



*1

:

UV

)

(UV

%

%

:

()*

-

.

.



2 bgd

:

UV (UVR) Ultraviolet Radiation
1999 (AWWA)

(Masschelein , 2002 - Oppenlander,
2003 –J.AWWA Consultants 2003)

UV (Protasowicki
2002- Parmelee 2001)
UV
() UV

UV UV
:(Metcalf 2003)

UV UV
(Cairns 2000)

(Swift et al , 2002) UV

)

UV

UV

(Cairns 2000-Clancy

UV

.2004)

:(Stedman2004)

AWWA,1999-)

()

.(Asano

UV

:UV

UV

UV

:

()

()

()

-

UV

UV-C

.(Metcalf, 2003)

UV

:

:UV

-

(mgd)



UV
 a (T%)
 % Collimated beam bioassay

Emerick et al, 2003 - (ml)
 (-Metcalf,2003)

UV Beer
 (Cairns 2000) : ()
 ()

(WHO A)
$$I_{ave} = I_o \frac{(1 - 10^{-ad})}{ad} = I_o, I_{ave}$$

() = d
 () = a
 ()

(
Collimated beam
UV
() /)
(ml
(Asano %
. 1998- Metcalf 2003)
:(Emerick etal , 2003 – Metcalf 2003)
- -
UV
-
:
(validation testing)
(MS₂)
UV)
(UV
)
(



() UV
 :)
 () (

$$\text{Log} \left(\frac{N}{N_0} \right) = 0.04 [UV_{\text{dose}} \text{ mJ/cm}^2] + 0.64$$

() MS₂

$$\text{Log} \left(\frac{N}{N_0} \right) = 0.03 [UV_{\text{dose}} \text{ mJ/cm}^2] + 0.20$$

() ()

)
 (UV
 UV - UV
) / /
 ()

UV
 () Collimated beam -
 UV

Collimated beam

(
(bank)
()
() UV ()
(module)
(Patourel
and Smith 2003) (bank)
()
(Clancy
.2004, Patourel 2003)
:
UV
)
()



()

Virtual Plant

)

(

(Stedman -2001-)

:

Metcalf&Eddy 2003

($T \sim 20^{\circ}C, pH \sim 7$)

/	/				
-	/ -	/ - /	/ - /	mg.min/L	
-	-	-	-	mg.min/L	
-	-	-	-	mg.min/L	
-	-	-	-	mJ/cm ²	UV*
-	-	/ - /	-	mg.min/L	
-	-	-	-	mg.min/L	
/ - /	/ - /	/ - /	-	mg.min/L	
-	-	-	-	mJ/cm ²	UV*
-	-	-	-	mg.min/L	
-	-	-	-	mg.min/L	
-	/ - /	/ - /	/ - /	mg.min/L	
-	-	-	-	mJ/cm ²	UV*
					* = UV *

-

UV

-

(Swift et al , 2002)

			← / ↓
50mWsec/cm ²	80mWsec/cm ²	100mWsec/cm ²	
0.5 NTU, with 95% of values <0.2 NTU	0.5 NTU, with 95% of values <0.2 NTU	Requirements vary	
90%	65%	55%	nm*
cm			*

- Stedman L. , (2004) A Unanimous vote of confidence . *Water* 21 : 31-32
- StedmanL., (2001) Virtual Certainty . *Water* 21 : 35 -36
- Swift J. , Emerick R.W. , Scheible K. , Soroushian,F. and Putnam,L.B. (2002) Treat , disinfect , reuse. *Journal of Water Environment & Treatment* Vol - 15- No. 11: 21 -25
- Clancy J.L , Marshall M.M Hargy T.M. and Korich,D.G.(2004) Susceptibility of five strains of *Cryptosporidium parvum* oocysts to UV light . *JAWWA* Vol96.No. 3:84-92
- Consultant's corner (2003) Hazen and Sawyer / CDM to design large UV plant for NYC *JAWWA* Vol 95 – No 12: 47
- Emerick R.W. , Salvesson A. , Tchobanoglous G. , et al (2003) It is good enough for reuse? *Journal of Water Environment and Treatment* –2003 : 40-45
- Asano T.(1998). *Water quality management – Vol 10: Wastewater reclamation and reuse* . Technomic Pub. 345 – 380
- AWWA (1999) *Water quality and treatment* . 5 th Ed. Mc Graw-Hill
- Cairns W., Wright H.B. (2000) Is UV disinfection the best available technology? *IWA yearbook 2000* – 26 – 28
- Masschelein W.J.(2002) *Ultraviolet light in water and wastewater sanitation*. Lewis pub.
- Metcalf & Eddy , Inc (2003) *Wastewater engineering , treatment and reuse*. 4th Ed. Mc Graw – Hill
- Oppenlander T(2003) *Photochemical purification of water and air*. Wiley. VCH Verlag.
- Parmelee M.A. , (2001) UV applications to increase . *JAWWA* Vol – 93 No. 9:56
- Patourel G.L., Smith F. (2003) Implementation of primary UV disinfection at the Mannheim water treatment plant : *JAWWA* Vol 95 No-10:57-61
- Protasowicki R.G. (2002) Ultraviolet disinfection of drinking water , a growing trend . *Journal of Water Environment and Management* Vol 149. No.11: 11-13



DESIGN CRITERIA FOR ULTRAVIOLET DISINFECTION OF WATER AND WASTEWATER

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UV radiation is selected as the primary disinfectant in numerous water and wastewater treatment plants of EU and North American countries having different ranges of capacities, and it is expected that the method which can qualify for designation as the best available technology will become more widespread over chemical disinfection. As UV is claimed to be the only method which has no detrimental effect for the health of operators, consumers and the environment even in the case of overdose it is essential for treatment plants' directors to know how to apply new criteria in correct design of UV systems for meeting the different objectives of treatment.

The recent guideline is based on testing the UV system at various hydraulic loading rates (expressed in liters per minute per UV lamp). The rate that corresponds to the desired germicidal dose is used to design the system. Other design factors include water quality and characteristics of the utilized lamps and quartz sleeves. According to this new approach, lamp's output is assumed to drop by 50% during its life and sleeve fouling to reduce nominal UV light intensity by 20%.

This article describes the required data that must be collected by performing pilot testing in the site of treatment plant and also addresses how to use these data in the process of system design. The advantage of the approach is that the variability in the most important parameters are reflected in the design and at the same time it becomes possible to determine the number of lamps required under the worst-case conditions and to meet the stringest treatment requirements.

Keywords: *Ultraviolet radiation, Disinfection system design, Water, Wastewater, Germicidal dose*

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