

Rennaker, Joanne (DEQ)

From: Prysby, Mike (DEQ)
Sent: Monday, September 09, 2013 12:03 PM
To: Cook, Pat (DEQ); Busch, Stephen (DEQ)
Subject: Flint WTP CT
Attachments: CT Calc at 18 MGD w. softening.xls

Pat, Steve....

Attached is the revised CT calc using 3-log removal for giardia as the starting point for the CT calc. The assumptions made were; 18 MGD, 0.1 ppm CL2 in the contact units and filters, 1.0 ppm CL2 in clearwell, 0.5 deg C, pH 9.0. The disinfection process provides an additional 0.57 log removal which exceeds the 0.5 log removal required for a conventional WTP. I will tweak the calc further based on actual operating levels in the clearwell after tomorrow's softening class at the WTP. Thanks for your input on this!

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Flint WTP CT Calculation

Assumptions; softening - pH 9.0, 0.5 deg C, 18.0 MGD

1. Ozone: @ 12 MGD per contactor train

		HRT	T10	O3 Conc.	CT
Diffusion Chamber Cell 1	Counter Current	0.72 min	0.36 min		
Diffusion Chamber Cell 2	Co-Current	0.72 min	0.36 min		
Contact Chamber 1		1.76 min	0.88 min		
Contact Chamber 2		3.22 min	1.61 min		
Contact Chamber 3		3.22 min	1.61 min		
Contact Chamber 4		3.22 min	1.61 min		
Contact Chamber 5		3.22 min	1.61 min		
Contact Chamber 6		2.48 min	1.24 min		

3 ozone monitoring points: end of diffusion cell 2, end of chamber 3, end of chamber 6

Ozone concentrations are as follows: Diff Cell 1 - 0.15 mg/l - dectable residuals are not maintained through Chambers #3 and 6; thus they cannot be used in the CT dtm.

Dosage Diffusion Chamber Cell 1: **Counter - Current Flow**

Cell 1 cannot be credited CT since the ozone concentration is not measured at the exit point of Cell 1 prior to the second ozone diffuser in Cell #2.

$$C = C_{out} = 0.00 \text{ mg/l}$$

$$C_T = C \times T_{10}$$

$$C_T = 0.0 \text{ mg/l} \times 0.36 \text{ min} = 0.000 \text{ min} - \text{mg/l}$$

$$C_T \text{ needed for 3 - Log removal of giardia @ 0.5 deg. C} = 2.9 \text{ min} - \text{mg/l}$$

$$C_T \text{ needed for 4 - Log removal of virus @ 0.5 deg. C} = 1.8 \text{ min} - \text{mg/l}$$

$$\text{Inactivation Ratio: } C_{T \text{ calc}}/C_{T 99.9} = 0.000 \text{ min-mg/l}/2.9 \text{ min-mg/l} = 0.00$$

$$\text{Giardia Inactivation: } 3 \times \text{inactivation ratio or } 3 \times 0.00 = \mathbf{0.0}$$

$$\text{Inactivation Ratio: } C_{T \text{ calc}}/C_{T 99.9} = 0.000 \text{ min-mg/l}/1.8 \text{ min-mg/l} = 0.00$$

$$\text{Virus Inactivation: } 4 \times \text{inactivation ratio or } 4 \times 0.00 = \mathbf{0.0}$$

Dosage Diffusion Chamber Cell 2: **Co - Current Flow**

$$C = (C_{out} + C_{in})/2$$

$$C = (0.15 \text{ mg/l} + 0.00 \text{ mg/l})/2 = 0.075 \text{ mg/l}$$

$$C_{T \text{ calc}} = C \times T = 0.075 \text{ mg/l} \times 0.36 \text{ min} = 0.027 \text{ min} - \text{mg/l}$$