

Section 5.5

Disinfection with Ultraviolet Light



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Water and Wastewater Treatment Engineering

Physicochemical Technology

1. Characters of ultraviolet

Ultraviolet (UV) is invisible light with wavelength of 100-400nm.

Band A: long-wave ultraviolet
UV-A, 320~400 nm

It produces melanin or a “tan” in human skin; but has poor disinfection ability.

Band B: middle-wave ultraviolet
UV-B, 275~320 nm

Has disinfection ability

Band C: short-wave ultraviolet
UV-C, 200~275 nm

Band D: vacuum ultraviolet
UV-D, 100~200 nm

It can generate ozone in air

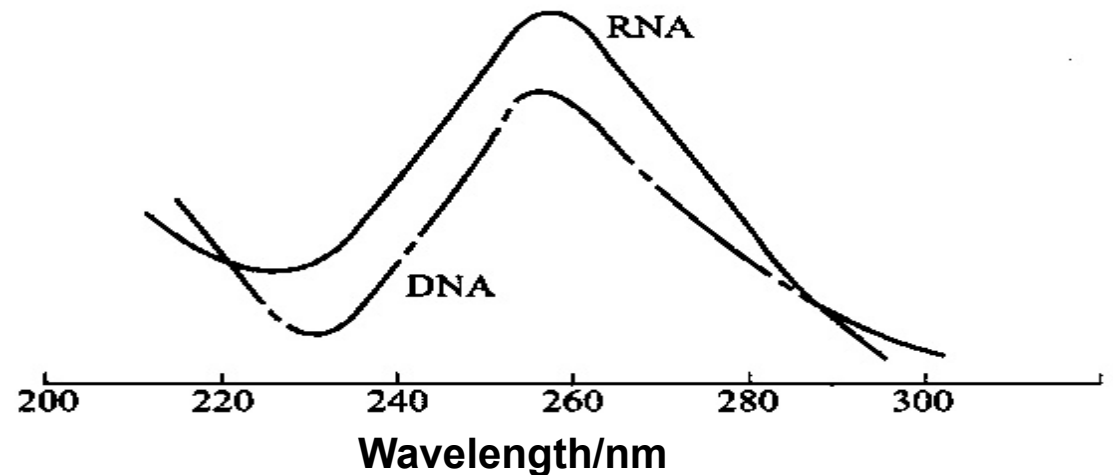


2. Mechanism of disinfection with ultraviolet light

UV with wavelength of 240~280 nm has a strong disinfection ability.

Ultraviolet of 250 ~ 260 nm can be absorbed by DNA and RNA. Other structure of protein, such as phenylalanine, tryptophan, tyrosine aromatic ring have the absorption peak at around 280 nm.

UV can alter and damage the structure of DNA or RNA, change the nucleic acid structure, and make the organisms lose the ability of reproduction, and thus achieve the inactivation of organisms.



3. Equipment for disinfection with ultraviolet light

Artificial UV light is usually applied in water disinfection.

Main types of UV light :

Low pressure low intensity UV lamp

Low pressure high intensity UV lamp

Medium pressure high intensity UV lamp

Most widely used



3. Equipment for disinfection with ultraviolet light

Tubular disinfection equipment and canal disinfection equipment



Tubular disinfection equipment
(Mostly in water disinfection)



Canal
disinfection equipment
(Mostly in wastewater disinfection)

Multiple UV lights are set inside either equipment.
Disinfection is finished within seconds as water flows
across the UV lights.

4. Dosage of ultraviolet light

$$D = It$$

D : Dosage of UV, mJ/cm^2

I : Intensity, mW/cm^2

T : Irradiation time, s

- Inactivation performance is related to the dosage of UV.
- Similar to chemical disinfection's CT values.

Under the same condition, once the dosage of UV is the same, the disinfection result is the same as well.



4. Dosage of ultraviolet light

UV disinfection for drinking water:

Mandatory minimum dosage of UV disinfection:

45mJ/cm² (Australia) , 40mJ/cm² (USA)

In China: 40 mJ/cm²

UV disinfection for wastewater :

“Code for design of outdoor wastewater engineering” in China rules the UV dosage should be determined based on reference practical experiences or experiment data.

Reference number: Secondary effluent: 15-22 mJ/cm²

Reclaimed water: 24-30 mJ/cm²

UV disinfection technology for large-scale applications in water treatment began in the late 1990s.

