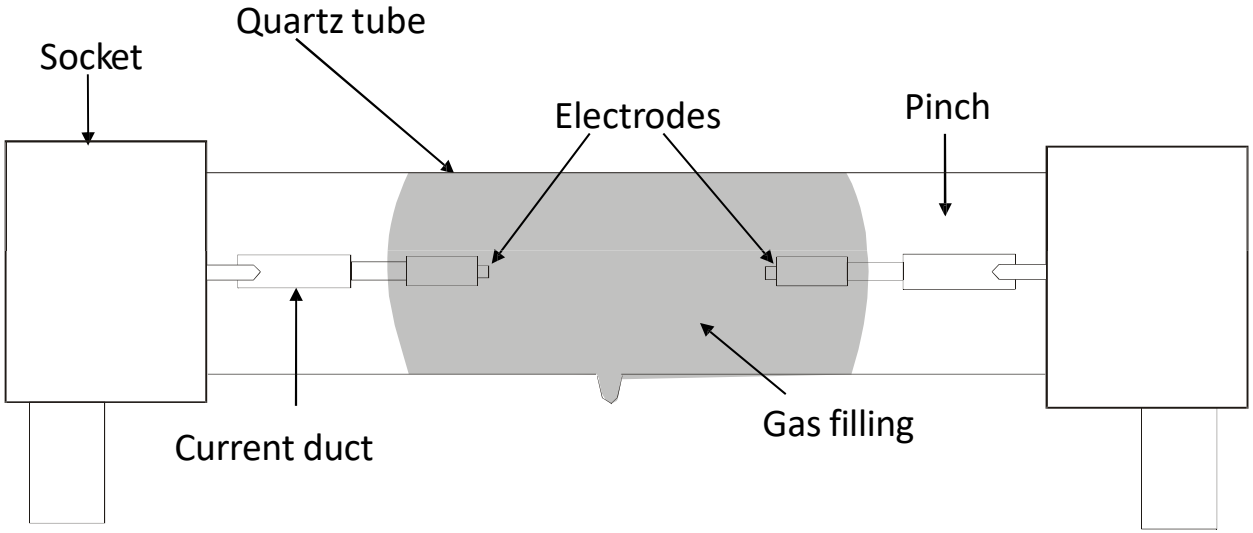
The Lamp Unit

- Air-cooled housing in stainless steel (1.4571)
- Water protection according to IP65 or IP67
- 3-A Rated to meet Sanitary Standards for equipment for packaging viscous products
- Integrated, pneumatical operated shutter system
- Parabolic or Elliptic reflector shape is available
- Medium-pressure UV lamp
- Power output 100 up to 240 W/cm
- High UV-C irradiation intensity > 400 mW/cm²
- Optional quartz breakage detection

Lamp Unit – Shutter System



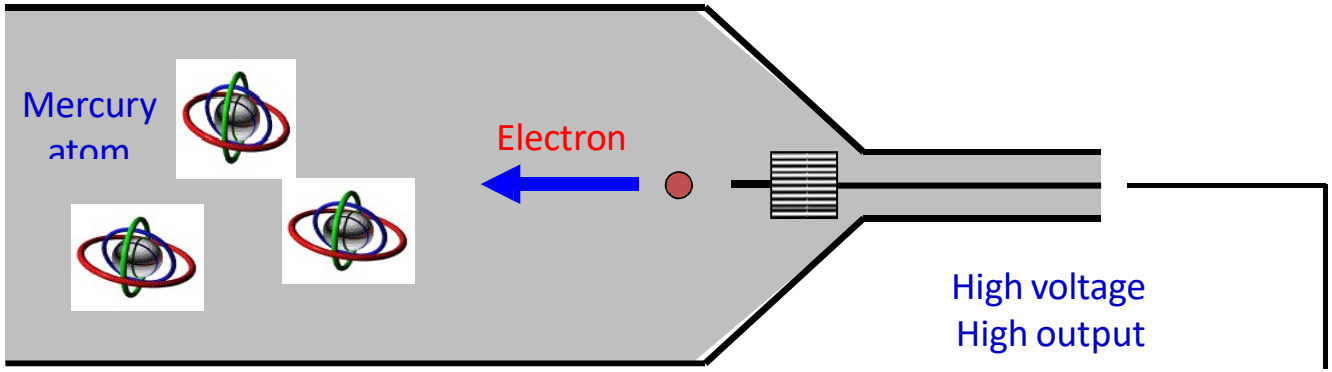
Design of a gas discharge lamp



UV-C is one of many electromagnetic frequencies emanating from the sun. Like other of these waveforms, its' properties are unique to its wavelength. To synthesize this frequency, a glass tube is evacuated and refilled with argon at far below atmospheric pressure. Add to this is a small amount of mercury. When the mixture is energized (excited) it creates a glowing plasma of electrons that pass through the mercury vapor. As they strike mercury atoms, a mercury electron is liberated at a frequency representative of mercury's spectral line, which is 253.7nm. The dominant emission (>90%) from these lamps is UV-C energy. The "C" frequency of the electromagnetic UV family has, amoungst other things, germicidaleffects.

Medium Pressure Lamp

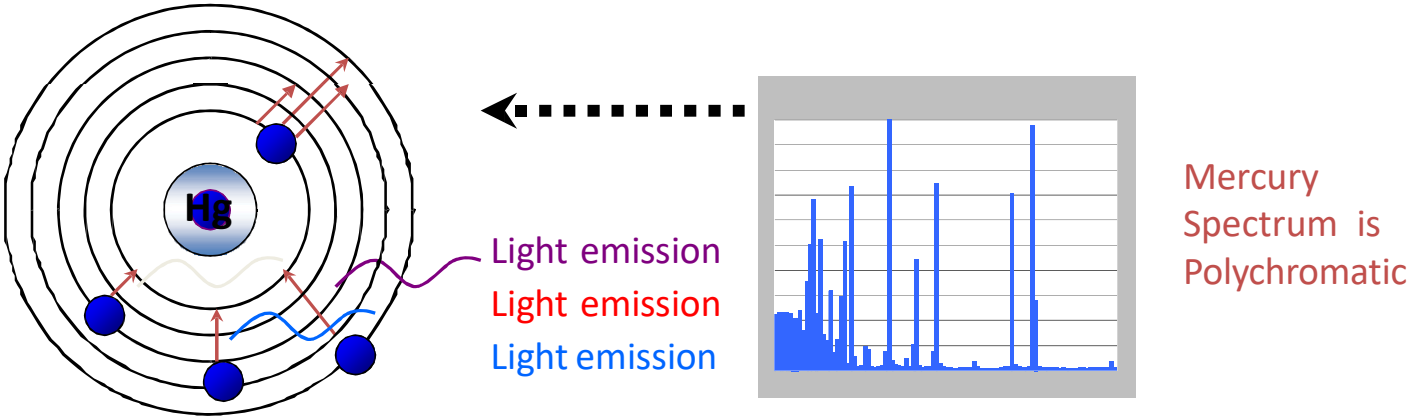
The medium pressure lamp is able to activate more mercury atoms because of the upper kinetic energy of the electrons. Thereby a higher intensity in the UV spectrum is created.



Medium pressure lamps can be used for surface disinfection with short irradiation times because of the higher output of 100 – 240 W/cm (watts per centimeter).

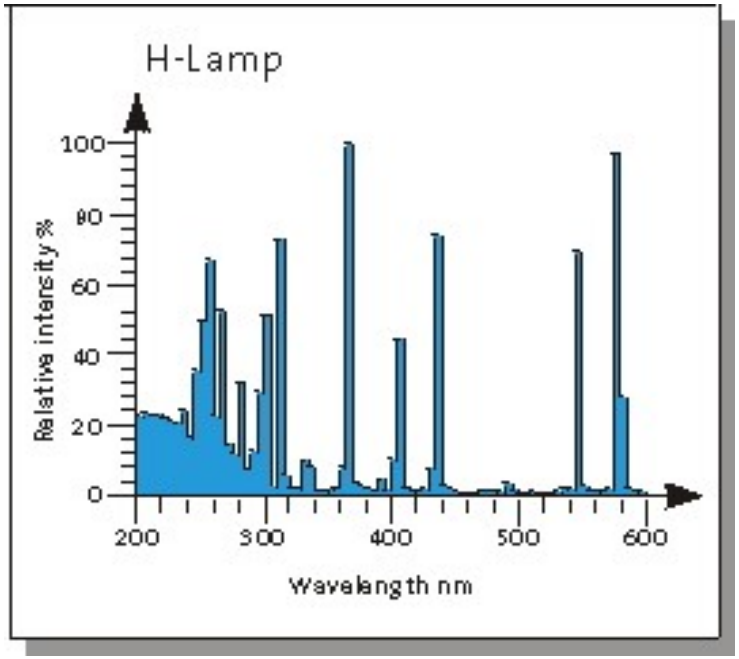
Activation in Medium Pressure Lamps

The atom is set in many different activated conditions because of the high energy of the electrons. Beneath the peak many side lines are created and generate the characteristic spectrum of UV medium-pressure lamps with pure mercury filling.



(Polychromatic: of a number of wavelengths, frequencies or light and radiation)

Medium Pressure Lamp (Mercury / H - Lamp)



High intensity part in the whole UV-C wavelength range:

* Disinfection of surfaces and liquids

Technical Features

Electronic power supply (EPS)

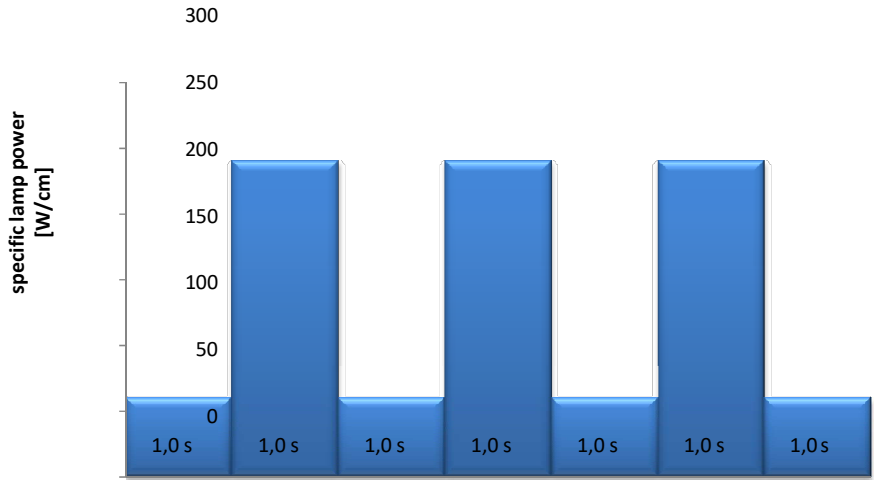
The EPS is a full electronic controllable AC power supply for UV-discharge lamps of max. 10 kW nominal power.

Features:

- Higher efficiency because of rectangular current output compared to a standard power supply
- Continuously variable power control between 15% to 100%
- Power Control of lamp power at 5 ms possible
- No ignitor needed
- Detailed error monitoring
- Improved re-ignition

Technical Features

EPS power control operation of the UV lamp for 30 work cycles per minute



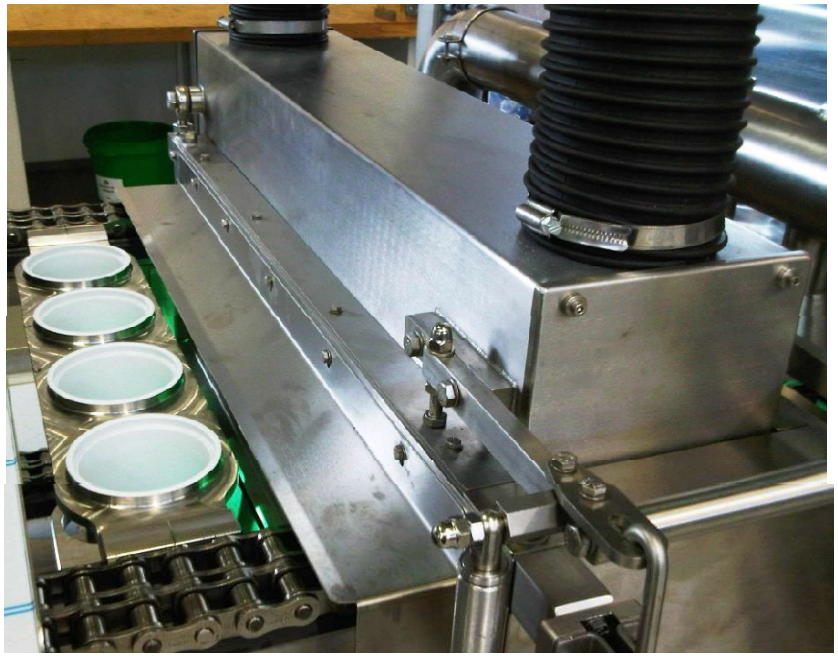
The electronic ballast enables varying power control operation of the UV lamp.

The power of the UV lamp is switched between highest 240 W/cm and low power level 60 W/cm correspondent to the cycle time of the filling machine.

This procedure will create a much higher radiation intensity and ensure an effective disinfection for larger cups with deeper depths.

UV-C Applications

UV-C Application



Filling machine for pre-formed cups.

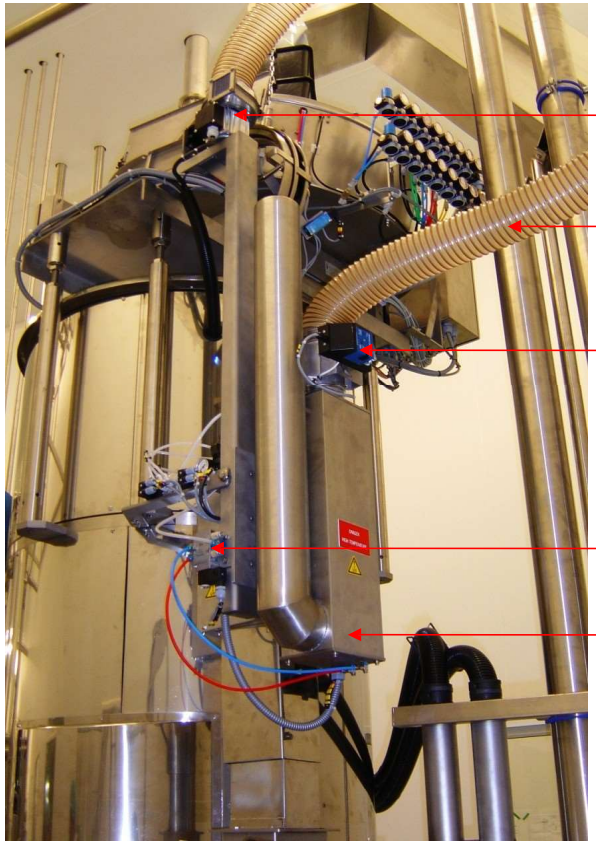
Disinfection of cups and lids

UV-C Application

Thermoform filling machine.

Foil disinfection

UV-C Application



Bottling plant

Disinfection of srcew-caps

Cooling fan

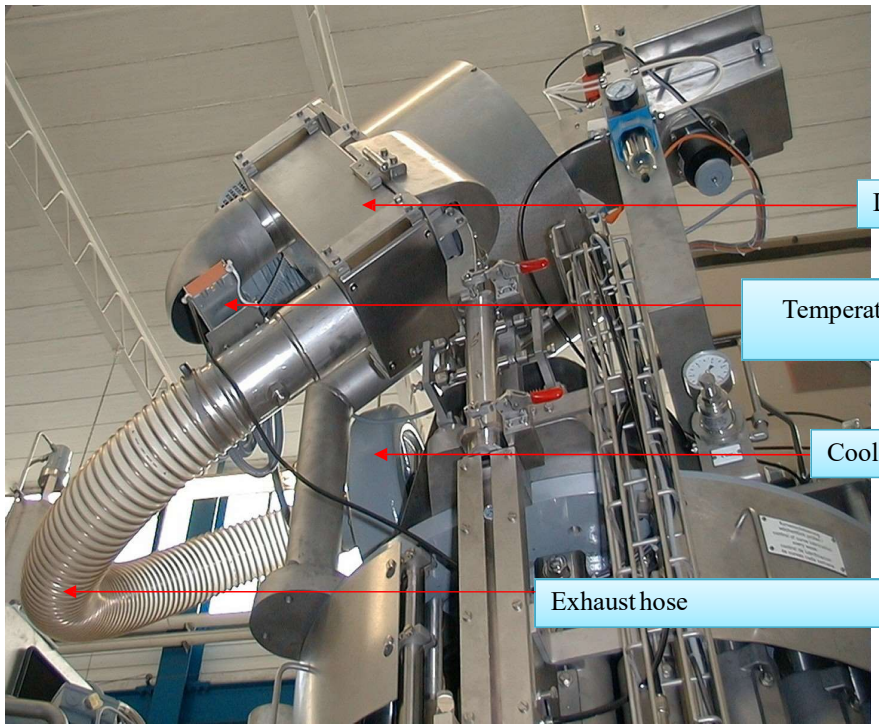
Exhaust hose

Temperature controlled Air throttle

Magnetic valve

Lamp unit

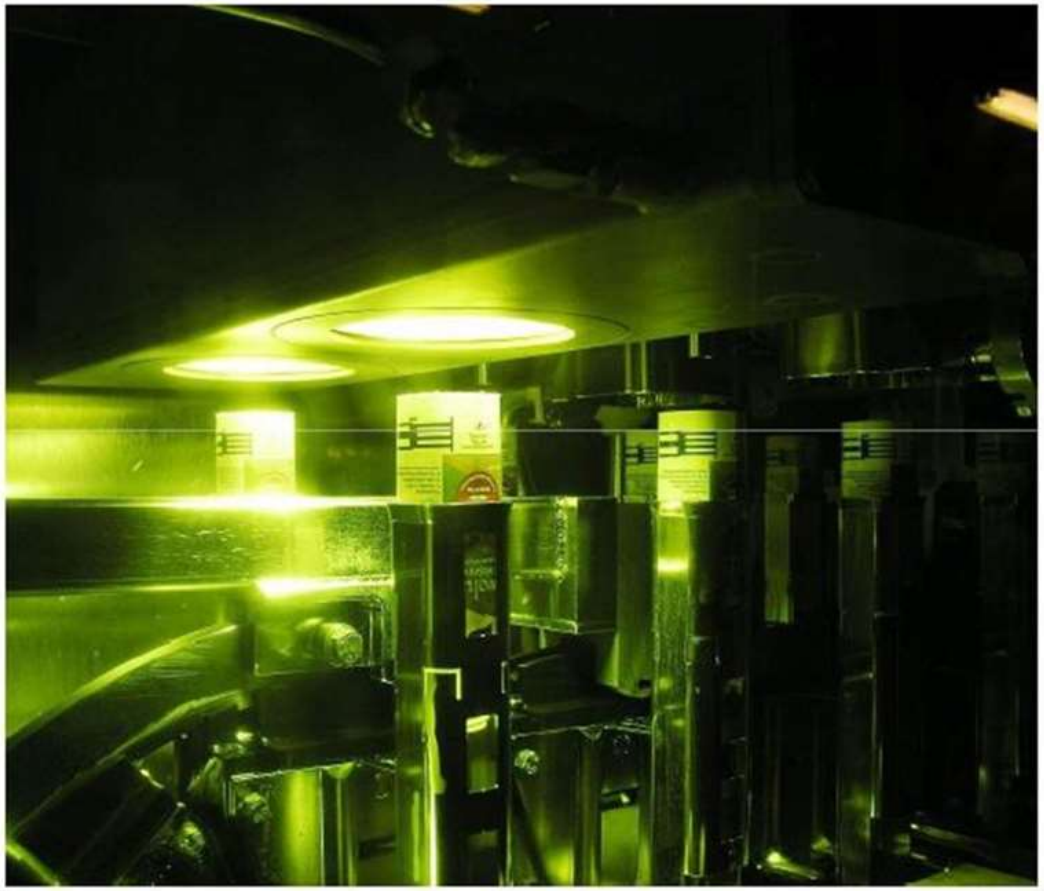
UV-C Application

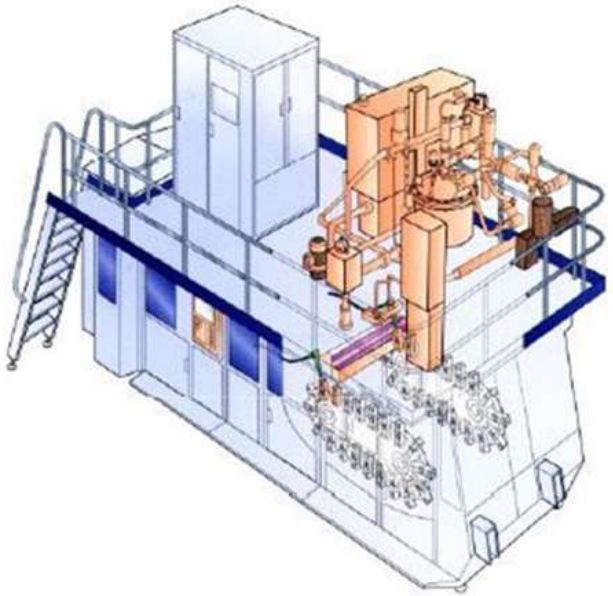


Bottling plant

Disinfection of crown corks

UV-C Application





Carton filling line

Disinfection of carton in combination with hydrogen peroxide

UV-C Results

Lower Complaint Rates - Extended Shelf Life

Key benefits of UV-C Irradiation for Disinfection:

- Disinfection in less than a second, e.g. foil @ 0.3 sec
- Inactivation rate for mould spores higher than log 4
- Inactivation rate for bacteria higher than log 4
- Lower complaint rates - Extended shelf life
- Compact design - easy retro-fitting and integration in new machines
- No overheating possible
- Effectivity is confirmed by independent laboratories

Log Reduction Testing

UV-C disinfection results are measured in Log Reduction Testing.

Independent laboratories are used to measure log reduction. Sample material, cups, caps, foils, etc., is sent to the lab for testing. The lab applies microorganisms to the material and then applies UV-C in a controlled test environment for specific amounts of time and records the log reduction results.

“Log reduction" is a mathematical term (as is "log increase") used to show the relative number of live microbes eliminated from a surface by disinfecting or cleaning.

For example, a "5-log reduction" means lowering the number of microorganisms by 100,000-fold, that is, if a surface has 100,000 pathogenic microbes on it, a 5-log reduction would reduce the number of microorganisms to one.

Log Reductions

1 log reduction means the number of germs is 10 times smaller

2 log reduction means the number of germs is 100 times smaller

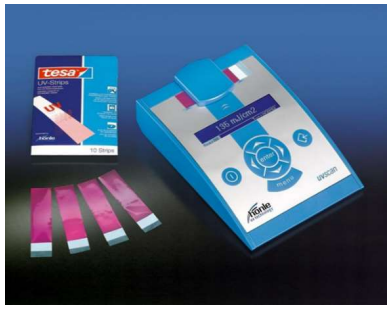
3 log reduction means the number of germs is 1000 times smaller

4 log reduction means the number of germs is 10,000 times smaller

5 log reduction means the number of germs is 100,000 times smaller

(Source: The Cleaning Industry Research Institute)

UV-C Disinfection Production Testing



- UV scan meters are used as a reading device for evaluation and storage of the data
- The meters use photo chromatic film for UV dose measurement on object surfaces
- The film is available in self-adhesive flexible measuring strips
- Minimal thickness of measuring strip allows for easy application
- Reproducible results are attained
- Measurement even on complex surface geometries and on surfaces which are difficult to access
- UV scan meters are used in the food industry as a reading device for evaluation and storage of the data

UV-C Disinfection tests on 2-lane rotary cup filling machine

Cup / Ref.		Test series	Germs	Pack material	Result	
A-B4 Ø 95mm H= 59 mm, PP, 200 ml	A-B4.1	One UV-lamp unit	Aspergillus niger DSM 1957	10 cups	log 4,5	
	A-B4.2	Two UV-lamp unit	Aspergillus niger DSM 1957	10 cups	log 5,4	
B-B1 Ø 70mm H= 109mm PP 210 ml	B-B1.1	One UV-lamp unit	Aspergillus niger DSM 1957	10 cups	log 2,9	
	B-B1.2	Two UV-lamp unit	Aspergillus niger DSM 1957	10 cups	log 5,2	

hönle group

Strong Brands – Strong Products

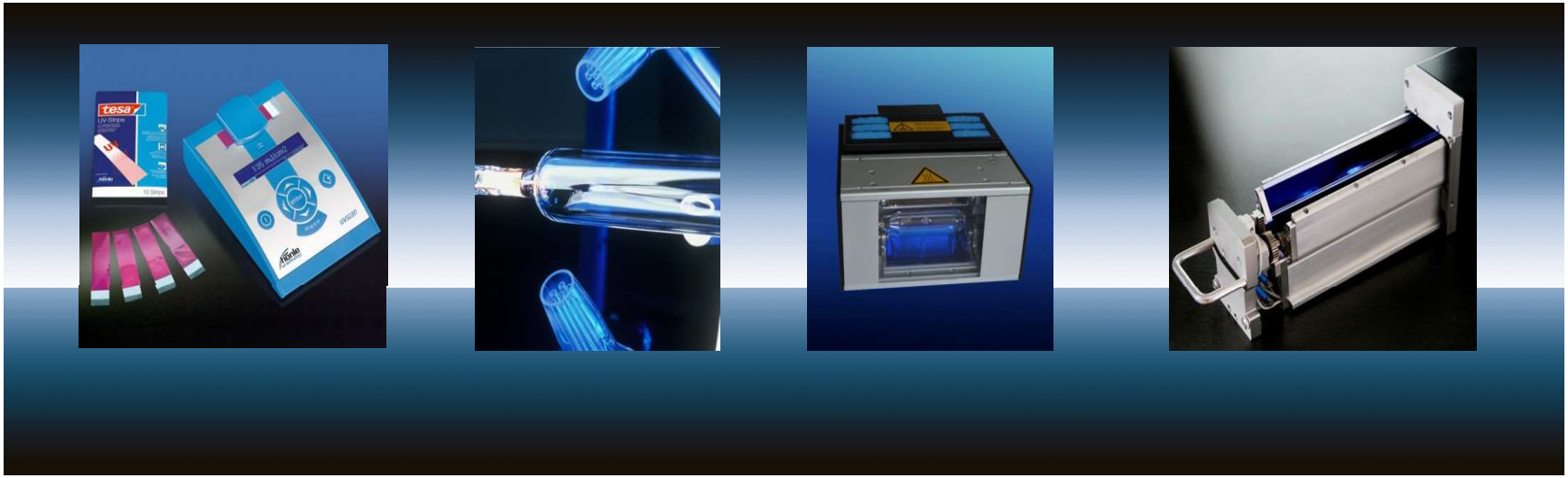
Hönle Group – key figures of the financial year 2018:

- 17 companies
- Annual turnover > EUR 120 million
- > 600 employees
- In-house development and production
- International service and sales team

Hönle is an innovative and stock listed company

Honle Worldwide

Thank you for your attention
Henry Black



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