

COVID19 -VS- Ultraviolet Germicide

Webinar Master
Montréal, 2 Avril 2020

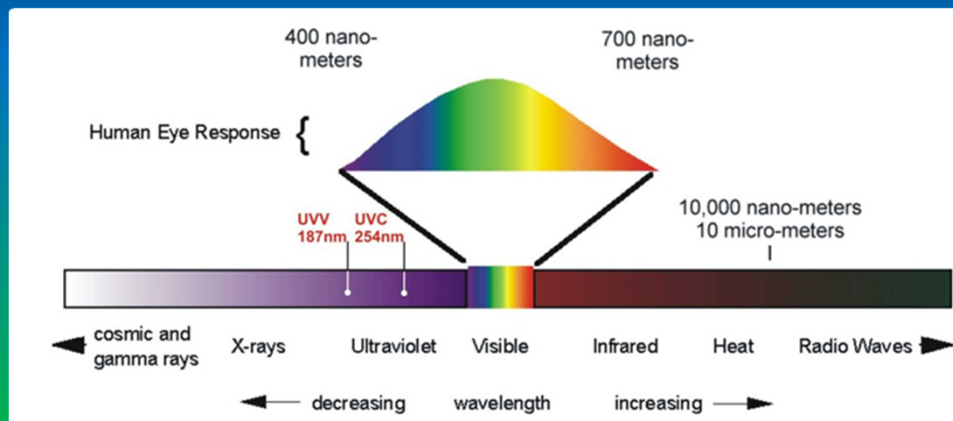
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SPECTRE VISIBLE ET UV

- ▶ **UV-A** (400-315 nm) Verres teintés
- ▶ **UV-B** (315-280 nm) Bronzage
- ▶ **UV-C** (280-200 nm) **Germicide**
- ▶ **UV-V** (200-30 nm) V = Vacuum : $O_2 \rightarrow O_3$



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ENERGIE des Photons

$$E = h \cdot \frac{c}{\lambda}$$

Lumière visible 550 nm **E = 217** kJ/mol

UVC 254 nm **E = 470** kJ/mol

UVV 185 nm **E = 646** kJ/mol

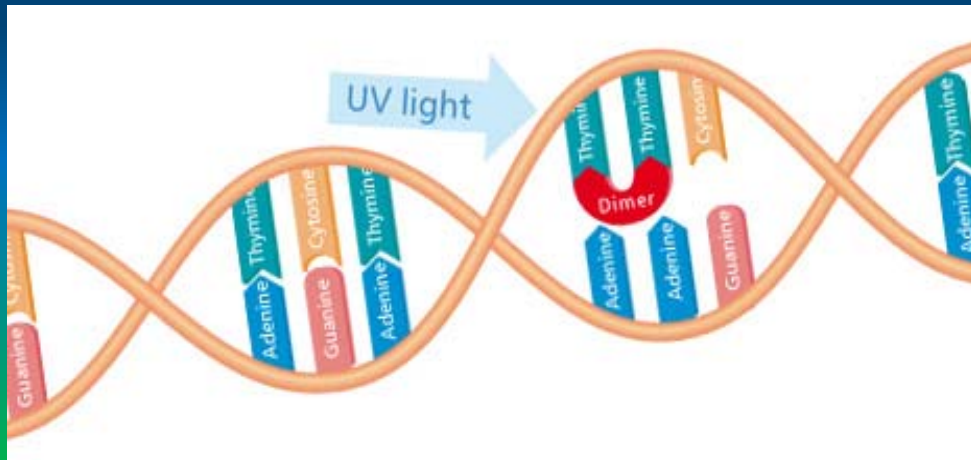
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ADN : Watson et Crick 1953

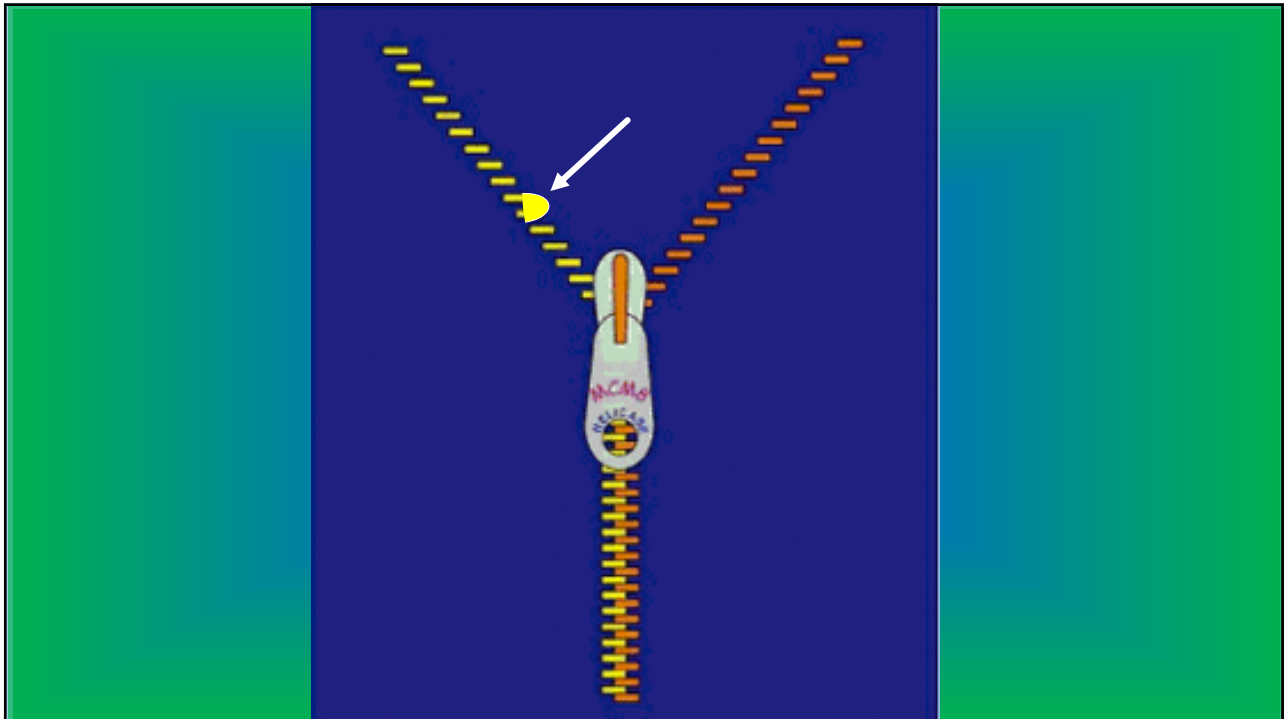


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Mécanisme de stérilisation UVC: Dymérisation des paires Thymines



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Principe fondamental de la désinfection UV

$$\text{Dose UV} = \text{intensité} \times \text{temps}$$

joule/ m² watt/m² sec

Plus la Dose est grande,
plus l'ADN sera endommagée,
ce qui rend la reproduction du
microorganisme impossible d'où
Stérilisation

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Relation Désinfection-vs-Dose UV

$$\frac{N(t)}{N_0} = e^{-k \cdot I \cdot t} = e^{-k \cdot \text{Dose}}$$

N_0 = Nombre initial de micro-organismes

$N(t)$ = Nombre de micro-organismes survivant au temp "t"

I = Intensité UV en W/m²

t = durée d'exposition en secondes

Dose = $I \times t$, en Joule/m²

K = coefficient de susceptibilité UV du microorganisme en m²/joule

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Disinfection -vs- UVC Dose	SIZE		Data reference	Disinfection	Calculated value
	Type	micron			
			UV Dose (mJ/cm2)=10		
			Data reference	LOG	% Disinfection
Mycobacterium tuberculosis	bacteria	0.637	Riley 1976 - AIR at 50%RH	20.5	100.0000%
Candida auris	virus	0.113	Knudson 1986- Surface	19.4	100.0000%
Coronavirus (SARS)	virus	0.113	Kowalski(2015)	16.4	100.0000%
Coronavirus (COVID-19)	virus	0.113	Kowalski Genomics(2020)	14.3	100.0000%
Proteus mirabilis	bacteria	0.494	Hofemeister 1975	12.6	100.0000%
Mycoplasma pneumoniae	bacteria	0.177	VanOsdell 2002	12.1	100.0000%
Salmonella	bacteria	0.800	Collins 1971	9.6	100.0000%
Aeromonas	bacteria	2.098	Sako 1985	8.8	100.0000%
Rickettsia prowazekii	bacteria	0.600	Allen 1954	7.6	100.0000%
Staphylococcus epidermis	bacteria	0.866	VanOsdell 2002	7.0	100.0000%
E. Coli	bacteria	0.500	Luckiesh 1949- AIR at low RH	6.8	100.0000%
Yersinia enterocolitica	bacteria	0.707	Butler 1987	6.7	100.0000%
Coxiella burnetii	bacteria	0.283	Little 1980-Water	6.7	100.0000%
Lactobacillus reuteri	bacteria	0.920	Kowalski calc.	6.7	100.0000%
Vaccinia virus	virus	0.307	Jensen 1964-AIR at 65% RH.	6.6	100.0000%
Smallpox	virus	0.200	Mongold 1992 -Surface	6.6	100.0000%
Newcastle disease	virus	0.212	Jepson 1973	6.3	99.9999%
Acinetobacter baumannii	bacteria	1.225	Rastogi 2007	5.6	99.9997%
Influenza A virus	virus	0.098	Jensen 1964-AIR at 68% RH.	5.2	99.9993%
MRSA	bacteria	0.866	Nakamura 1987-AIR Low RH	4.9	99.9988%
Coxsackievirus	virus	0.027	Chick 1963	4.8	99.9985%
Avian Influenza virus	virus	0.098	Rastogi 2007	4.6	99.9975%
Measle virus	virus	0.329	Distefano 1976 -Water	4.6	99.9973%
Pseudomonas aeruginosa	bacteria	0.494	Elasti 1999-Surface	4.5	99.9972%
Serratia marcescens	bacteria	0.632	Fletcher 2003	4.1	99.9925%
Bacillus subtilis			Chick 1963	4.0	99.9900%

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Culture de surface des ailettes moisissure + bactéries



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Croissance Exponentielle !!!

$$2 \times 2 \times 2 \times 2 \times \dots \times 2 = ?$$

$$2^{10} = 1,024$$

$$2^{20} = 1 \text{ million} +$$

$$2^{30} = 1 \text{ milliard} +$$

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Désinfection des serpentins

- Élimination du biofilms sur les ailettes
- Réduction de perte de pression
- Meilleur transfert de chaleur
- Économies d'énergie

• **Critères de design du système UV:**

- Minimiser la puissance requise
- Distribuer l'intensité également

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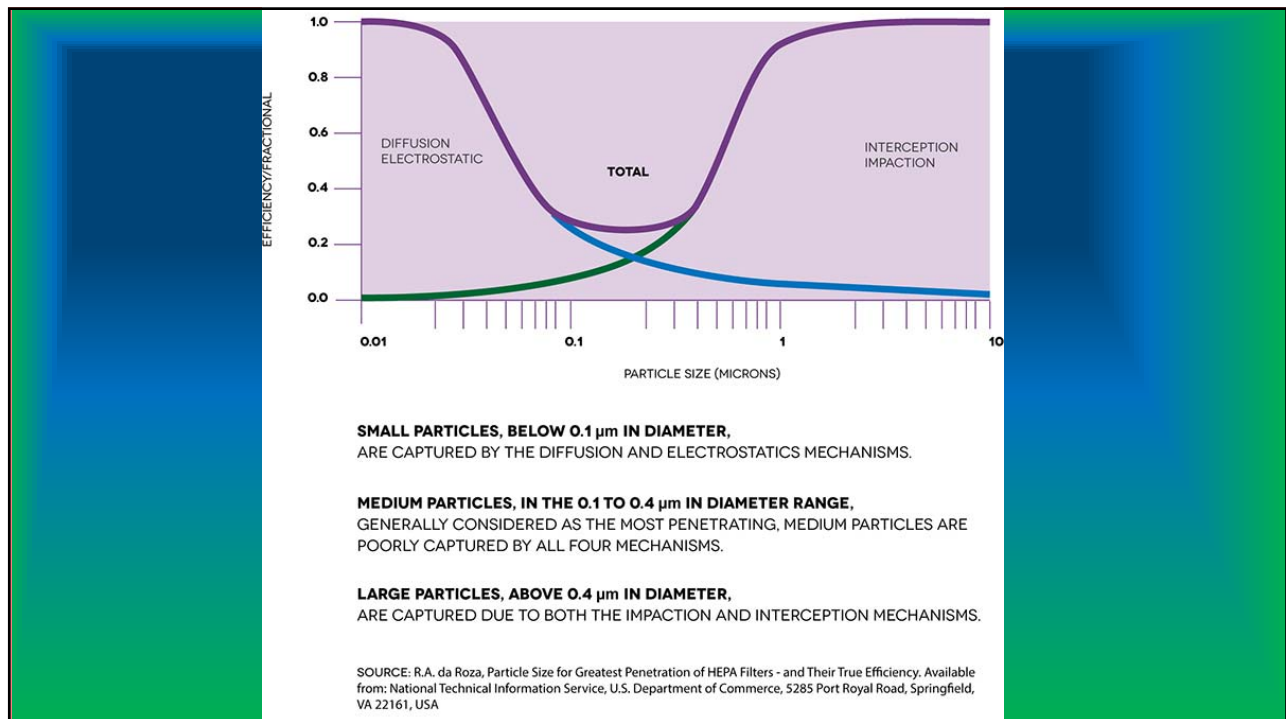
TEST avec système UV en service



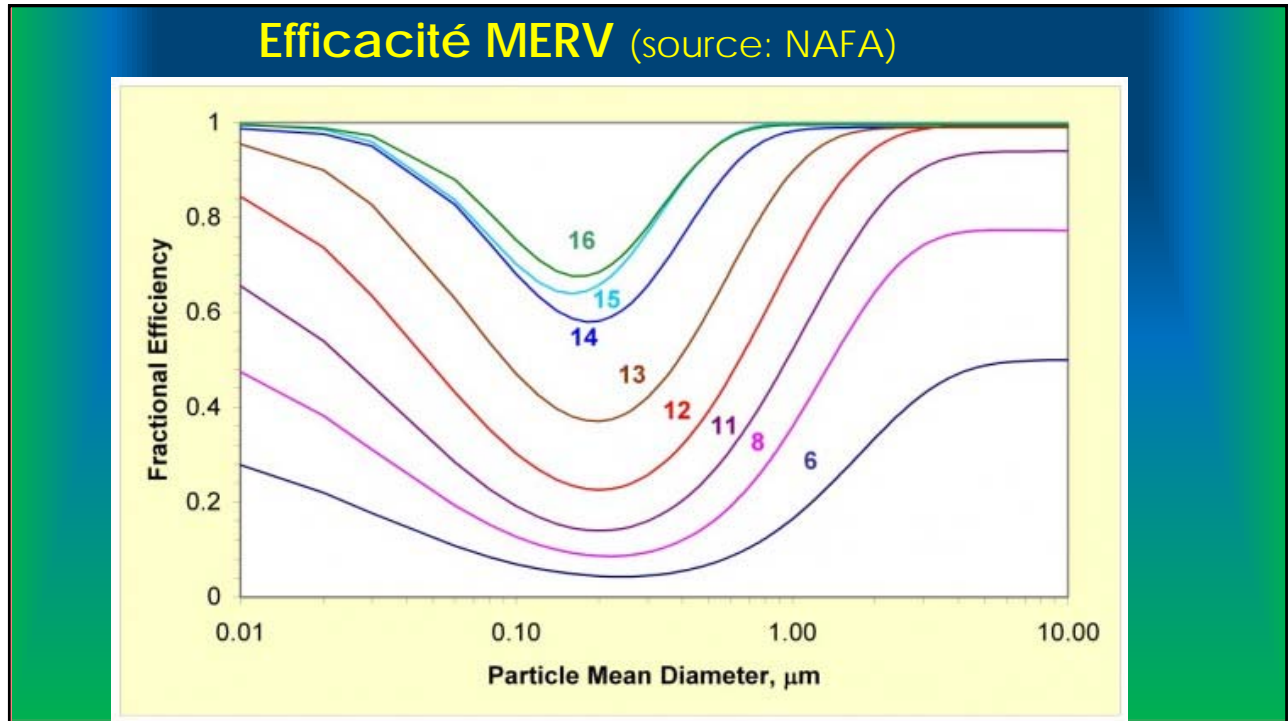
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À propos des Filtres ?

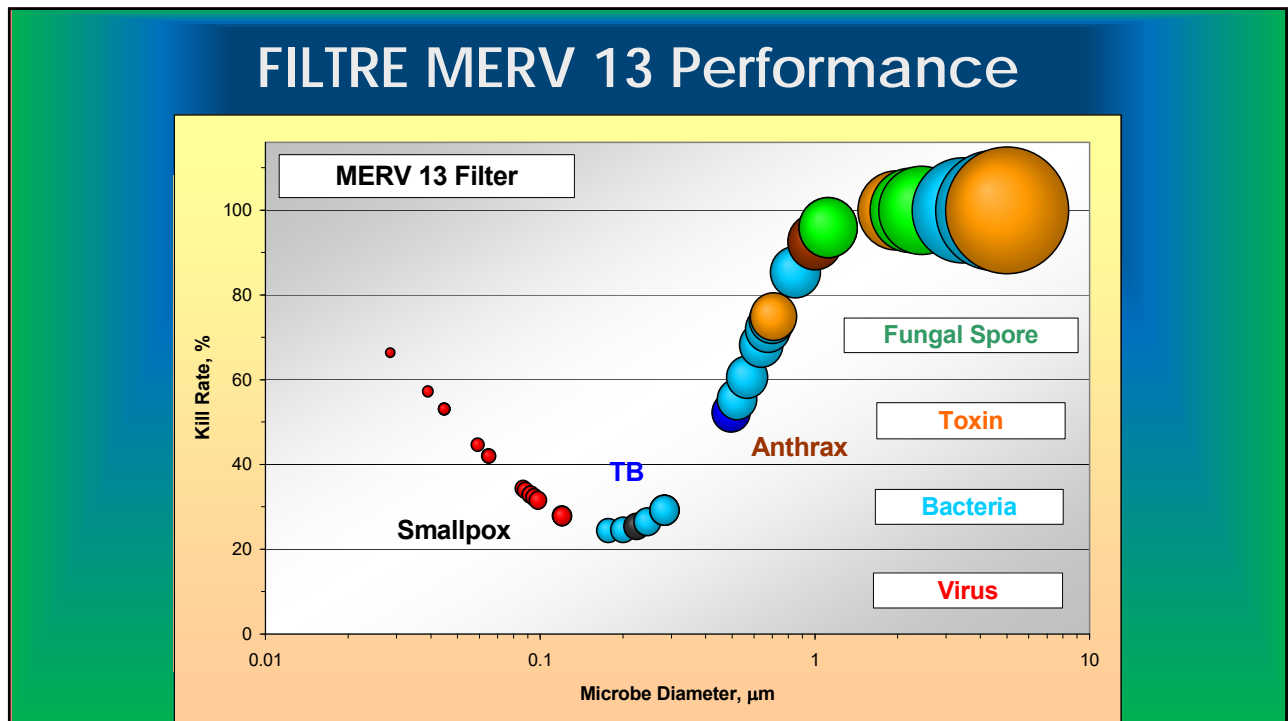
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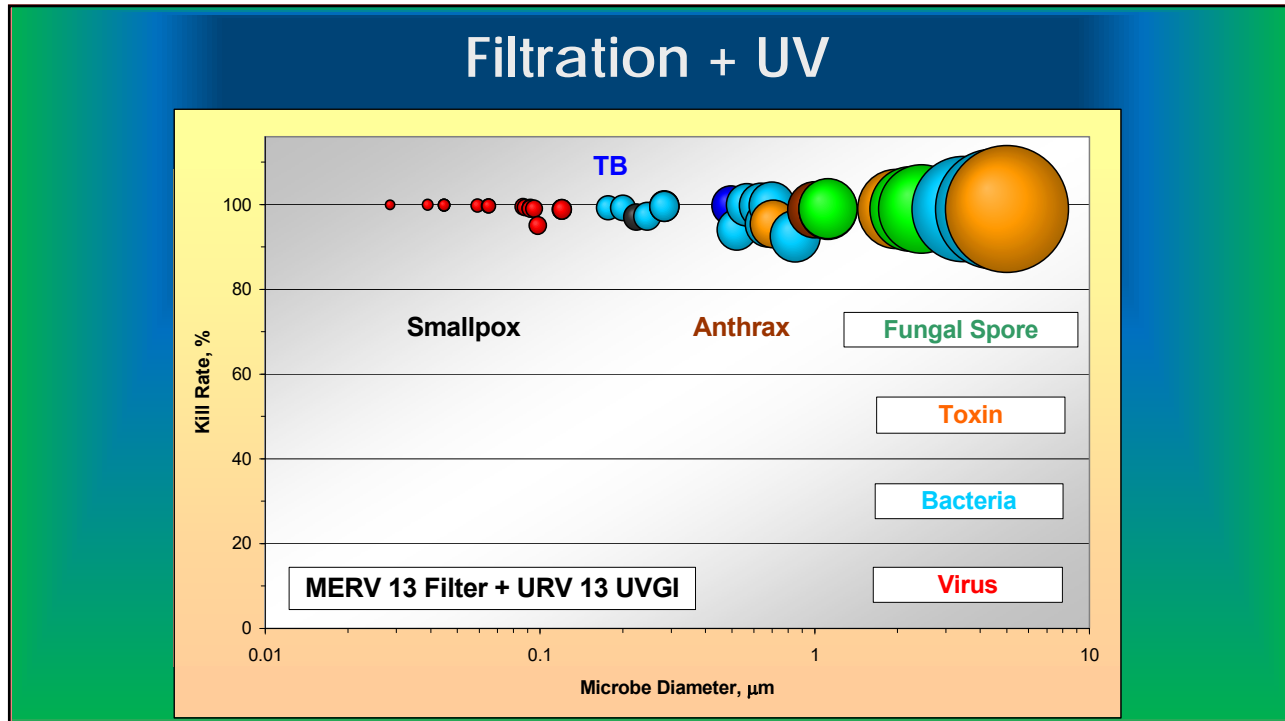
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La Question: Air ou Serpentin?

AIR

Destroy bio-chemical contaminants circulating through the facility

AIR: SHORT EXPOSURE TIME

COIL

Destroy mold & other microbial growth on the coil & surrounding areas.
Improve energy efficiency by maintaining a clean coil

COIL: LONG EXPOSURE TIME

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CoilClean IL

High-Intensity 19 mm. Mercury Vapor Quartz UVC Germicidal 254nm. Lamp

Patent Pending Anodized Aluminum Parabolic Reflector / Shield

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UV Bio-Wall

Tested by the Environmental Protection Agency (EPA) & US Dept. of Homeland Security on Biological Warfare Agents (BWAs).

A SINGLE UV Bio-Wall 50" (also available in 40" & 60" lengths) showed greater than 99.97% destruction on one pass on airborne bacteria, 99% on viral & 93% on spore.

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4.0 PROPOSAL for EVAPORATOR COIL 100"H X 200"W

This UV system may be installed on either the return or supply side. Filtration Group recommends return installation. Please refer to page 4 (section 3.0) for more information on the benefits of a return (upstream) side installation.

LAMP POSITIONING DIAGRAM (Not to scale)

Coil Size 200" W x 100" H This Coil requires (2) rows of (2) CoilClean IL 60's per row

COIL HEIGHT (inches)

COIL WIDTH (inches)

TOTAL NUMBER OF UNITS= 4 x CoilClean IL 60"

All sizing & calculations are based on "end of Lamp life" which is after 2 years of continuous operation (17,000 hours). Kill Rates from "Day 1" will be exponentially higher.

4.1 REAL-TIME SIMULATION

200"W x 100"H Coil

Figure A. represents UV Intensity measured in microwatts per cm² in Real-Time on the evaporator Coil. The larger the number represents higher levels of intensity. Microwatts are the measure of "strength" of the UV germicidal energy.

Figure A.

Figure B. represents the survival time in minutes of spore forming aspergillus Niger on the evaporator coil. Aspergillus Niger is the most difficult to sterilize of bacterial spores requiring 330,000 microwatts per sec/cm² for 99% destruction.

Each color represents minutes. In this case, aspergillus Niger will take 7 minutes (purple area) of irradiation for 99% destruction. The 4 corners will be receiving the least amount of UV intensity (approx. 431 microwatts as per Figure A.) requiring not more than 25 minutes for complete destruction. The average time for complete destruction across the coil will be 13 minutes.

Figure B.

UV Coil Clean Sizing

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ÉLIMINATION DES ODEURS

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Principes de la Photo-Oxidation UV

1. Rupture des liaisons moléculaires

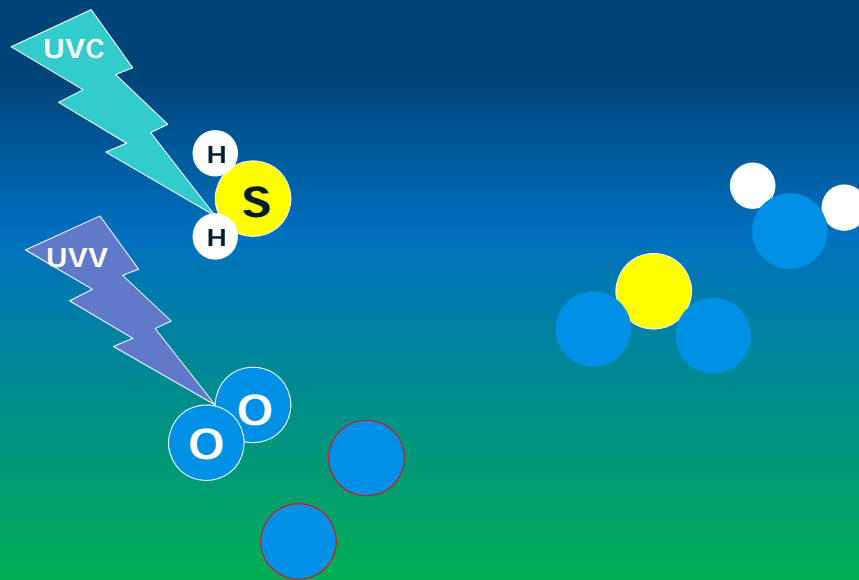
- ▶ L'énergie des photons UV doit être supérieure à l'énergie de liaison chimique.

2. Oxydation de la molécule fractionnée

- ▶ Avec de l'oxygène libre.

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Photo-oxidation: H₂S exemple



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CONCLUSIONS

1. UV-C garde les serpentins stériles et efficaces
2. UV-C détruit les virus, bactéries et spores aéroportés
3. UV-C+ UV-V brise les molécules odorantes et les oxyde, éliminant ainsi les odeurs.

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