∗1

:

UV

)

(UV

.

%   %

.

;

(   ) ∗

:

2 bgd   .

.   (UVR)

UV   Ultraviolet Radiation

. 1999 (AWWA)

.

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

(Protasowicki
UV

. 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)   :   (

( )

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

(WHO   A   ) $= I_o$, I_{ave}

(   )   = d

(   )   = a

.(   )

)

.

.(% /

Collimated beam)

. (

.

UV .

/) (   )

(ml

(Asano % .

. 1998- Metcalf 2003)

.

:(Emerick etal , 2003 – Metcalf 2003)

- -

:

UV -

. .

- :

(validation testing) .

(MS$_2$)

. UV)

(UV

) .

(

( ) UV

:)

( ) (

$$Log_{50}=(N/N_o)=0.040[UV_{dose},mJ/cm^2]+0.64$$

.

( ) MS_2

$$Log_{50}=(N/N_o)=0.033[UV_{dose},mJ/cm^2]+0.20$$

.

( ) ( )

)

.(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 . *J.AWWA* Vol96.No. 3:84-92

Consultant's corner (2003) Hazen and Sawyer / CDM to design large UV plant for NYC J.AWWA Vol 95 – No 12: 47

Emerick R.W. , Salveson 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 : J.AWWA 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 ULTRAVIOLT DISINFECTION OF WATER AND WASTEWATER

ForooghVaezi*[1,] Hassan Pishrafti

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 quality 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 intensty 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 stringentest treatment requirements.

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

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