Pathogen Path Consulting LLC

Food And Conveyor Belt Disinfection

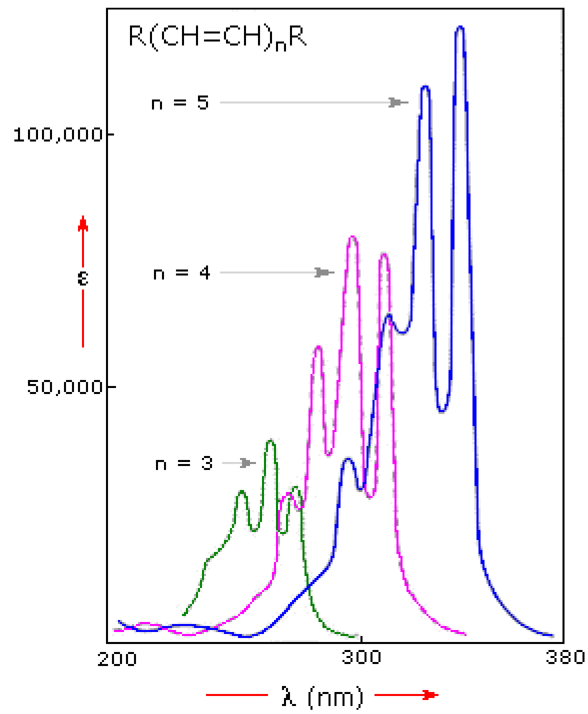
BACKGROUND:

Proteins that make up the outer membranes and cellular walls of viruses and the nitrogenous bases of their DNA have chromophores with peak absorption at the different wavelengths that are not near the mercury lamp emission of 254 nm, commonly known as UVC. Thus, standard UVC germicidal lamps are not as effective for killing and reducing bacteria and viral concentrations.

Pathogen Path Consulting LLC (PPC) has developed two lamps designed to produce the correct photon wavelength to break up and destroy the fundamental capsid proteins and DNA of microorganisms. The emission is in the Far-UV band which is at a wavelength shorter than 240 nm.

Chemical absorption of photons occurs when molecules with different bond energies are in close proximity. Such groups are called chromophores.

As the number of molecules in a group increase or change, the peak wavelength that it will absorb will also change. For example, the conjugation of double and triple bonds shifts the absorption maxima to longer wavelengths (see insert).



DRY CHEMICAL FREE HIGH-LEVEL DISINFECTION:

Far-UV is 10 to 1000 times more effective in killing and reducing microorganism concentrations on surfaces and in air. Air tests using staphylococcus aureus obtained 99.98% reduction in 0.2 seconds at 500 fps air flow. Surface testing has obtained over 99.99% reduction of difficult test bacteria in less than 4 seconds and over 99.9% reduction in less than 1 second. These tests used inoculated concentrations because normal and generally clean conditions on food products don’t find concentrations above 100 or so.

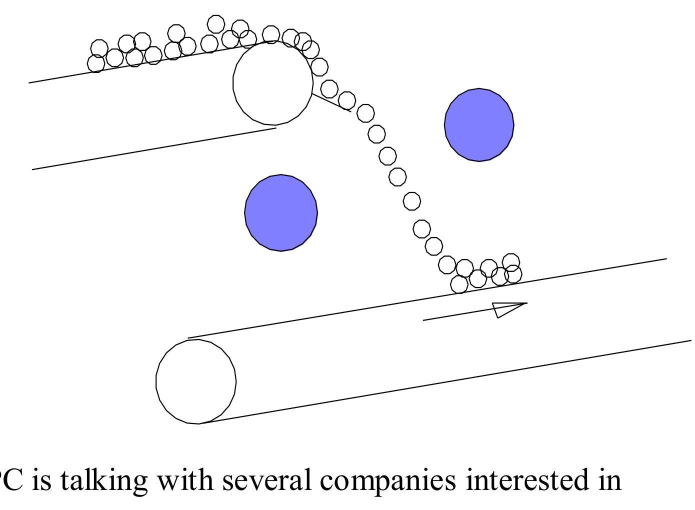
Conveyor Belts:

Placing a Far-UV Sterilray™ lamp close to the conveyor belt will produce a 100% reduction of any bacteria, fungus and microorganisms after two or three passes. Operating the belt with the lamp on prior to carrying product will ensure a highly disinfected belt. Far-UV has been extensively tested on most belt material and has been found to not cause volumetric material failure. This is predominantly due to the fact that Far-UV light is absorbed in the first molecular layers of all plastic materials. Consequently, no bulk material destruction can occur.

Foodstuffs:

US FDA regulates the use of UV to directly disinfect foodstuffs. PPC has inquired with key FDA personnel as to the necessary steps to obtain a license to use Far-UV to disinfect food. The FDA requires PPC to present a detailed proposal to a committee at FDA headquarters. After the presentation, the FDA will present an outline describing the tests that must be done to obtain certification to use Far-UV. The tests are simple and straightforward and should require less than 3 months to complete. Final costs are dependent on the number of foodstuffs that are to be tested and the preliminary tests that have been done and included in the presentation.

The proper use of Far-UV Sterilray™ lamps to directly photo-disinfect the surface of foodstuff products on conveyor belts is at the junction of two belts where the flow direction is changed. This junction has one belt over the other with the product spilling over the edge of the upper belt and falling onto the lower belt. In this region, two lamps can be used to disinfect the largest surface area of each individual piece of product. It would also provide for real time disinfection of both belts. A knife-edge or similar guide can be used to help spread out the product to ensure a single layer profile. A sketch is included to provide more clarity to the concept.



Another approach is to install the Far-UV Sterilray™ lamps above vibrating conveyors. PPC is talking with several companies interested in adding our Far-UV Sterilray™ lamps to their vibrating conveyor systems. This may be of particular interest for products having hard surfaces like berries and potatoes.

RTE testing:

A three-month trial testing Far-UV Sterilray™ disinfection is almost completed for a large ready-to-eat (RTE) manufacturer. Surfaces being studied include conveyor belts as well as food slicing and handling machines. During operations, counts range from a couple of hundred to too-many-to-count (TMTC >3,010 cfu) after their normal cleaning procedures.

Post-UV disinfection show microbial counts of 10 or less and many cases zero. The customer has never seen such low counts with any chemical cleaning methods. The counts remained very low for as much as one week. One week, a high spike in post UV disinfection was observed. Investigation revealed that prior to taking the post UV swabs, their normal cleaning wipes were used over the surfaces. The wipes actually increased the microbial count on a surface that had been photo-disinfected by Far-UV Sterilray™. The table below shows a typical swab result.

Swab Results Australia	Pre UV	Post UV
Drain	760 cfu	<10 cfu
Meat Mincer under slide bar 20710D	110 cfu	<10 cfu
C/shredder holes 20450F	3,010 cfu	<10 cfu
Raque 1 reclaim 1 20490A	10 cfu	<10 cfu
Raque 4 Hopper 20645A	10 cfu	<10 cfu
C/shredder infeed belt 20455B	1,910 cfu	<10 cfu

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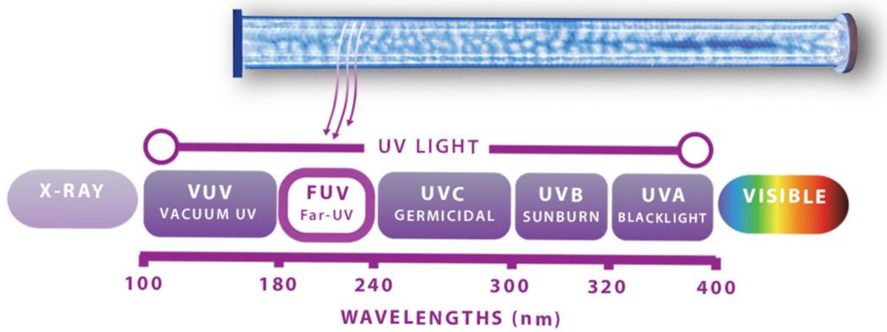
Far-UV Sterilray™ Safety:



The Ultraviolet light spectrum has bands of energy that affect skin and eyes differently. Think of these bands like color to the eye. Each color has a different effect on the retina. The bands UV-A, UV-B and UV-C similarly have different effects on the skin and eyes since they penetrate through the epidermis and into the dermis.

Sterilray is in the Far-UV spectrum and does not penetrate the epidermis and cornea of the eye. It is absorbed very quickly by proteins on the skin and eyes surface. Since it does not reach live tissue and live cells, it can not damage human cell DNA. Far-UV Sterilray™ does not cause DNA effects that can occur with over-exposure of mercury based 254 nm lamps. Because it is designed to target the proteins of microorganisms, it can kill these organisms at a dose that is well below the safe skin and eye TLV exposure limits. This can not be done by other UV light sources. Far-UV Sterilray™ will not penetrate plastic. Until this wavelength is certified by the FDA, it is recommended that standard covers be used to protect the lamps supports, and thin plastic covers be used to prevent exposure to workers in the area.

PPC has a separate paper on TLV (Threshold Limit Values) exposure limits. Please request it if you would like a copy.

A case for using Far-UV Sterilray™

Using Far-UV Sterilray™ lamps to proactively disinfect the entire process of handling foodstuffs significantly reduces the ability for the microbes to reach the log phase of development. Cellsalive.com/ecoli.htm states that after the lag phase, cells can multiply at a logarithmic rate every 20 minutes in optimum conditions. In cool conditions, multiplication times will be slowed, but keeping the starting number low will increase the lag phase time and potentially prevent the bacteria from moving into the log phase of development where over 400,000 can develop in less than one day. In cool conditions, multiplication times will be slowed, but keeping the starting number low will increase the lag phase time and potentially prevent the bacteria from moving into the log phase of development where over 400,000 can develop in less than one day.

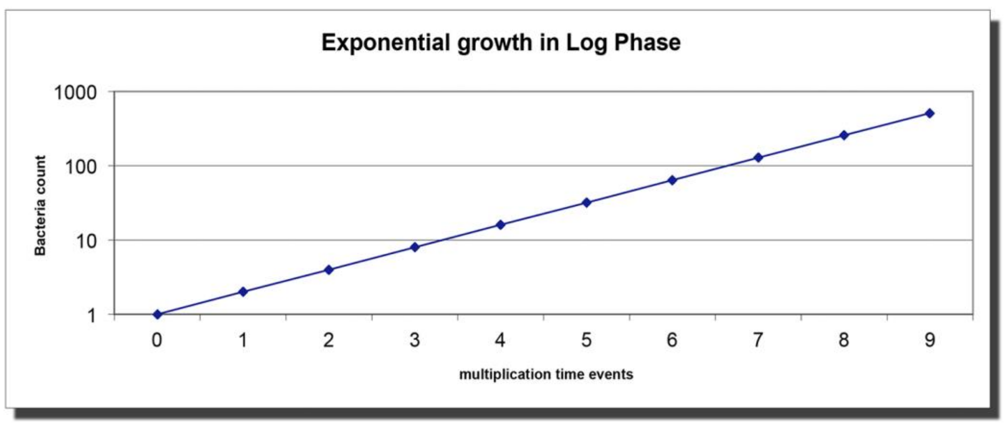
Doubling time in 20 minutes (1/3 per hour)
1 bacteria grows to 1 million in 400 minutes
511 bacteria grow to 1 million in 220 minutes
1 million bacteria grow to 8.4 million in 60 minutes

Doubling time in 1 hour
1 bacteria grows to 1 million in 20 hours
511 bacteria grow to 1 million in 11 hours
1 million bacteria grow to 8.4 million in 3 hours

Doubling time in 3 hours
1 bacteria grows to 1 million in 2.5 days
511 bacteria grow to 1 million in 1.4 days
1 million bacteria grow to 8.4 million in 9 hours

minutes or hours for doubling time counts

X division time		y=exp (0.693 x)
0	1	1
1	2	2
2	4	4
3	8	8
4	16	16
5	32	32
6	64	64
7	128	128
8	256	256
9	511	511
10	1022	1,022
11		2,045
12		4,089
13		8,176
14		16,350
15		32,696
16		65,382
17		130,744
18		261,450
19		522,824
20		1,045,494
21		2,090,680
22		4,180,745
23		8,360,259
24		16,718,058



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