

Naturlig Desinfektion:

- Startet in 2006
 - Developed and sold UV products since 2008
 - Supplier
 - European
 - Each with over 45 years of experience with UV light
 - Focus
 - Customized solutions
 - efficiency
 - Service / needs
 - Security
 - Products
 - UV –C for disinfection
 - UV-A (Blacklight) for detection of contamination, bad habits, cleaning quality
- Background:
 - Cand. Agro



Why is UVC interesting:

- Non contact technology
- No Water
- No chemical substances
- No known resistance
- Shelf life
 - Without additives
- Fast development due to technological capabilities
- LED technology is the future

UV-Light:

According to CIE classification the UV light is divided into 3 bandwidths

- UVA (long wave UV light) from 315 nm to 400 nm (Black Light)
- UVB (middle wave UV light) from 280 nm to 315 nm
- UVC (short wave UV light) From 100 nm to 280 nm (Damaging cells)



X-rays are 0,01 til 10 nm

10 to 100 nm is called Vacuum UV and/or extreme UV. Absorbed very quickly in air

UV-C light and corners:

- Effect:
 - Where it can reach!



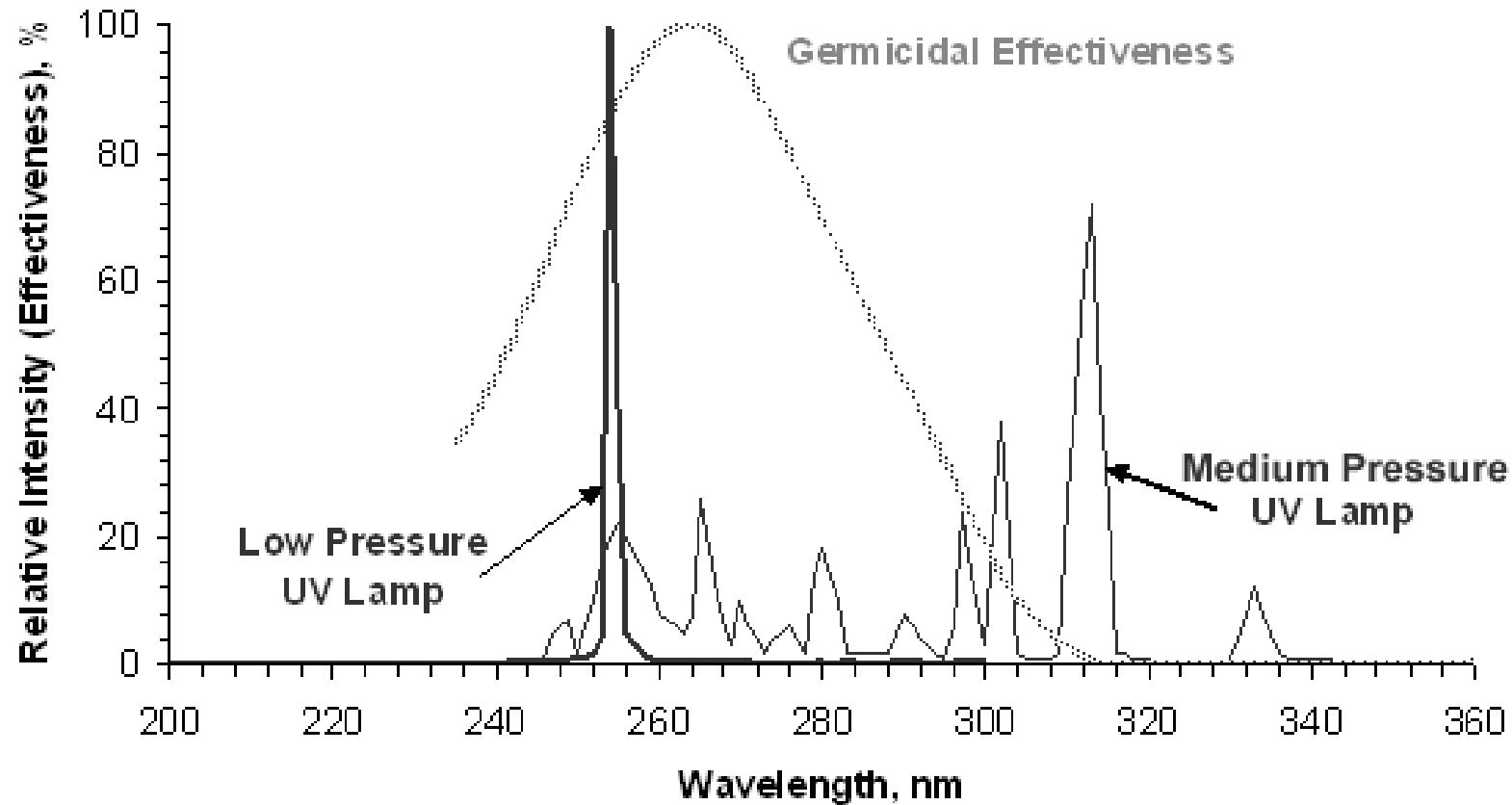
Reality



Sales people

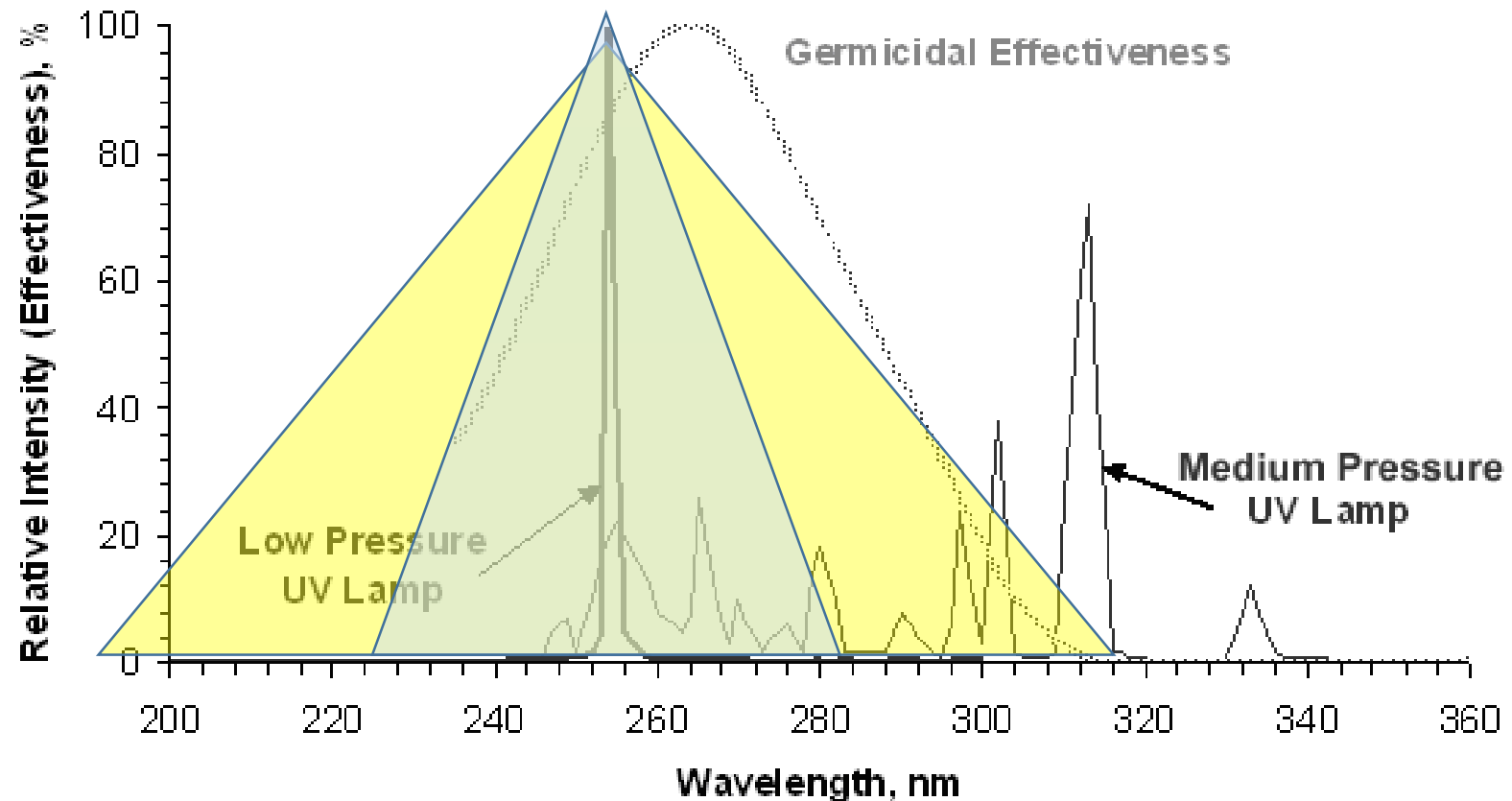
UVC lamp physics:

- UVC Lamp
 - Low- medium- and High pressure



UVC lamp physics:

- UVC Lamp
 - Current discharge depends on the quality.



UVC lamp physics

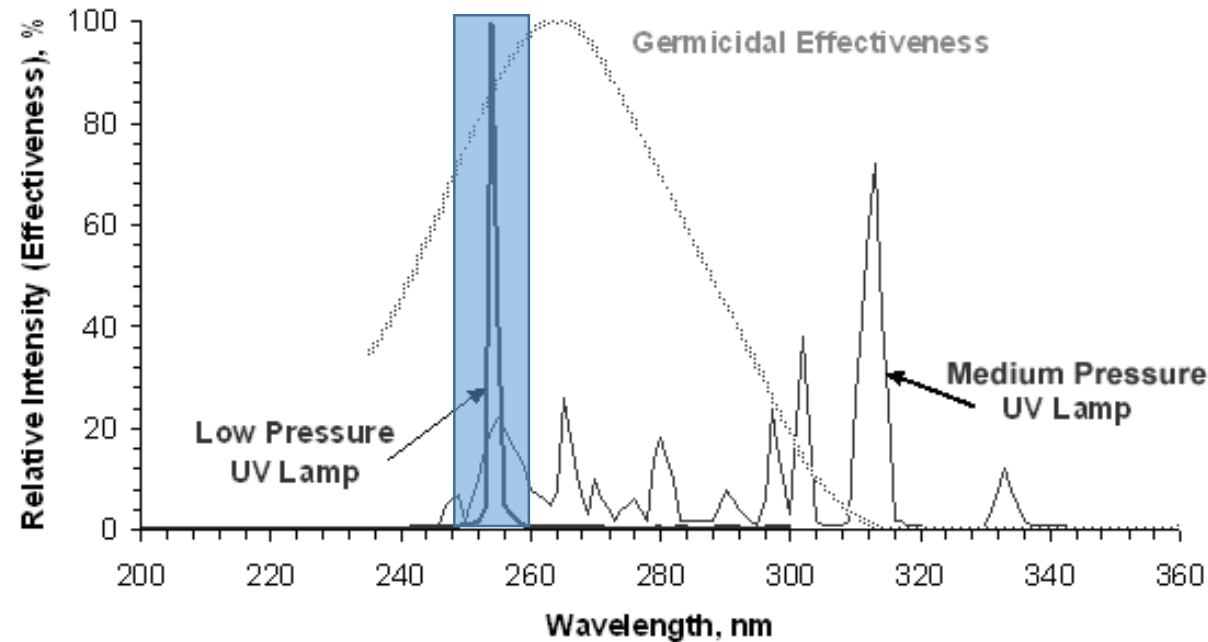
- OZON FREE
 - Special quartz glass
 - Filter wavelength below 200 nm away

- No PLEXI GLASS
 - Filters 99 % away
 - ☹️



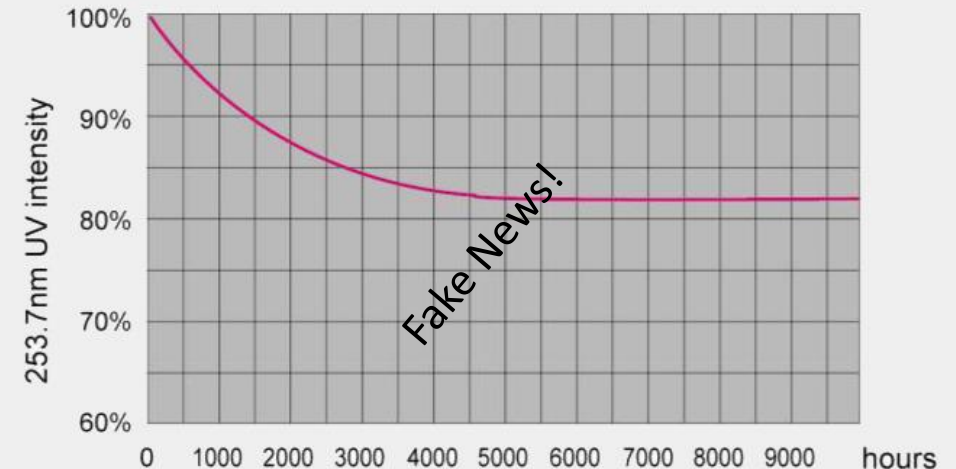
UVC lamp physics

- Lamp/bulb is a discharge lamp
- Under 200 nm results in the formation of ozone
 - Often unwanted
 - Ozon generators are UVC lamps below 200 nm



UV-C light, focus:

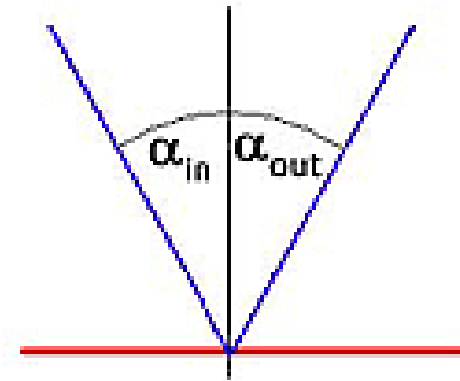
- Known common mistakes:
 - When calculating the effect it should be based on the last use day. 60% of the lamps original capacity.
 - Often it is calculated on start capacity eg. 100%
 - Forgotten is often the transmission loss over glass, membranes etc.
 - Fake curves are sometimes produced
 - The lamp will always become less and less effective



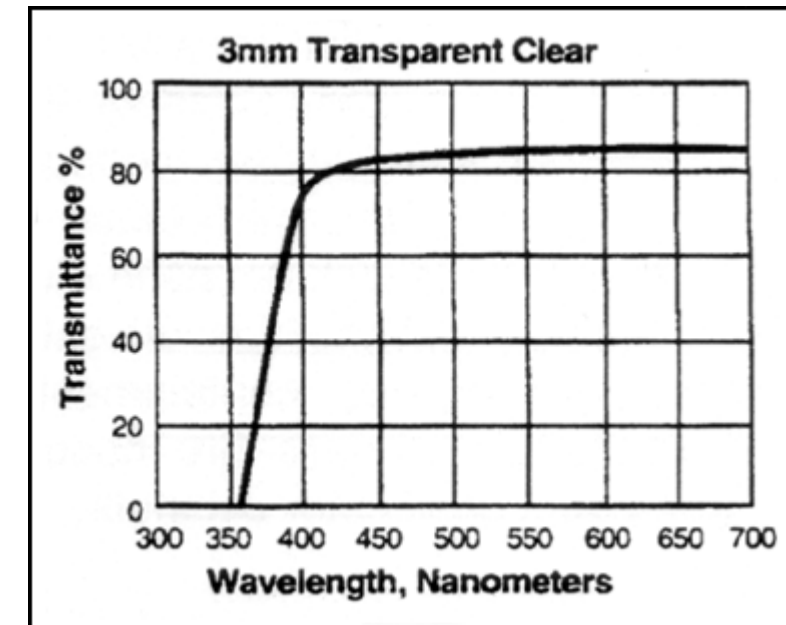
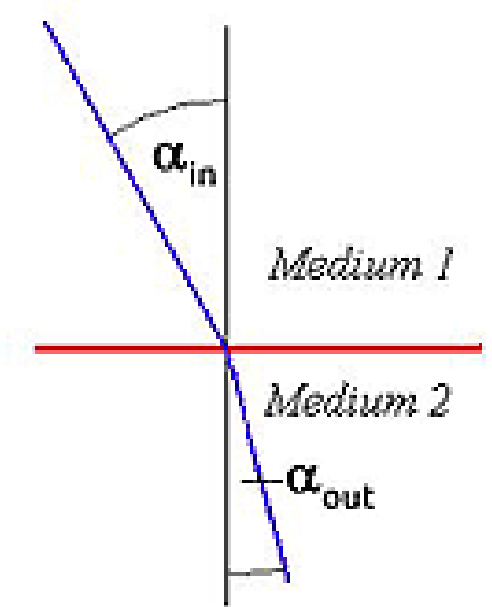
UV-C light Focus

- Reflection and transmission:
- Reflection:
 - Mirror 20-40 %
 - High-gloss polished stainless steel 20-50%
 - Special coatings up to 90%
- Transmission
 - Quartz glas
 - Plexiglass over 3 mm
 - Normal windows, thermo

Reflection



Transmission



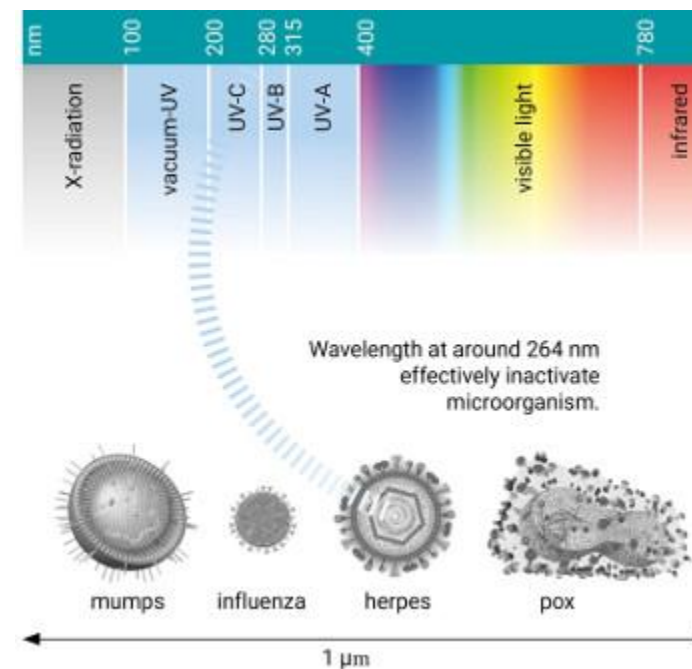
UV-C light, calculation:

- Effect:
 - The UV radiation from a given source is expressed in watts (W) and the radiation density is expressed in watts per square meter (W/m^2).
 - In order to achieve a significant effect on microorganism, we must achieve a certain dose, ie. radiation density over time. This is defined as Joule per square meter J/m^2



UV-C light as "killer":

- Short wave light around 260 nm
 - Kills all microorganisms by destroying cells walls, RNA/DNA
 - No chemical waste
 - No resistance
- Be aware:
 - Bacteria are still present but they are dead
 - Measuring methos



UV-C lamp dosis:

- If we know what to kill
- If we can reach it
- Time available

- Then we can kill it all!

UV dosis

I tabellen herunder er angivet nødvendig UV dosis for inaktivering af en lang række mikroorganismer I niveau for 90-99,99%. Tallene er baseret på anerkendte og publicerede undersøgelser.

Inaktivering af mikroorganismer med UV-lys er en eksponentiel proces. Jo højere UV lyseksponering (dosis), jo højere er andelen af mikroorganismer bliver inaktiveret, dvs.:

UV lys eksponering (dosis) nødvendig for at inaktivere 99% er 2 gange værdien for at inaktivere 90%.

UV lys eksponering (dosis) nødvendig for at inaktivere 99,9% er 3 gange værdien for at inaktivere 90%.

UV lys eksponering (dosis) nødvendig for at inaktivere 99,99% er 4 gange værdien for at inaktivere 90%.

Bakterier

Mikrobe	UVC dosis i J/m ² nødvendig for at opnå 90% – 99,99% reduktion af den specifikke organisme			
	90% (1 log)	99% (2 log)	99.9% (3 log)	99.99% (4 log)
Bacillus anthracis – Anthrax	45.2	90.40	135.60	180.80
Bacillus anthracis spores – Anthrax spores	243.2	486.40	729.60	972.80
Bacillus magaterium sp. (spores)	27.3	54.60	81.90	109.20
Bacillus magaterium sp. (veg.)	13.0	26.0	39.0	52.0
Bacillus paratyphusus	32.0	64.0	96.0	128.0
Bacillus subtilis spores	116.0	232.0	348.0	464.0
Bacillus subtilis	58.0	116.0	174.0	232.0
Campylobacter jejuni	11.0	22.0	33.0	44.0
Clostridium difficile (C. difficile or C. diff)	60.0	120.0	180.0	240.0
Clostridium tetani	130.0	260.0	390.0	520.0

UV-C lamp dosis:

- Bacteria, moderate dosis
- Virus , medium to high dosis
- Molds, High dosis

Listeria Monocytogene	40.0	80.0	120.0	160.0
Micrococcus candidus	60.5	121.0	181.5	242.0
Micrococcus sphaeroides	100.0	200.0	300.0	400.0
Mycobacterium tuberculosis	60.0	120.0	180.0	240.0
MRSA	32.0	64.0	96.0	128.0
Mycobacterium tuberculosis	62.0	124.0	186.0	248.0
Neisseria catarrhalis	44.0	88.0	132.0	176.0
Phytomonas tumefaciens	44.0	88.0	132.0	176.0
Proteus vulgaris	30.0	60.0	90.0	120.0
Pseudomonas aeruginosa	55.0	110.0	165.0	220.0
Pseudomonas fluorescens	35.0	70.0	105.0	140.0
Proteus vulgaris	26.4	52.8	79.2	105.6
Salmonella enteritidis	40.0	80.0	120.0	160.0
Salmonella paratyphi – Enteric fever	32.0	64.0	96.0	128.0
Salmonella typhosa – Typhoid fever	21.5	43.0	64.5	86.0
Salmonella typhimurium	80.0	160.0	240.0	320.0

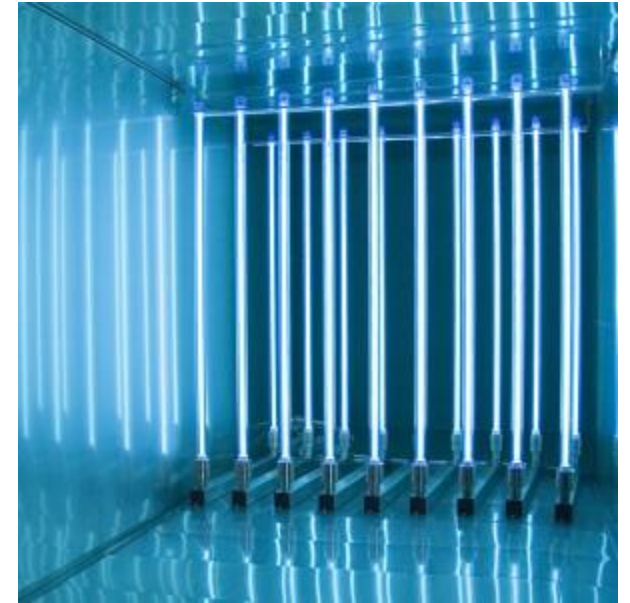
UVC Liquid:

- Effect:
 - Where it can pass through
 - Clean water, process water (brine) colored liquids (juice, polluted water)
 - Oil (diesel plaque)
 - Turbidity:
 - Stronger light
 - Longer time
 - Thinner film



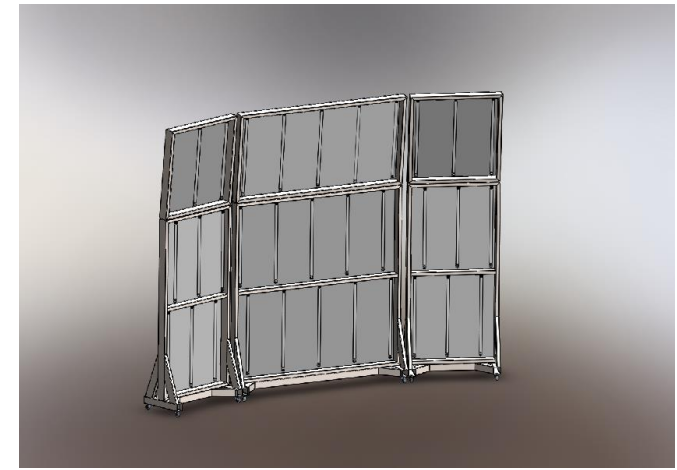
UVC air:

- Direct
 - UVC lamps are mounted so that they can light up freely
 - In a room
 - In the ventilation
 - Behind the ventilation etc.
 - 50% effect due to economics
 - Indirectly
 - Controls how the air passes by a number of lamps
 - Realistic is a 80% kill per pass
 - Cleaning of slats in refrigeration plant
 - Steril air
 - 100% control gives us a 99,99 % kill
- Factors influencing effect:
 - Humidity
 - Temperature
 - Particles in the air



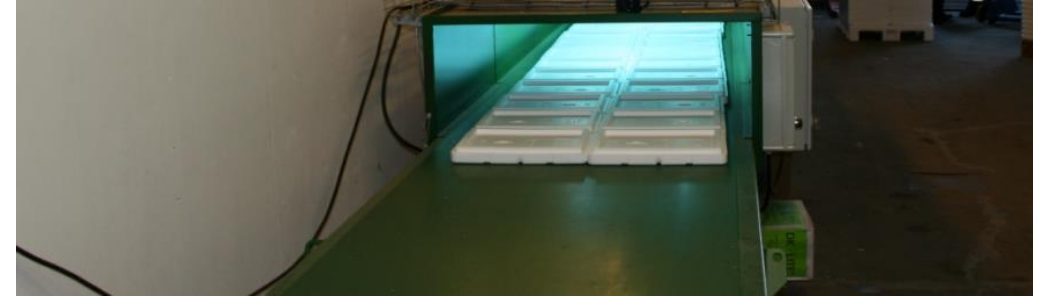
UVC surface:

- Direct
 - UVC lamp in room:
 - Mounted on the wall so they light on surfaces
 - On the ceiling and with light on the ceiling
 - Moving devices that moves around in the room
 - Robot device that finds its own way
 - Up to 99% depending on distance, time, subject to be eliminated
 - Packaging units
 - Sterilization of knives
 - Sterilization of conveyor belts
 - Sterilization of packaging
 - Realistic 99% depending on distance, time and item to be eliminated
 - Head-space of capsules
 - Production equipment
 - After cleaning before re-use
 - During production
 - Factors that influence effect:
 - distance
 - Time
 - Level of contamination



UVC Use:

- **Production:**
 - Water:
 - Entrance factory
 - Point of use
 - Brine, cleanliness
 - Cooling water, cleanliness
 - Surfaces:
 - Production belts continuous
 - Maturing rooms: all surfaces cleaning before new product
 - Tools that are stored after cleaning
 - Packaging
 - Immediately before filling
 - Boxes and items going into production
 - Water sensitive subjects
 - Acces control
 - Subjects into the clean room
 - Tools, lap tops, spare parts ..



UVC use:

- Products
 - Sensitive to UV treatment
 - Unsaturated fat
 - Some proteins
 - Less sensitive to UV treatment
 - Sugar
 - Starch
- Experience with these products:
 - Cheese
 - Products with lactic bacteria
 - Meat
 - Fruit
 - Vegetables
 - Juice
 - Bread
 - Chocolate/candy
 - Eggs



UV-C lamps and food:

- **Glass og food !!!**

- Covered with a special coating
- Allows 95% of UVC through
- Glued on glass
 - Removes all glass in case of breakage
- Approved for use in food production
- Not in plexiglass



UVC common mistakes:

- Temperatur
 - Different lamps for different uses; frost, normal temperatur and plus 60 C.
 - The distance between the lamps and the product.
 - Energy moves only a short distance
- The time the element is within the reach of the light
- Maintenance of UV units:
 - Cleaning of the tubes
 - Changing the bulbs
- Energy consumption:
 - Turn on/off with production



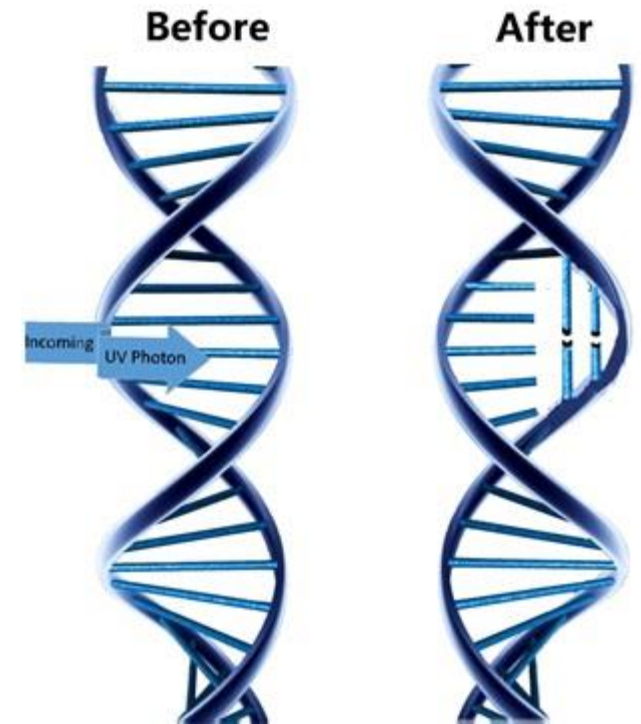
Mistakes we see:

- Bulbchanging
 - According to life time and number of on/off
 - Either a standardized routine or electronic surveillance
- Daily cleaning
 - Units are not cleaned
 - Lacking procedures
 - Not possible without tools
- Mounting failures
 - Not understanding UVC effect
 - Here and now, not longterm
 - Not understanding the production
 - Must be placed at the correct point



UV-C safety:

- UV-C destroys cells with energy
- UV-C is damaging to all living cells, according to dosage
- Personel should not be in direct UVC light without UVC blocking mask and clothing
- Warning signs
- Risc assesment!!!!!!!!!!!!!!!



Future:

- Disinfection
 - During production
 - Without water
 - Sterile rooms after cleaning until next production
 - Dry-Wash
 - Combined with other techniques
 - Smart systems
 - Engaging according to need
 - Water flow
 - Air flow
 - Treatment of different sizes packaging/products
 - Precise dosage for sensitive food
 - Registration and adaption, sensory technique.
- LED!!!!



UVC LED

- Application:
 - Everywhere
 - Handles, touch panels, rolls, channels etc.
 - Energy efficient 60-70 % UVC
- Problem
 - Life time
 - Distribution of the light from LED
 - Powercontrol
 - Price
- Current UVC LED
 - Low efficiency
 - Blue lamp....

